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Metabolic Syndrome Risk, Healthy Lifestyle Behaviors, and Physical Activity Levels of University Students

ABSTRACT

Objective: The goal of this study is to compare metabolic syndrome risk, healthy lifestyle behaviors, and physical activity levels among university students.

Methods: This research was conducted as a descriptive cross-sectional study, consisting of university nursing and midwife students (n = 375), with a total of 264 students who participated voluntarily. Data were obtained via International Physical Activity Questionnaires, Type-II Diabetes Mellitus Risk Questionnaires, the Healthy Lifestyle Behaviors Scale-II, biochemical tests, as well as liver and carotid Doppler ultrasonography.

Results: The questionnaires showed that 54.3% had insulin resistance, 15.5% had impaired glucose intolerance, 6% had microalbuminuria, and 15.97% had a fatty liver (grade I-II). Totally, 40.68% of the students were inactive, and the Healthy Lifestyle Behaviors Scale-II mean score was 129.75 ± 17.43. There was a statistically significant difference between microalbuminuria and physical activity groups, as well as triglyceride values and the physical activity groups.

Conclusions: It was determined that some students had previously undiagnosed insulin resistance, impaired glucose tolerance, fatty livers, and microalbuminuria. The study showed that the university students had metabolic syndrome risk despite being a younger generation.

Keywords: Healthy lifestyle behaviors, metabolic syndrome, physical activity, risk of diabetes, students

Introduction

Metabolic syndrome (MetS) is a leading public health issue and clinical problem around the world. It has been reported that MetS prevalence varies between 10% and 84%[1]; MetS incidence, calculated per 1000 individuals/year, is 38 (95% CI: 32-44) and regression incidence is 36 (95% CI: 31-41).[2] Metabolic syndrome is seen in Turkey at a rate of 44% in men aged 40-49 years and 24% in women aged 30-39 years, while this percentage gradually increases in women aged 60-69 years, reaching up to 56%.[3] Metabolic syndrome is defined by the World Health Organization (WHO) as a pathological condition characterized by abdominal obesity, insulin resistance, hypertension, and hyperlipidemia.[4] The WHO classifies MetS as a pre-disease condition. Therefore, pre-MetS screenings should be conducted to exclude individuals with existing diabetes and known cardiovascular diseases.[5] While MetS can lead to complications such as atherosclerosis, insulin resistance, and kidney disease in the short term, it also leads to serious chronic diseases such as cardiovascular disease, stroke, and type-II diabetes mellitus (type II DM) in the long term.[6,7] A range of health problems caused by MetS increases both morbidity and mortality and leads to increased costs for healthcare systems.[8] For these reasons, it is critically important to detect MetS in younger age groups, as obesity, which is rapidly increasing among younger people, increases the risk of MetS by leading to insulin resistance.[9,10]

Many young people starting their university education spend much of their lives away from their families and are open to new and interesting stimuli. Such stimuli may affect students' dietary habits and physical activity (PA) levels, thereby leading to the development of detrimental habitual behavior,[11] particularly a preference for high-calorie, low-fiber fast food and a reduction in PA levels, which has a powerful effect on the development of MetS.[4] Totally,

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59% of university students were reported to be hardly active.[12] A strong correlation has been noted between the lack of PA and mortality. According to WHO data, the mortality rate due to physical inactivity is 17%. Regular PA helps to reduce acute coronary syndrome, lower the risk of diabetes, regulate blood pressure, and prevent obesity and other complications.[13,14] The risk for MetS may be reduced even in elderly patients by changing individual lifestyles.[15] The main methods for reducing MetS-related morbidity and mortality are early detection of risk factors, screening for metabolic disorders, and the development of new treatments. Dietary changes and PA are the only treatment approaches currently in use.[16] Therefore, the very first step to prevent MetS development in young people is to screen individuals carrying a risk for chronic metabolic diseases and to identify those in the highest risk group. Thus, it is highly crucial to conduct health screenings of university students for the early detection of MetS and to identify the risk factors at an early stage for both increasing the quality of life and mitigating the national economic burden.

After examining the available research, no study could be found that investigates the correlation of MetS risk components and healthy lifestyle behaviors, the risk for diabetes, and PA levels. Hence, this study can contribute greatly to the current literature.

