Nutrición Hospitalaria

Trabajo Original

Obesidad y síndrome metabólico

Restrained, emotional eating and depression can be a risk factor for metabolic syndrome

La alimentación emocional y restrictiva, junto con la depresión, pueden ser un factor de riesgo para el síndrome metabólico

Tugçe Akillioglu, Murat Bas, Gizem Kose

Faculty of Health Sciences. Department of Nutrition and Dietetics. Acıbadem Mehmet Ali Aydınlar University. Atasehir, Istanbul. Turkey

Abstract

Introduction: metabolic syndrome (MetS) can have a bidirectional effect on emotional and restrained eating.

Objectives: our aims are to find interrelations between MetS and emotional eating, restrained eating, additionally with depression.

Methods: cross-sectional study. Participants aged between 18 and 63, and mostly were obese (n = 200). Eating Attitudes Test (EAT-26), Beck Depression Inventory (BDI) and Dutch Eating Behavior Questionnaire (DEBQ) were used to find associations between eating patterns and metabolic syndrome.

Results: our study ensured evidences for physiological relations between restrained and emotional eating with MetS. Biochemical parameters showed that restrained eaters were less insulin resistant and participants with MetS had higher emotional eating and lower restrained eating. Besides, restrained eaters had lower triglyceride, homeostasis model assessment-insulin resistance (HOMA-IR), fasting insulin, blood glucose, and higher high-density lipoprotein cholesterol (HDL-C) levels; and emotional eating was parallel with fasting insulin level and HOMA-IR.

Conclusions: MetS had strong associations with eating behaviors as restrained, emotional and external. In line with the findings of the study, additionally, women were more susceptible to MetS than men were. In the regulation of restrictive, emotional and external eating behaviors, dietitians and psychology experts should be in cooperation to treat disordered eating patterns.

Conflict of interest: the authors declare no conflict of interest.

Statement of ethics: the study was approved by an ethics committee. All of the participants gave their written informed consent before taking part in the study.

Author contributions: all persons who meet authorship criteria are listed as authors, and all authors certify that they have participated sufficiently in the work to take public responsibility for the content, including participation in the concept.

Correspondence:

Murat Baş. Faculty of Health Sciences. Department of Nutrition and Dietetics. Acıbadem Mehmet Ali Aydınlar University. Kayisdagi Caddesi, 32. Atasehir, Istanbul. Turkey

e-mail: murat.bas@acibadem.edu.tr

Resumen

Introducción: el síndrome metabólico (MetS) puede tener un efecto bidireccional sobre la alimentación emocional y restrictiva.

Objetivos: nuestro objetivo es encontrar interacciones entre el MetS y la alimentación emocional y la alimentación restrictiva, sumado a la depresión.

Métodos: se trata de un estudio transversal. Un grupo de participantes de entre 18 y 63 años, en su mayoría obesos (n = 200). Para encontrar asociaciones entre los patrones de alimentación y el síndrome metabólico se utilizaron el Test de Actitudes Alimentarias (EAT-26), el Inventario de Depresión de Beck (BDI) y el Cuestionario Holandés de Comportamiento Alimentario (DEBQ).

Resultados: nuestro estudio mostró evidencias de relaciones fisiológicas entre la alimentación restrictiva y emocional con el MetS. Los parámetros bioquímicos reflejaron que aquellos que comían contenidamente eran menos resistentes a la insulina y los participantes con MetS presentaban una mayor alimentación emocional y una menor restricción alimenticia. Además, los que comían contenidamente tenían niveles más bajos de triglicéridos, HOMA-IR, insulina en ayunas y glucosa en sangre, frente a niveles más altos de HDL-C. Asimismo, la alimentación emocional reflejó una relación paralela con el nivel de insulina en ayunas y HOMA-IR.

Palabras clave:

Alimentación restrictiva. Alimentación emocional. Obesidad. Depresión. Síndrome metabólico.

Conclusiones: se evidenció una notable asociación entre el MetS y los comportamientos alimenticios restrictivos, emocionales y externos. De acuerdo con los hallazgos del estudio, además, las mujeres eran más susceptibles al MetS que los hombres. En la regulación de las conductas alimenticias restrictivas, emocionales y externas, los dietistas y los expertos en psicología deben coadyuvar para tratar patrones de desórdenes alimenticios.

INTRODUCTION

Metabolic syndrome (MetS) has emerged as a major problem in both developed and developing countries (1-6). MetS doubles the risk of cardiovascular disease and increases the risk of type 2 diabetes up to five times (2). Various metabolic factors involve in the development of cardiovascular disease, such as glucose intolerance (type 2 diabetes, impaired glucose tolerance, or impaired fasting glycaemia), insulin resistance, central obesity, dyslipidemia, and hypertension (3-5). The most commonly used definition of metabolic syndrome is made by the National Cholesterol Education Program-Adult Treatment Panel III (NCEP-ATP III) including impaired fasting glucose (IFG), abdominal obesity, high blood pressure, high fasting triglyceride and low high-density lipoprotein cholesterol (HDL-C) (6). The prevalence of metabolic syndrome varies widely between countries (1-6) and in a recent meta-analysis, metabolic syndrome prevalence in Turkey showed to be increasing widely (6).