The aim of this research is to determine the MetS risk, healthy lifestyle behaviors, and PA levels of university students.

Material and Methods

This study is a descriptive and cross-sectional study. The population of the study consisted of nursing and midwife students in the Faculty of Medical Sciences at a university in Northwestern Turkey (n = 375). The students volunteered to participate in the study and had no previous MetS diagnosis (n = 264). All students were included in the study without any sample calculations (70.4% of the population).

Data Collection Tools

Personal Information Form: This form consisted of 15 questions that queried the students' age, gender, height, weight, waist circumference, body mass index (BMI), indirect arterial blood pressure, chronic disease status in the family, status of having a relative diagnosed with MetS, previous diagnosis of polycystic ovary syndrome (if any), presence of any chronic diseases, depression diagnosis, constant use of medications, smoking habits, and alcohol use.

MAIN POINTS

- Metabolic syndrome continues to be a leading public health problem worldwide.
- The study showed that the university students had insulin resistance, impaired glucose intolerance, microalbuminuria, and fatty liver (grade I-II) despite being a younger generation.
- The study showed that the university students' physical activity levels were noted as inactive.
- Nursing and midwife students should primarily focus on their health as they will take the lead in the protection and development of public health as role models in society.

Healthy Lifestyle Behaviors Scale-II): A revised Healthy Lifestyle Behavior Scale (HLBS) version[17] that was restudied and reviewed in 1996 and developed by Walker et al[18] was used in this study. Turkish validity and reliability studies were conducted by Pınar et al.[19] This 4-point Likert scale consisting of 52 items had a total of 6 subdimensions: health responsibility, PA, diet (D), moral development (MD), interpersonal relations (IR), and stress management. The lowest possible score was 52 and the highest possible score was 208. The scale had no breakpoint. The higher the total scores acquired from the scale and its subdimensions, the higher the level of healthy lifestyle behaviors. The Cronbach alpha value of the original version of the scale was 0.93, and Cronbach alpha values of the subdimensions ranged between 0.70 and 0.87. The Cronbach alpha value was 0.70 in the study by Pınar et al[19] while it was found to be 0.85 in this study.

Type-II Diabetes Mellitus Risk Questionnaire: The questionnaire was issued by the International Diabetes Federation and had 8 questions in total.[20] Question scores were added and the risk of developing diabetes in the next decade was calculated. A total score of <7 was considered as low, 7-11 as mild, 12-14 as medium, 15-20 as high, and scores over 20 indicated extremely high risk. Although it is not valid and reliable in Turkish, the use of the Type II DM Risk Questionnaire was recommended by the Turkish Endocrine and Metabolism Society, and so, this questionnaire was included in the study.[21]

International Physical Activity Questionnaire (Brief Form): International validity and reliability studies of the questionnaire were conducted by Craig et al[22] and Turkish validity and reliability studies were conducted by Öztürk.[23] This form had 7 questions regarding the time spent on PA during the past week. The brief form included categories on the time spent walking and performing moderately intense and highly intense activities. The amount of time spent sitting was also considered in a separate question. Calculations were then carried out.

The total PA score (metabolic equivalents (MET)-min/week) was determined by converting highly and moderately intense activity and walking time periods to MET, corresponding to the basal metabolic rate, by means of the following calculations:[24]

Walking score (MET-min/week) = 3.3 × [walking period] × [walking days]

Moderately intense activity score (MET-min/week) = 4.0 × [moderately intense activity period] × [moderately intense activity days]

Highly intense activity score (MET-min/week) = 8.0 × [highly intense activity period] × [highly intense activity days]

Total physical activity score (MET-min/week) = walking + moderately intense activity + highly intense activity scores.

The PA levels of the participants were then classified as low (under 600 MET-min/week), medium (between 600 and 3000 MET-min/week), and high (above 3000 MET-min/week) depending on the PA scores.

Implementation of the Study

The study data were collected between the dates of September 1, 2017, and March 31, 2018. The study was conducted in 3 stages following the order of preparation, descriptive tests, and test results as explained in the following sub-sections.

Preparation Stage

Students who accepted to participate in the study were provided with the Personal Information Form, the HLBS, the International Physical Activity Questionnaire (Brief), and the Type-II DM Risk Questionnaire to complete. Participants were informed of the preparations for biochemical and radiological examinations required for the study (i.e., not changing their dietary habits for at least 3 weeks, not consuming alcohol from 3 days before the study, not smoking before the blood draw, not participating in an extremely strenuous exercise program, and having to give blood after a 12-hour fast) and appointments were then scheduled.

Descriptive Test Stage

Three weeks after informing the participants, blood (fasting serum glucose and insulin, high-density lipoprotein (HDL), low-density lipoprotein, triglyceride, total cholesterol, C-reactive protein, gamma-glutamyl transferase, aspartate transaminase, and alanine aminotransferase) and urine samples (creatine, albumin) were taken at the hospital following a minimum 12-hour fast. Carotid Doppler ultrasonography (USG) was performed to determine any endothelial dysfunction of the participants, and liver USG was performed to check for fatty liver within the scope of radiological examinations. Analyses of the students' BMI, body fat rates, measurements of their waist circumference, and measurements of indirect arterial blood pressures were carried out by means of the TANITA MC780 Body Analysis device.

Test Result Stage

A body composition analysis of all participants was carried out by an internal medicine specialist from the project team. Additionally, in accordance with the Adult Treatment Panel-III 2001 criteria recommended by the National Cholesterol Education Program, the MetS risks of the participants were also assessed by the same specialist. The summary of the results of the blood and radiological imaging and the points that the students should take into consideration were

Table 1. Descriptive Characteristics, Health History, and Laboratory Values of Students (n = 263)

Variables	n	%	Variables	n	%
Gender			Smoke use		
Female	220	83.65	Yes	27	10.27
Male	43	16.35	No	236	89.73
Chronic disease status in the student			Alcohol use		
Yes	11	4.18	Yes	2	0.76
No	252	95.82	No	261	99.24
Chronic disease status in the mother			Body mass index		
Yes	61	23.19	<30 kg/m^2	258	98.1
No	202	76.81	≥30 kg/m^2	5	1.9
Chronic disease status in the father			Microalbuminuria		
Yes	53	20.15	<30 mg/g	247	93.92
No	210	79.85	≥30 mg/g	16	6.08
Chronic disease status in the sibling			HOMA Index		
Yes	16	6.08	<2.7	120	45.63
No	247	93.92	≥2.7	143	54.37
Chronic disease status in the family			Non-alcoholic fatty liver		
Yes	152	57.79	Yes	221	84.03
No	111	42.21	No	42	15.97
Diagnosis of metabolic syndrome in the family				**Min.- Max.**	**X ± SD**
Yes	5	1.9	Age	17-33	20.37 ± 2.0
No	258	98.1	Systolic BP (mm Hg)	70-180	101.1 ± 12.6
Diagnosis of depression			Diastolic BP (mm Hg)	40-130	65.59 ± 9.98
Yes	10	3.8	Waist circumference (cm)	54-118	76.68 ± 11.06
No	253	96.2	CRP (mg/dL)	3-19.6	3.4 ± 1.78
Prediagnosed polycystic ovary syndrome			Cholesterol	96 ± 257	154.56 ± 26.56
Yes	8	3.04	LDL	52 ± 194	107.64 ± 22.58
No	255	96.96	AST	14 ± 107	21.84 ± 7.65
			ALT	6 ± 152	16.46 ± 12.84
			GGT	6 ± 100	15.32 ± 8.6
			Endothelial dysfunction		
			Carotid USG—IMT right	0.2-0.6	0.42 ± 0.06
			Carotid USG—IMT left	0.3-0.8	0.43 ± 0.07
			Carotid USG—EMT right	0.1-1	0.55 ± 0.11
			Carotid USG—EMT left	0.1-1	0.56 ± 0.11

BP, blood pressure; CRP, C-reactive protein; LDL, low-density lipoprotein; AST, aspartate aminotransferase; ALT, alanine aminotransferase; GGT, serum gamma-glutamyl transferase; USG, ultrasonography; IMT, intima-media thickness; EMT, extra-media thickness.