Restrained eating is a construct that researchers described as an individual's attempt to manage body weight by cognitively controlling food intake (7). Conversely, unrestrained eaters self-regulate eating based on appetite and satiety. Studies have prospectively linked restrained eating to a higher risk of developing obesity in preadolescent and adolescent girls (8,9), as well as greater weight gain in adults; furthermore, dietary restraint is associated with weight gain in non-overweight individuals (10). As some degree of cognitive restraint is necessary for weight control for most people, further research was warranted into the potential mediating factors behind the association between restrained eating and obesity.

On the other hand, similar to the body mass index (BMI) evidence, the findings in relation to restrained are mixed. It is possible that these mixed findings could reflect the type of restraint exerting the most influence (e.g., rigid or flexible restraint) on an individual; however, studies do not consistently report these restraint sub-factors consistently to state this conclusively. Restrained eating was found to be related to a more healthful dietary profile (11), higher satiety quotient and lower energy intake, lower craving and liking of processed foods (12), lower fat intake and lower appetite ratings (13), all of which supports a behavioral profile conducive for weight regulation. Restrained eating behavior has also been linked to altered substrate use. In a study, restrained women eaters had significantly higher concentrations of fasting plasma triglycerides compared with unrestrained women eaters, suggesting that mobilized fatty acids were more readily esterified in chronically restrained eaters. Patients with eating disorders showed evidence of reduced insulin sensitivity (14).

Emotional eating is becoming more interest because emotional eating has been consistently associated with weight concerns such as overweight and obesity (9,15). Additionally, individuals with overweight have been found to exhibit less effective coping skills in response to negative emotions, leading them to emotionally eat more frequently (16). Difficulties with weight loss have also been associated with emotional eating (17). In various cross-sectional studies, emotional eating was indeed found to act as a mediator between depression and obesity (18,19). The effects of chronic stress system could be exemplified by increased cortisol secretion or chronic administration of pharmacological glucocorticoids (20). Both of these conditions have been associated with visceral obesity, hypertension, insulin resistance with/without type 2 diabetes *mellitus,* dyslipidemia (the entire metabolic syndrome), as well as depression (16,17,20). Previous studies have shown that anxiety and mood disorders were also related to adverse health outcomes, such as diabetes *mellitus* and cardiovascular disease (21,22), while obesity and concurrent clinical and metabolic disorders may mediate such relations. Indeed, anxiety and depression have been linked to abdominal obesity, elevated blood pressure and metabolic abnormalities, such as abnormal lipid profile and insulin resistance (23).

The aim of the present study was to examine the association between metabolic syndrome, emotional eating, restrained eating and depression. Our hypotheses in this study were that individuals with metabolic syndrome have higher emotional eating, restrained eating and depression scores than individuals who did not have metabolic syndrome, and there were sex-specific differences. This research will support uncertain joint relationships of body mass index and metabolic syndrome with depression and emotional, restrained eating in the literature.

MATERIALS AND METHODS

This study was performed with the participation of 200 individuals with a participant rate of 86.9 % (total participant as 230). Participants were aged between 18 and 63 with various BMIs and were admitted to the private weight management center in Istanbul from June 2017 to January 2018. People who were using any kind of medicines, vitamins, or minerals were not included in this study. Pregnant or lactating females, as well as people with a pre-diagnosed disease or those diagnosed with a disease during the study period were not excluded.

ANTHROPOMETRIC MEASUREMENTS

Height, body weight and waist circumferences were measured from 08:00 to 10:00 hours after a 12 hour fasting. Height was measured using a stadiometer accurate to $\pm$ 0.5 cm, and body weight was measured with participants wearing light clothing and no shoes using a calibrated scale, accurate to $\pm$ 0.1 kg. BMI was calculated using the standard equation (kilograms per meters squared). Waist circumference was measured in a standing position, midway between the lower margin of the last rib and the iliac crest, at mid exhalation. Anthropometric measurements were taken twice, and mean values were used. BMI was used as global adiposity parameters and waist circumference were used to evaluate abdominal adiposity.

Individuals who participated in the study consisted of volunteers who were evaluated by an endocrinologist in a private weight management center from June 2017 to January 2018. The diagnosis of metabolic syndrome was based on NCEP-ATP III (6).

All patients provided informed written consent. The study protocol conformed to the ethical guidelines of the 1975 Declaration of Helsinki. The present study was approved by the Human Research Ethics Committee of Acibadem Mehmet Ali Aydinlar University with meeting date June 22nd, 2017 and decision number 2017-11/13.

THE EATING ATTITUDES TEST (EAT-26)

The Eating Attitudes Test (EAT-26) is a widely used self-report measure for eating disorders. It was developed by Garner et al. (1982) to measure symptoms of eating disorders (24). Total scores on the EAT-26 are derived as a sum of the composite items, ranging from 0 to 53, with the score of 20 on the EAT-26 was used as the cut-off. The EAT-26 consists of three-factor score: a) F1: dieting, the degree of avoidance of fattening foods and preoccupation with being thinner; b) F2: bulimia and preoccupation with food; and c) F3: oral control, the degree of self-control around food and the perception of pressure from others to gain weight. The Turkish version of EAT-26 measures disturbance in eating attitudes and behaviors and the reliability was determined by Bas et al. (2004) (25).

BECK DEPRESSION INVENTORY (BDI)

Depression was measured with the 21-item Beck Depression Inventory (BDI) (26). BDI measures the severity of depressive symptoms. Items were scored on a four-point scale. One item concerning weight loss was excluded from the analysis, and the total from the remaining 20 items was calculated. A higher score indicates more severe depression. A recommended cut-off of 17 is used to de ne depression. The BDI is an internally consistent and valid measurement. A valid and reliable Turkish version of the scale (27) was used and found Cronbach's alpha coefficients for the sample of adolescents were 0.88 in the present study.