Table 2. Distribution of Diabetes Mellitus Risk Levels, Physical Activity Levels, and Healthy Lifestyle Behavior Scale Scores of Students (n = 263)

Diabetes Mellitus Risk Levels	n	%
Low and mild risk	244	92.78
Medium risk	14	5.32
High and very high risk	5	1.9
Physical activity levels	n	%
Inactive	107	40.68
Minimally active	95	36.12
Highly active	61	23.19
Healthy Lifestyle Behavior Scale sub-dimension and total scores	Min.- Max.	X ± SD
Health responsibility	9-36	20.85 ± 4.75
Physical activity	8-32	16.29 ± 4.3
Diet	10-29	19.5 ± 3.51
Moral development	16-36	27.06 ± 3.88
Interpersonal relations	15-36	26.54 ± 4.0
Stress management	8-32	19.51 ± 3.52
Total scores	80-195	129.75 ± 17.43

SD, standard deviation.

recorded in the "Clinical Result Report" prepared by the researchers. All students were provided with their test results.

Ethical Approval

The Human Rights Declaration of Helsinki was followed throughout this study. Institutional permission was acquired from the Clinical Studies Ethical Board of the Hitit University (July 11, 2017-2017-47; October 17, 2017-2017-82). Informed written consents were acquired from all participants.

Statistical Analysis

The data were analyzed using the Statistical Package for the Social Sciences version 21.0 (IBM Corp.; Armonk, NY, USA). The Mann–Whitney *U* test, the chi-square test, and the Kruskal–Wallis H-test were used for analysis along with the frequency and percentage distribution. The significance level was accepted to be $P < .05$.

Table 3. Frequency and Total Component Distribution of the MetS Components of Students (n = 263)

MetS Component Frequency	n	%
Fasting blood glucose ≥110 mg/dL	5	1.9
Hypertriglyceridemia		
≥150 mg/dL	19	7.22
Blood pressure ≥ 130/85 mm Hg	3	1.14
HDL		
Female < 50 mg/dL	51	23.08
Male < 40 mg/dL	8	18.6
Abdominal obesity (waist circumference)		
Female > 88 cm	7	3.18
Male > 102 cm	5	11.63
Total MetS component		
MetS negative components	187	71.1
One positive component	64	24.33
Two positive components	10	3.8
MetS	2	0.76

MetS, metabolic syndrome; HDL, high-density lipoprotein.

Results

Descriptive Characteristics, Health History, and Laboratory Values of Students

The personal information surveys indicated that 83.6% of the students aged 20.37 ± 2.0 were female, 95.8% had no chronic diseases, 3.8% were diagnosed with depression, 3% were examined for polycystic ovary syndrome, 89.7% did not smoke, and 99.2% did not consume alcohol. It was also seen that 98.1% of the students had BMIs under 30 kg/m^2, 6 students had microalbuminuria, 54.3% had insulin resistance according to the Homeostasis Model Assesment (HOMA) index, and 15.97% had fatty livers (Table 1).

Distribution of Diabetes Mellitus Risk Levels, Physical Activity Levels, Healthy Lifestyle Behavior Scale Scores, and Metabolic Syndrome components of Students

In total, 92.7% of the students participating in the study were in the low- and mild-risk group in terms of developing diabetes and 40.6% had inactive levels of PA. The HLBS score (average) was found to be 129.75 ± 17.4, and the D, MD, and IR subgroups had higher scores compared to the other subgroups (Table 2). The frequency and total component distribution of the MetS components of the students are summarized in Table 3.

Comparison of Students' Metabolic Syndrome Components and Physical Activity, Diabetes Risk Levels, and Healthy Lifestyle Behavior Scale

While there was no statistically significant difference between the MetS risk factors of fasting blood glucose (FBG), blood pressure (BP), HDL, and waist circumference and the PA groups ($P > .05$), there was a statistically significant difference between the hypertriglyceridemia variable and the PA groups ($P < .05$). It was observed that 86.8% of those with high PA levels had triglyceride values below 150 mg/dL (Table 4).

A statistically significant difference was noted between the MetS risk factor FBG and the DM risk questionnaire scores ($P < .05$). 99.1% of students in the low- and mild-risk group were detected to have FBGs < 109 mg/dL (Table 4).

There was also a statistically significant difference between the MetS risk factor abdominal obesity (waist circumference) and the risk of developing DM in both male and female students ($P < .05$). There was no statistically significant difference between the MetS risk factors BP, HDL, and hypertriglyceridemia with DM risk scores ($P > .05$) (Table 4).

No statistically significant difference was found between the MetS risk factors FBS, BP, hypertriglyceridemia, waist circumference, and HDL values of male students and the HLB total and sub-dimension mean scores of all students ($P > .05$). There was, however, a statistically significant difference between the MetS component HDL values of female students and the mean scores of the HLB MD sub-dimension ($P < .05$). The students with HDL values of 50 and above had significantly higher MD scores (Table 5). There was also a statistically significant difference between microalbuminuria and the PA groups ($P < .05$). Microalbuminuria was detected as "inactive" in 10.28% of the PA group, "minimally active" in 4.21%, and "highly active" in 1.64% (Table 6).

Discussion

Although the university students constitute a younger generation, it has been shown with this study that they carry MetS risk (insulin resistance, impaired glucose tolerance, fatty liver, and microalbuminuria). An improvement in dietary and lifestyle habits combined with the adoption of moderate exercise in adolescents has been indicated to be effective in improving cardio-metabolic indicators and reducing body fat.[25] Therefore, it is extremely important to examine the MetS risk factors and healthy lifestyle behaviors of adolescents and younger adults.

Most of the students in this study were of normal weight. Similar to this study, other studies exist that show that university students have a normal weight,[11] while there are also opposing studies that state that university students are overweight.[26-28] The most common method for obesity diagnosis in this field is the calculation of BMI. Body mass index is obtained by dividing an individual's body weight (in kilograms) by the square of their height (in meters). Body mass index is only a general indirect indicator of the total body fat and it does not provide any information on the distribution of fat. It has been reported that the distribution of fat tissue throughout the body is as important as the amount of fat in the body, and for this reason, waist circumference and waist/hip ratio are crucial for the evaluation of obesity-related risk.[26] A waist circumference of ≥88 cm in women and ≥102 cm in men is considered high risk.[29] Considering this information, it can be stated that the students in this study group were within normal limits according to waist circumference measurements. On the other hand, the accumulation of fat in the abdominal area poses a risk for cardio-metabolic diseases. Insulin resistance, type-II diabetes, dyslipidemia, and coronary artery disease are known to be high-risk factors for obesity.[26] Therefore, it is crucial to raise awareness of obesity among university students and to develop healthy lifestyle behaviors for better control thereafter.

Microalbuminuria is an indicator of vascular damage in DM and it indicates the increased risk of diabetic nephropathy in type-II DM and cardiovascular disease. It is known that microalbuminuria is frequently found in diabetic cases. However, it has been highlighted

Table 4. Comparison of MetS Components and Physical Activity and Diabetes Risk Levels of Students