DUTCH EATING BEHAVIOR QUESTIONNAIRE (DEBQ)

This questionnaire consists of 33 items which measure emotional (13 items), external and restrained eating (both ten items). All items had to be rated on a five-point scale from 1 (never) to 5 (very often). Examples of items are: "Do you have a desire to eat when you are irritated?" (emotional eating); "If food smells and looks good, do you eat more than usual?" (external eating); and "Do you try to eat less at mealtimes than you would like to eat?" (restrained eating). The DEBQ scales have high internal consistency, high validity for food consumption, and high convergent and discriminative validity. The reliability and validity of the DEBQ for the Turkish population is determined by Bozan, Bas, and Asci (2011) (28). DEBQ demonstrated good internal consistency and reliability in the sample (Cronbach's coefficient $\alpha = 0.85$). Cut-off analyzes were made with emotional and restrained eating median scores in the study population.

BIOCHEMICAL ANALYSIS

Blood samples were collected after a 12 hour fasting period. Biochemical evaluation included blood glucose, insulin, total cholesterol, HDL-C, low-density lipoprotein cholesterol (LDL-C), and triacylglycerols (TG). Fasting plasma glucose, insulin, total cholesterol, HDL-C, LDL-C, TG and HbA1C levels were measured using original kits and an Abbott-Aeroset® autoanalyzer (29). Insulin resistance was estimated from fasting serum measurements using the homeostasis model assessment-insulin resistance (HOMA-IR) (insulin [μU/ml] X glucose [mg/dl] ÷ 425). Metabolic syndrome was diagnosed according to NCEP-ATP III (3). Thus, a participant had MS if he or she had three or more of the following: a) abdominal obesity: waist circumference > 102 cm in men and > 88 cm in women; b) plasma triglycerides: ≥ 150 mg/dl; c) plasma HDL-C: < 40 mg/dl in men and < 50 mg/dl in women; d) SBP: ≥ 130 mmHg, DBP: ≥ 85 mmHg, or the use of antihypertensive medicine; e) plasma glucose: ≥ 110 mg/dl or the use of antidiabetic medicine/insulin.

STATISTICAL ANALYSIS

Data of the study were analyzed using the SPSS program. We used descriptive, Chi-squared and Pearson correlation analysis for data evaluation. Participants' age, waist circumference, body mass index, blood parameters and scores of DEBQ, EAT-26, and BECK scales according to sex-specific factors were compared with Chi-squared analysis. In order to evaluate in terms of eating behavior, restrained and emotional eating presence and blood parameters were performed with Chi-squared analysis at a significance level of $p < 0.05$. Chi-squared analysis was used to evaluate the difference in mean scores between waist circumference, body mass index and DEBQ, EAT-26, and BECK scores depending on the presence of metabolic syndrome. Finally, Pearson correlation analysis was performed for age, waist circumference, body mass index, blood parameters and scale scores.

RESULTS

In our study, mean BMI (kg/m^2) for females was 35.3 ± 6.9, with 24.2 % reporting an overweight BMI (between 25 and 29.9) and 75.8 % reporting an obese BMI, based on the World Health Organization (WHO) classification (6). In addition, mean BMI for the males was 36.9 ± 7.6 kg/m^2, with 21.3 % reporting an overweight BMI, and 78.7 % reporting an obese BMI. Males had significantly higher waist circumferences than females ($p < 0.05$). Females had significantly higher scores than males on restrained eating (2.3 ± 0.7 for females and 2.0 ± 0.8 for males), EAT-26 (11.8 ± 7.1 for females and 9.4 ± 5.8 for males) and BECK (16.2 ± 9.9 for females and 12.4 ± 8.5 for males) scores ($p < 0.05$).

Table I demonstrated mean fasting blood glucose, fasting insulin, HOMA-IR, total cholesterol, LDL-C, HDL-C and triglyceride levels by sex-specificity. Male participants had significantly higher level of total cholesterol (total-C) (204.8 ± 39.1 mg/dl for females and 222.0 ± 43.9 mg/dl for males), LDL-C (134.3 ± 36.2

mg/dl for females and 148.0 ± 42.3 mg/dl for males), and triglycerides (123.6 ± 63.3 mg/dl for females and 188.0 ± 127.3 mg/dl for males), than female participants ($p < 0.05$). Besides, females had significantly higher levels of HDL-C (45.8 ± 11.3 mg/dl for females and 37.2 ± 8.8 mg/dl for males) than male participants ($p < 0.05$). There was no significant difference in fasting blood glucose, fasting insulin and HOMA-IR levels between the female and male participants ($p > 0.05$).

Biochemical parameters according to the presence of restrained and emotional eating status by sex-specificifity were shown in tables II and III. Participants who had restrained eating (all 45.5 % and females 48.3 %) had significantly lower fasting blood glucose and insulin, HOMA-IR and TG levels, as well as higher HDL-C levels ($p < 0.05$) than unrestrained eaters. Only blood fasting glucose difference between restrained (80.8 ± 10.1 mg/dl) and unrestrained eaters (94.9 ± 25.4 mg/dl) was statistically significant in males ($p < 0.05$). Besides, when it was evaluated in terms of emotional eating, all (55.5 %) and female (58.2 %) emotional eaters had higher BMI, fasting insulin and HOMA-IR levels than unemotional eaters ($p < 0.05$); there was no statistically significant difference in males ($p > 0.05$). Moreover, HDL-C level was higher in unemotional eaters than emotional eaters in females ($p < 0.05$). Even if there were no relations between waist circumference, all other MetS criteria relations were determined with restrained and emotional eating.

Table IV shows the mean waist circumference, BMI, restrained eating, emotional eating, external eating, EAT-26 and BECK scores by sex-specificity and metabolic syndrome status. A significantly higher proportion of males (46.8 %) than females (28.1 %) met criteria for MetS ($p < 0.05$). The participants with MetS had significantly higher scores of emotional eating (2.8 ± 1.1 for participants with MetS and 2.3 ± 1.2 for participants without MetS) ($p < 0.05$). On the contrary, the participants with MetS had significantly lower scores of restrained eating (2.0 ± 0.7 for participants with MetS and 2.3 ± 0.7 for participants without MetS) ($p < 0.05$).

Table I. Biochemical parameters according to sex-specificity

	Female (n = 153)		Male (n = 47)		p values
	Mean	SD	Mean	SD	
Fasting blood glucose (mg/dl)	88.4	17.9	89.8	22.1	0.653
Fasting insulin (uIU/ml)	12.7	9.5	15.7	10.4	0.067
HOMA-IR	2.9	2.7	3.5	2.4	0.164
Total cholesterol (mg/dl)	204.8	39.1	222.0	43.9	0.011*
LDL cholesterol (mg/dl)	134.3	36.2	148.0	42.3	0.031*
HDL cholesterol (mg/dl)	45.8	11.3	37.2	8.8	0.000*
Triglycerides (mg/dl)	123.6	63.3	188.0	127.3	0.000*

Significant difference between female and male.

Table II. BMI and biochemical parameters according to restrained eating (n = 200)

Variables	Restrained eating					
	Female (n = 153)		Male (n = 47)		Total (n = 200)	
	Yes (n = 74)	No (n = 79)	Yes (n = 17)	No (n = 30)	Yes (n = 91)	No (n = 109)
WC (cm)	101.3 ± 14.3	102.7 ± 13.8	119.7 ± 14.4	121.9 ± 21.1	104.7 ± 15.9	107.9 ± 18.2
Total BMI (kg/m²)	34.6 ± 7.0	35.9 ± 6.9	34.7 ± 6.6	38.1 ± 7.9	34.6 ± 6.9	36.5 ± 7.2
OW BMI (kg/m²)	27.2 ± 2.1	26.7 ± 2.2	26.5 ± 0.9*	28.7 ± 0.9*	27.1 ± 1.9	27.3 ± 2.1
Obese BMI (kg/m²)	37.7 ± 5.9	38.1 ± 5.7	37.3 ± 5.4	40.4 ± 7.1	37.6 ± 5.7	38.7 ± 6.2
FBG (mg/dl)	84.4 ± 11.3*	92.1 ± 21.8*	80.8 ± 10.1*	94.9 ± 25.4*	83.8 ± 11.1*	92.9 ± 22.8*
F1 (uIU/ml)	9.4 ± 4.8*	15.8 ± 11.6*	14.2 ± 8.8	16.5 ± 11.2	10.3 ± 6.0*	16.0 ± 11.4*
HOMA-IR	2.0 ± 1.1*	3.8 ± 3.4*	3.0 ± 2.1	3.8 ± 2.6	2.2 ± 1.4*	3.8 ± 3.2*
Total-C (mg/dl)	203.8 ± 40.8	205.7 ± 37.7	213.8 ± 35.5	226.7 ± 47.9	205.7 ± 39.9	211.5 ± 41.6
LDL-C (mg/dl)	133.5 ± 36.3	135.0 ± 36.2	145.7 ± 36.2	149.2 ± 45.9	135.8 ± 36.4	139.0 ± 39.4
HDL-C (mg/dl)	48.1 ± 9.9*	43.6 ± 12.0*	39.4 ± 10.0	35.9 ± 7.9	46.5 ± 10.5*	41.5 ± 11.5*
TG (mg/dl)	112.3 ± 53.5*	134.2 ± 70.0*	143.8 ± 83.7	212.9 ± 141.6	118.2 ± 61.0*	156.0 ± 101.0*

*WC: waist circumference; OW: overweight; FBG: fasting blood glucose; FI: fasting insulin; HOMA-IR: homeostasis model assessment-insulin resistance; Total-C: total cholesterol; LDL-C: LDL cholesterol; HDL-C: HDL cholesterol; TG: triglyceride. *p < 0.05.*

Table III. BMI and biochemical parameters according to emotional eating (n = 200)