NCEP Criteria	Physical Activity Levels			Diabetes Risk Levels		
	Inactive n (%)	Minimally Active n (%)	Highly Active n (%)	Low and Mild Risk n (%)	Medium Risk n (%)	High and Very High Risk n (%)
Fasting blood glucose						
<109 mg/dL	105 (98.13)	93 (97.89)	60 (98.36)	242 (99.18)	12 (85.71)	4 (80.0)
≥110 mg/dL	2 (1.87)	2 (2.11)	1 (1.64)	2 (0.82)	2 (14.29)	1 (20.0)
	χ^2/P = -/.594			**χ^2/P =* /.005**		
Hypertriglyceridemia						
<150 mg/dL	98 (91.59)	93 (97.89)	53 (86.89)	227 (93.03)	13 (92.86)	4 (80.0)
≥150 mg/dL	9 (8.41)	2 (2.11)	8 (13.11)	17 (6.97)	1 (7.14)	1 (20.0)
	χ^2/P =7.097/.029			χ^2/P =*/.268		
Blood pressure						
<130/85 mm Hg	100 (100.0)	93 (97.89)	60 (98.36)	242 (99.18)	13 (92.86)	5 (100.0)
≥ 130/85 mm Hg	0 (0.0)	2 (2.11)	1 (1.16)	2 (0.82)	1 (7.14)	0 (0.0)
	χ^2/P = -/.22			χ^2/P =*/.209		
Abdominal obesity (waist circumference), female						
<88 cm	95 (95.96)	81 (95.29)	37 (100.0)	202 (98.06)	8 (80.0)	3 (75.0)
≥88 cm	3 (3.06)	4 (4.71)	0 (0.0)	4(1.94)	2(20.0)	1 (25.0)
	χ^2/P =-/.398			**χ^2/P =*/.008**		
Abdominal obesity (waist circumference), male						
<102 cm	7 (77.78)	8 (80.0)	23(95.83)	36(94.74)	8 (80.0)	1 (100.0)
≥102 cm	2 (22.22)	2 (20.0)	4 (4.17)	2(5.26)	2 (20.0)0	0 (0.0)
	χ^2/P = -/.097			**χ^2/P =* /.041**		
HDL, female						
<50 mg/dL	27(27.55)	20(23.53)	4(10.53)	45 (21.74)	4 (40.0)	2 (50.0)
≥50 mg/dL	71(72.45)	65(76.47)	34 (89.47)	162(78.26)	6 (60.0)	2 (50.0)
	χ^2/P = 4.487/.106			χ^2/P =*/.065		
HDL, male						
<40 mg/dL	2 (22.22)	2 (20.0)	4 (16.67)	7 (18.42)	1 (25.0)	0 (0.0)
≥40 mg/dL	7 (77.78)	8 (80.0)	20 (83.33)	31(81.58)	3 (75.0)	1 (100.0)
	χ^2/P = - /.434			χ^2/P = */.699		

*Montecarlo simulation has been applied.
Significance of values given in bold is $P < .05$
χ^2, chi-square; NCEP, National Cholesterol Education Program Adult Treatment Panel; HDL, high-density lipoprotein; MetS, metabolic syndrome.

Table 5. Comparison of MetS Components and Healthy Lifestyle Behaviors Scale Scores of Students