Variables	Emotional eating					
	Female (n = 153)		Male (n = 47)		Total (n = 200)	
	Yes (n = 89)	No (n = 64)	Yes (n = 22)	No (n = 25)	Yes (n = 111)	No (n = 89)
WC (cm)	103.5 ± 13.9	99.9 ± 13.9	121.8 ± 18.7	120.5 ± 19.2	107.2 ± 16.6	105.7 ± 18.1
Total BMI (kg/m²)	36.4 ± 6.9*	33.8 ± 6.8*	38.1 ± 8.1	35.8 ± 7.1	36.7 ± 7.1*	34.3 ± 6.9*
OW BMI (kg/m²)	27.5 ± 2.0	26.6 ± 2.1	27.8 ± 1.1	27.9 ± 1.6	27.6 ± 1.9	26.9 ± 2.0
Obese BMI (kg/m²)	38.1 ± 6.1	37.5 ± 5.1	39.7 ± 7.4	38.8 ± 5.8	37.9 ± 5.3	38.5 ± 6.4
FBG (mg/dl)	89.3 ± 18.2	87.1 ± 17.6	90.0 ± 27.0	89.7 ± 17.3	89.5 ± 20.1	87.8 ± 17.4
F1 (uIU/ml)	14.6 ± 10.7*	10.1 ± 6.7*	18.3 ± 12.3	13.3 ± 7.8	15.3 ± 11.1*	11.0 ± 7.2*
HOMA-IR	3.3 ± 2.9*	2.3 ± 2.4*	4.1 ± 2.9	3.0 ± 1.9	3.5 ± 2.9*	2.5 ± 2.3*
Total-C (mg/dl)	204.6 ± 40.6	205.0 ± 37.3	215.4 ± 38.9	227.8 ± 47.8	206.7 ± 40.3	211.4 ± 41.5
LDL-C (mg/dl)	135.0 ± 38.6	133.3 ± 32.7	140.8 ± 29.6	154.2 ± 50.7	136.2 ± 37	139.2 ± 39.5
HDL-C (mg/dl)	43.7 ± 10.9*	48.6 ± 11.3*	37.8 ± 9.6	36.6 ± 8.1	42.6 ± 10.9	45.2 ± 11.7
TG (mg/dl)	128.9 ± 63.2	116.3 ± 63.3	191.2 ± 108.5	185.0 ± 144.0	141.2 ± 77.9	135.6 ± 97.4

*WC: waist circumference; OW: overweight; FBG: fasting blood glucose; FI: fasting insulin; HOMA-IR: homeostasis model assessment-insulin resistance; Total-C: total cholesterol; LDL-C: LDL cholesterol; HDL-C: HDL cholesterol; TG: triglyceride. *p < 0.05.*

Table IV. Parameters by metabolic syndrome and sex-specificity baseline (n = 200)

Variables	Metabolic syndrome status					
	Female (n = 153)		Male (n = 47)		Total (n = 200)	
	Yes (n = 43)	No (n = 110)	Yes (n = 22)	No (n = 25)	Yes (n = 65)	No (n = 135)
WC (cm)	110.5 ± 11.7[†]	98.7 ± 13.4	126.0 ± 13.4*	116.8 ± 21.9*	115.8 ± 14.3[‡]	102.0 ± 16.8
Total BMI (kg/m^2)	39.1 ± 6.4[†]	33.8 ± 6.6	38.8 ± 7.2	35.1 ± 7.6	39.0 ± 6.6[‡]	34.0 ± 6.8
OW BMI (kg/m^2)	28.9 ± 0.3	26.9 ± 2.1	29.5 ± 0.0	27.7 ± 1.4	29.1 ± 0.4	27.0 ± 1.9
Obese BMI (kg/m^2)	39.6 ± 6.2	37.1 ± 5.4	39.2 ± 7.1	39.3 ± 6.2	39.5 ± 6.4	37.4 ± 5.6
DEBQ						
Restrained eating	2.0 ± 0.6	2.4 ± 0.8[†]	1.9 ± 0.8	2.1 ± 0.7	2.0 ± 0.7	2.3 ± 0.7[c]
Emotional eating	3.1 ± 1.0*, [†]	2.4 ± 1.2	2.4 ± 1.1	2.1 ± 1.2	2.8 ± 1.1[‡]	2.3 ± 1.2
External eating	2.7 ± 1.0[†]	2.4 ± 0.7	2.3 ± 0.7	2.2 ± 0.7	2.6 ± 0.9	2.3 ± 0.7
EAT-26	12.0 ± 6.6	11.7 ± 7.4	10.0 ± 6.7	8.8 ± 4.9	11.4 ± 0.8	11.1 ± 0.6
BECK	16.7 ± 9.5	16.0 ± 1.0	12.3 ± 10.6	12.4 ± 6.2	15.2 ± 1.2	15.4 ± 0.8

*Significant difference between females with MetS and males with MetS. [†]Significant difference between participants with MetS and without MetS baseline by sex-specificity. [‡]Significant difference between participants with MetS and without MetS. WC: waist circumference; BMI: body mass index; DEBQ: Dutch Eating Behaviour Questionnaire; EAT-26: Eating Attitudes Test; BECK: BECK Depression Scale.

There was no significant difference in external eating, EAT-26 and BECK scores between the participants with MetS and participants without MetS (p > 0.05). Female participants with MetS had significantly higher scores than male participants with MetS on emotional eating and external eating, and male participants with MetS had lower scores on restrained eating (p < 0.05).

There was a negative correlation between DEBQ-R score and fasting insulin (r = -0.226; p < 0.01), HOMA-IR (r = -0.203; p < 0.01) and triglyceride level (r = -0.246; p < 0.01). Also, DEBQ-E score was positively correlated with fasting insulin level (r = 0.215; p < 0.01) and HOMA-IR (r = 0.188; p < 0.01), and negatively correlated with DEBQ-R score (r = -0.156; p < 0.05) and HDL-C level (r = -0.207; p < 0.01). However, there was a positive correlation between BMI and fasting blood glucose level (r = 0.245; p < 0.01), fasting insulin level (r = 0.491; p < 0.01), HOMA-IR (r = 0.487; p < 0.01) and TG level (r = 0.233; p < 0.01) (Table V).

DISCUSSION

In our study, the relation hypothesis about emotional eating with metabolic syndrome was accepted and supported by blood parameters (fasting insulin and HOMA-IR). Individuals with metabolic syndrome had higher emotional eating and lower restrained eating scores. Again, sex-specific differences hypothesis was accepted too, as females were more tending to diet restraint. In

addition, there were sex-specific differences in eating attitudes, depression scores and some blood parameters.

The current study ensures evidence for physiological differences between restrained and unrestrained eaters or emotional and unemotional eaters with metabolic syndrome. Despite finding a significant effect of restraint eating on fasting plasma levels of glucose, insulin, HOMA-IR, triglyceride and HDL-C, there were no effects on LDL-C and total-C. A range of parameters including blood lipids did not differ significantly between the restrained and unrestrained eaters, and mean values were generally very similar (30). In a study, restrained female eaters who have normal-weight had significantly higher concentrations of fasting plasma triglycerides compared with unrestrained ones, suggesting that mobilized fatty acids are more readily esterified in chronically restrained eaters (14). Song and Lee (2020) reported that emotional eaters had lower HDL-C and a higher risk for obesity (31). On the contrary, our results showed that emotional eaters had lower HDL-C and restrained eaters had lower triglyceride and higher HDL-C levels. In previous studies, lower fasting insulin plasma levels had already been reported in restrained female eaters (14,32). In contrast, it was reported that restrained eating does not seem to impact on triacylglycerol and non esterified fatty acids plasma levels in healthy volunteers (33), but was likely to exert a positive role on glucose metabolism towards a more insulin-sensitive state. Insulin plays a predominant role in energy fuel use (32). Similar to other studies (32,33), our study indicated that restrained eaters had reduced fasting insulin levels

Table V. Correlation analysis between some MetS determinants, age, BMI, waist circumferences, subscales of DEBQ, BECK and EAT-26 scores

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
1. Age (year)	1													
2. BMI (kg/m²)	.052	1												
3. WC (cm)	.124	.769†	1											
4. DEBQ-E	.004	.237†	.095	1										
5. DEBQ-R	.136	-.108	-.142*	-.156*	1									
6. DEBQ-Ex	.065	.008	.045	.236†	-.160*	1								
7. EAT-26	.019	.019	-.011	-.080	.255†	.035	1							
8. BECK	-.073	.178*	.108	.057	.030	.104	.245†	1						
9. FBG (mg/dl)	.359†	.245†	.215†	.076	-.119	.043	-.006	.084	1					
10. FI (μIU/ml)	-.026	.491†	.427†	.215†	-.226†	-.022	-.083	.116	.240†	1				
11. HOMA-IR	.089	.487†	.410†	.188†	-.203†	-.003	-.050	.148*	.527†	.926†	1			
12. Total-C (mg/dl)	.292†	.038	.100	-.016	-.007	-.045	-.125	-.143*	.157*	-.067	-.027	1		
13. LDL-C (mg/dl)	.257†	-.002	.078	-.003	.006	-.054	-.113	-.123	.087	-.110	-.092	.914†	1	
14. HDL-C (mg/dl)	-.053	-.167*	-.325†	-.207†	.320†	.008	.112	-.031	-.031	-.237†	-.176*	.029	-.093	1
15. TG (mg/dl)	.166*	.233†	.300†	.108	-.246†	-.004	-.096	-.040	.216†	.283†	.294†	.332†	.023	-.374†

WC: waist circumference; BMI: body mass index; DEBQ-E: emotional eating; DEBQ-R: restrained eating; DEBQ-Ex: external eating; EAT-26: eating attitudes test; BECK: BECK Depression Scale; FBG: fasting blood glucose; FI: fasting insulin; Total-C: total cholesterol; LDL-C: LDL cholesterol; HDL-C: HDL cholesterol; TG: triglyceride.
$p < 0.05$. †$p < 0.001$.

compared with the unrestrained eaters but it did not differ by sex-specificity. In addition, restrained eaters in our study were less insulin resistant.

Past researches have demonstrated that higher BMI is associated with increased restrained and emotional eating (11-13). Besides, positive associations between restrained eating and BMI should mainly be interpreted in the sense that higher BMI predicted more restrained eating (11). Also, it was stated that girls had more emotional and restrained eating. In four-year follow-up studies with adolescents, researchers found that BMI and restrained eating had a strong negative correlance (8,9). On the contrary, in another follow-up study, restrained eating was associated with higher waist circumference (31). Again, studies could not find any effect of restrained or external eating on BMI change (16,34). It is still unclear whether restrained eating is a cause or a result of overeating and BMI increase (28). Our study indicated that there were no BMI differences between restrained and unrestrained eaters, but emotional and unemotional female eaters' BMI differed. Emotional eating seems to be more relevant to BMI changes and, as a result, it may increase tendency to MetS (31). Olguin et al. (2017) stated that 24-60 % of obese participants with binge eating met the criteria for MetS (36). Moreover, MetS effected binge eating and early age of diets. Having an

eating pathology predicts increased waist circumference that is a risk for MetS (37). In the present study, we could not find any relation to disordered eating in MetS.