HLBS Scores	Health Responsibility	Physical Activity	Diet	Moral Development	Interpersonal Relations	Stress Management	HLBS Total Scores
	X ± SD	X ± SD	X ± SD	X ± SD	X ± SD	X ± SD	X ± SD
Fasting blood glucose							
<109 mg/dL (n = 51)	20.84 ± 4.74	16.31 ± 4.34	19.5 ± 3.54	27.06 ± 3.91	26.56 ± 3.99	19.5 ± 3.5	129.77 ± 17.52
≥110 mg/dL	21.2 ± 5.89	14.8 ± 1.3	19.8 ± 1.48	27.2 ± 2.17	25.4 ± 4.77	20 ± 4.64	128.4 ± 12.66
	*z**: −0.217	*z*: −0.937	*z*: −0.319	*z*: −0.006	*z*: −0.560	*z*: −0.340	*z*: −0.104
	P: .828	*P*: .349	*P*: .750	*P*: .995	*P*: .575	*P*: .734	*P*: .917
Hypertriglyceridemia							
<150 mg/dL	21 ± 4.71	16.2 ± 4.3	19.57 ± 3.53	27.02 ± 3.93	26.59 ± 3.97	19.46 ± 3.58	129.84 ± 17.45
≥150 mg/dL	18.95 ± 4.99	17.32 ± 4.32	18.63 ± 3.15	27.53 ± 3.29	25.95 ± 4.42	20.11 ± 2.56	128.47 ± 17.6
	z: −1.659	*z*: −0.835	*z*: −1.107	*z*: −0.683	*z*: −0.383	*z*: −1.022	*z*: −0.030
	P: .097	*P*: .404	*P*: .268	*P*: .494	*P*: .701	*P*: .307	*P*: .976
Blood pressure							
<130/85 mmHg	20.84 ± 4.76	16.24 ± 4.3	19.48 ± 3.51	27.08 ± 3.9	26.54 ± 4.02	19.49 ± 3.54	129.67 ± 17.49
≥130/85 mmHg	21.33 ± 5.03	20 ± 2.65	21.67 ± 4.04	25.67 ± 0.58	26.67 ± 2.52	21 ± 0	136.33 ± 9.07
	z: −0.299	*z*: −1.730	*z*: −0.962	*z*: −0.908	*z*: −0.115	*z*: −1.219	*z*: −0.955
	P: .765	*P*: .084	*P*: .336	*P*: .364	*P*: .908	*P*: .223	*P*: .340
Abdominal obesity (waist circumference) Female							
<88 cm	21.15 ± 4.75	15.81 ± 4.14	19.51 ± 3.52	27.17 ± 3.93	26.82 ± 4	19.55 ± 3.46	130.02 ± 17.36
≥88 cm	19.29 ± 6.07	16.71 ± 2.56	19.14 ± 4.41	25.29 ± 2.56	25.29 ± 3.64	19.86 ± 2.04	125.57 ± 12.88
	z: −1.262	*z*: −0.720	*z*: −0.091	*z*: −1.302	*z*: −0.966	*z*: −0.433	*z*: −0.546
	P: .207	*P*: .471	*P*: .928	*P*: .193	*P*: .334	*P*: .665	*P*: .585
Abdominal obesity (waist circumference) Male							
< 102 cm	19.76 ± 4.49	18.87 ± 4.84	19.68 ± 3.51	26.89 ± 3.92	25.16 ± 3.99	19.29 ± 4	129.66 ± 19.4
≥ 102 cm	18.2 ± 3.27	16.2 ± 1.92	18.2 ± 1.92	26.2 ± 2.77	26.8 ± 2.86	18.8 ± 4.38	124.4 ± 11.19
	z: −0.990	*z*: −1.483	*z*: −0.781	*z*: −0.819	*z*: −1.219	*z*: −0.591	*z*: −1.005
	P: .322	*P*: .138	*P*: .435	*P*: .413	*P*: .223	*P*:.554	*P*: .315
HDL, female							
<50 mg/dL	20.45 ± 5.15	15.73 ± 4.09	18.92 ± 3.35	25.78 ± 4.42	26.49 ± 3.6	18.8 ± 3.57	126.18 ± 17
≥50 mg/dL	21.21 ± 4.64	15.91 ± 4.09	19.69 ± 3.59	27.51 ± 3.63	26.82 ± 4.08	19.78 ± 3.33	130.92 ± 16.93
	z: −1.385;	*z*: −0.277	*z*: −0.962	*z*: −2.334	*z*: −0.799	*z*: −1.437	*z*: −1.640
	P: .166	*P*: .782	*P*: .336	*P*: **.020**	*P*: .424	*P*: .151	*P*: .101
HDL, male							
<40 mg/dL	19.5 ± 3.66	18.5 ± 3.21	19.5 ± 3.69	26.5 ± 2.75	24 ± 1.98	19.5 ± 2.66	132 ± 12.63
≥40 mg/dL	20 ± 4.82	18 ± 5.2	19 ± 3.35	27 ± 4.12	25 ± 4.31	19 ± 4.34	129 ±20.9
	z: −0.188	*z*: −0.157	*z*: −0.298	*z*: −0.800	*z*: −1.208	*z*: −0.110	*z*: −0.328
	P: .866	*P*: .890	*P*: .771	*P*: .433	*P*: .235	*P*: .915	*P*: .748

*Kruskal Wallis.
HLBS, Healthy Lifestyle Behaviors Scale Scores; MetS, metabolic syndrome; HDL, high-density lipoprotein; SD, standard deviation.

Table 6. Comparison of Physical Activity Level and Metabolic Syndrome Components of Students

		Physical Activity Levels			Test
		Inactive, n (%)	Minimally Active, n (%)	Highly Active, n (%)	Chi-square/*P*
Polycystic ovary syndrome	Yes	4 (3.74)	2 (2.11)	2 (3.28)	*/.49
	No	103 (96.26)	93 (97.89)	59 (96.72)	
Impaired glucose intolerance	Yes	16 1(4.95)	15 (15.79)	10 (16.39)	0.066/.968
	No	91 (85.05)	80 (84.21)	51 (83.61)	
Microalbuminuria	Yes	11 (10.28)	4 (4.21)	1 (1.64)	5.991/.049
	No	96 (89.72)	91 (95.79)	60 (98.36)	
Fatty liver	Yes	18 (16.82)	17 (17.89)	7 (11.48)	1.238/.538
	No	89 (83.18)	78 (82.11)	54 (88.52)	
Insulin resistance	Yes	60 (56.07)	51 (53.68)	32 (52.46)	0.233/.89
	No	47 (43.93)	44 (46.32)	29 (47.54)	
Body mass index	<30	104 (97.2)	93 (97.89)	61 (100)	*/.434
	≥30	3 (2.8)	2 (2.11)	0 (0)	