In a United Kingdom population-based study, researchers found that depression had a great effect on metabolic syndrome (37). Also, Ohmori et al. (2017) found women with MetS were more depressed, and coexistence of them is more common in females (38). However, in this study, metabolic syndrome had no effect on depression but the presence of MetS in females was consistent with the literature (37-39). The reason for this may be that BECK determines the participants' instantaneous depression levels. In the present study, females with MetS had higher emotional and external eating scores, and lower restraint eating scores. In a review, it was implied that emotional and disturbed eating behaviors had a prediction on central obesity and subsequently lead to MetS, as expected (20). As consistent with other studies, in our study, females who presented emotional eating were at higher risk in terms of MetS.

The limitation of the study is its cross-sectional nature. In order to observe changes in individuals with MetS, new research can be conducted with nutritional interventions. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Eating patterns may have some reliable interrelations with MetS. Restrained eating may positively affect on MetS. On the other hand, emotional and external eating can be a risk for MetS. In line with the study, females were more tending to emotional eating patterns and may be more susceptible to MetS.

REFERENCES

1. Marin KA, Hermsdorff HHM, Rezende FAC, Peluzio MCG, Natali AJ. A systematic review of cross-sectional studies on the association of sedentary behavior with cardiometabolic diseases and related biomarkers in South American adults. Nutr Hosp 2020;37(2):359-73.

2. Ansarimoghaddam A, Adineh HA, Zareban I, Iranpour S, HosseinZadeh A, Framanfarma KH. Prevalence of metabolic syndrome in Middle-East countries: meta-analysis of cross-sectional studies. Diabetes Metab Syndr: Clin Res Rev 2018;12:195-201. DOI: 10.1016/j.dsx.2017.11.004

3. Hirode G, Wong RJ. Trends in the prevalence of metabolic syndrome in the United States, 2011-2016. JAMA 2020;323:2526-8. DOI: 10.1001/jama.2020.4501

4. Ranasinghe P, Mathangasinghe Y, Jayawardena R, Hills AP, Misra A. Prevalence and trends of metabolic syndrome among adults in the Asia-Pacific region: a systematic review. BMC Public Health 2017;17:1-9. DOI: 10.1186/s12889-017-4041-1

5. Abacı A, Kılıçkap M, Göksülük H, Karaaslan D, Barçın C, Kayikçioglu M, et al. Data on prevalence of metabolic syndrome in Turkey: systematic review, meta-analysis and meta-regression of epidemiological studies on cardiovascular risk factors. Turk Kardiyol Dern Ars 2018;46:591-601. DOI: 10.5543/tkda.2018.00878

6. Third Report of the National Cholesterol Education Program (NCEP), author Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) final report. Circ J 2002;106:3143-421. DOI: 10.1161/circ.106.25.3143

7. Ruderman AJ. Dietary restraint: a theoretical and empirical review. Psychol Bull 1986;99:247-62. DOI: 10.1037/0033-2909.99.2.247

8. Stice E, Presnell K, Shaw H, Rohde P. Psychological and behavioral risk factors for obesity onset in adolescent girls: a prospective study. J Consult Clin Psychol 2005;73:195-202. DOI: 10.1037/0022-006X.73.2.195

9. Van Strien T, Snoek HM, Van der Zwaluw CS, Engels RCME. Parental control and the dopamine D2 receptor gene (DRD2) interaction on emotional eating in adolescence. Appetite 2010;54:255-61. DOI: 10.1016/j.appet.2009.11.006

10. Lampuré A, Castetbon K, Hanafi M, Deglaire A, Schlich P, Péneau S, et al. Relative influence of socioeconomic, psychological and sensory characteristics, physical activity and diet on 5-year weight gain in French adults. Nutrients 2017;9:1179-211. DOI: 10.3390/nu9111179

11. Ouwens MA, Cebolla A, Van Strien T. Eating style, television viewing and snacking in pre-adolescent children. Nutr Hosp 2012;27:1072-8.

12. Polk SE, Schulte EM, Furman CR, Gearhardt AN. Wanting and liking: separable components in problematic eating behavior? Appetite 2017;115:45-53. DOI: 10.1016/j.appet.2016.11.015

13. Smithson EF, Hill AJ. It is not how much you crave but what you do with it that counts: behavioural responses to food craving during weight management. Eur J Clin Nutr 2017;71:625-30. DOI: 10.1038/ejcn.2016.235

14. Pirke KM, Tuschl RJ, Spyra B, Laessle RG, Schweiger U, Broocks A, et al. Endocrine findings in restrained eaters. Physiol Behav 1990;47:903-6. DOI: 10.1016/0031-9384(90)90017-X

15. Van Strien T, Frijters JE, Bergers GPA, Defares PB. The Dutch Eating Behavior Questionnaire (DEBQ) for assessment of restrained, emotional, and external eating behavior. Int J Eat Disord 1986;5:295-315. DOI: 10.1002/1098-108X(198602)5:2<295::AID-EAT2260050209>3.0.CO;2-T

16. Koenders PG, Van Strien T. Emotional eating, rather than lifestyle behavior, drives weight gain in a prospective study in 1562 employees. J Occup Environ Med 2011;53:1287-93. DOI: 10.1097/JOM.0b013e31823078a2

17. Delahanty LM, Peyrot M, Shrader PJ, Williamson DA, Meigs JB, Nathan DM, et al. Pretreatment, psychological, and behavioral predictors of weight outcomes among lifestyle intervention participants in the Diabetes Prevention Program (DPP). Diabetes Care 2013;36:34-40. DOI: 10.2337/dc12-0733

18. Clum GA, Rice JC, Broussard M, Johnson CC, Webber LS. Associations between depressive symptoms, self-efficacy, eating styles, exercise and body mass index in women. J Behav Med 2014;37:577-86. DOI: 10.1007/s10865-013-9526-5

19. Goldschmidt AB, Crosby RD, Engel SG, Crow SJ, Cao L, Peterson CB, et al. Affect and eating behavior in obese adults with and without elevated depression symptoms. Int J Eat Disord 2014;47:281-6. DOI: 10.1002/eat.22188

20. Pervanidou P, Chrousos GP. Stress and obesity/metabolic syndrome in childhood and adolescence. Pediatr Obes 2011;6:21-8. DOI: 10.3109/17477166.2011.615996

21. Bucciarelli V, Caterino AL, Bianco F, Caputi CG, Salerni S, Sciomer S, et al. Depression and cardiovascular disease: the deep blue sea of women's heart. Trends Cardiovasc Med 2020;30:170-6. DOI: 10.1016/j.tcm.2019.05.001

22. Khaledi M, Haghighatdoost F, Feizi A, Aminorroaya A. The prevalence of comorbid depression in patients with type 2 diabetes: an updated systematic review and meta-analysis on huge number of observational studies. Acta Diabetol 2019;5:631-50. DOI: 10.1007/s00592-019-01295-9

23. Liang YZ, Dong J, Zhang J, Wang S, He Y, Yan YX. Identification of neuroendocrine stress response-related circulating microRNAs as biomarkers for type 2 diabetes mellitus and insulin resistance. Front in Endocrinol 2018;9:1-8. DOI: 10.3389/fendo.2018.00132

24. Garner DM, Olmsted MP, Bohr Y, Garfinkel PE. The eating attitudes test: psychometric features and clinical correlates. Psychol Med 1982;12:871-8. DOI: 10.1017/S0033291700049163

25. Bas M, Asci H, Karabudak E, Kiziltan G. Eating attitudes and their psychological correlates among Turkish adolescents. Adolescence 2004;39:593-9.

26. Beck AT, Ward CH, Mendelson M, Mock J, Erbaugh J. An inventory for measuring depression. Arch Gen Psychiatry 1961;4:561-71. DOI: 10.1001/archpsyc.1961.01710120031004

27. Hisli N. The validity of Beck Depression Inventory (Turkish). TPD 1988;6:118-26.

28. Bozan N, Bas M, Asci H. Psychometric properties of Turkish version of Dutch Eating Behaviour Questionnaire (DEBQ). A preliminary result. Appetite 2011;56:564-6. DOI: 10.1016/j.appet.2011.01.025

29. Pauli D, Seyfarth M, Dibbelt L. The Abbott Architect c8000: analytical performance and productivity characteristics of a new analyzer applied to general chemistry testing. Clin Lab 2005;51:31-42.

30. Bathalon GP, Hays NP, Meydani SM, Dawson-Hughes B, Schaefer EJ, Lipman R, et al. Metabolic, psychological, and health correlates of dietary restraint in healthy postmenopausal women. J Gerontol A Biol Sci Med Sci 2001;56(4):206-11. DOI: 10.1093/gerona/56.4.M206

31. Song YM, Lee K. Eating behavior and metabolic syndrome over time. Eat Weight Disord 2020;25:545-52. DOI: 10.1007/s40519-019-00640-9

32. Keim NL, Horn WF. Restrained eating behavior and the metabolic response to dietary energy restriction in women. Obes Res 2004;12:141-9. DOI: 10.1038/oby.2004.19

33. Martins C, Morgan LM, Robertson MD. Effects of restrained eating behaviour on insulin sensitivity in normal-weight individuals. Physiol Behav 2009;96:703-8. DOI: 10.1016/j.physbeh.2009.01.006

34. Konttinen H, Llewellyn C, Silventoinen K, Joensuu A, Männistö S, Salomaa V, et al. Genetic predisposition to obesity, restrained eating and changes in body weight: a population-based prospective study. Int J Obes 2018;42:858-65. DOI: 10.1038/ijo.2017.278

35. Stice E, Presnell K, Sprangler D. Risk factors for binge eating onset in adolescent girls: A 2-year prospective investigation. J Health Psychol 2002;21:131-8. DOI: 10.1037/0278-6133.21.2.131

36. Olguin P, Fuentes M, Gabler G, Guerdjikova AI, Keck PE, McElroy SL. Medical comorbidity of binge eating disorder. Eat Weight Disord 2017;22:13-26. DOI: 10.1007/s40519-016-0313-5

37. Dregan A, Rayner L, Davis KA, Bakolis I, Arias de la Torre J, Das-Munshi J, et al. Associations between depression, arterial stiffness, and metabolic syndrome among adults in the UK Biobank Population Study: a mediation analysis. JAMA Psychiatry 2020;77:598-606. DOI: 10.1001/jamapsychiatry.2019.4712

38. Ohmori Y, Ito H, Morita A, Deura K, Miyachi M, Saku Cohort Study Group. Associations between depression and unhealthy behaviours related to metabolic syndrome: a cross sectional study. Asia Pac J Clin Nutr 2017;26:130-40.

39. Kinder LS, Carnethon MR, Palaniappan LP, King AC, Fortmann SP. Depression and the metabolic syndrome in young adults: findings from the Third National Health and Nutrition Examination Survey. Psychosom Med 2004;66:316-22. DOI: 10.1097/01.psy.0000124755.91880.f4