Significance of values given in bold is *P* < .05

that further diagnostic tests should be performed as well.[30] Insulin resistance is defined as a reduced response to circulating insulin of normal concentration. The risk for developing insulin resistance increases with various factors including a genetic predisposition, obesity, sedentary lifestyle, and age. Insulin resistance lies at the center of MetS.[31] Insulin resistance has been detected in 90% of patients with MetS.[32] The fact that most of the students in this study had insulin resistance suggests that they should be followed closely in terms of the risk of developing MetS in the future.

In this study, most students were in the low and mild diabetes risk groups. Similarly, in a study by Topbas[33] examining the risk of type-II DM and associated factors in university students, most students (70.4%) were in the low-risk group. In a similar study conducted with nursing students, 67.1% were in the low-risk group with a 10-year type-II diabetes risk of 1%, 28.5% were in the mild-risk group with a 10-year diabetes risk of 4%, 2.2% were in the medium-risk group with a 10-year type-II diabetes risk of 16%, and 2.2% were in the high-risk group with a 10-year type-II diabetes risk of 33%.[34] The use of risk screening scales and anthropometric measurements prior to interventional procedures such as biochemical diagnostic tests in determining the risk of type-II diabetes may be effective in reducing the risk of DM by ensuring early diagnosis through risk screening in university students. Despite the widespread use of the Type II DM Risk Questionnaire by the Turkish Endocrine and Metabolism Association, its lack of validity and reliability in Turkey is considered a limitation.[35]

The study determined that most students were inactive in terms of PA. Similar results were obtained in some studies conducted with university students in available literature.[36,37] In a study by Ilaslan et al[38] examining the PA levels and associated factors of university students in a region, the students' mean MET scores were found to be high. Contrary to this study's results, a study by Pirinci et al[12] found that 9% of university students were inactive and 32% were sufficiently active. Physical activity is defined as actions that increase respiratory and heart rates and result in fatigue by burning energy using the muscles and joints. It is a proven fact that the incidence of diseases such as cardiovascular diseases, obesity, type-II diabetes, hypertension, and osteoporosis increases with the lack of PA.[12] The assessment of PA levels of university students in combination with awareness training and scheduled social activities to increase the PA levels of these students may contribute to a reduced risk of developing MetS among inactive students in the future.

Healthy Lifestyle Behavior Scale levels were found to be high in this study. There are some studies available in current research indicating that HLBS mean scores are at a moderate level in university students.[39-43] A healthy lifestyle means that individuals have control over all the behaviors that may affect their health and they choose and implement activities to improve their health in their daily lives. Healthy Lifestyle Behavior Scale, in turn, is defined as all the behaviors that an individual believes in and practices to stay healthy and to be protected from disease.[43] In this study, female students with an HDL value of ≥50 mg/dL had significantly higher HLPS levels in the dimension of MD. In a study conducted by Taskin Yilmaz et al[44] examining the correlation between the knowledge of cardiovascular disease risk factors and healthy lifestyle behaviors in individuals with type-II diabetes, it was determined that the mean HDL cholesterol values of the individuals did not affect the mean HLBS scores. In the same study, it was determined that only triglyceride levels decreased as the healthy lifestyle behaviors of the individuals increased.[44] High-density lipoprotein particles, which have many important functions in the body, play a key protective role against cardiovascular diseases. On the other hand, although it is known that individuals with high HDL levels have a lower risk of heart disease, it should be emphasized that half of the individuals with a history of heart attacks have healthy cholesterol values.[45] The MD dimension of HLBS also means a self-development dimension of individuals. Therefore, it is an expected result in this study that university students with the desired HDL value studying at a health-related faculty exhibit healthy lifestyle behaviors in the moral dimension. However, the HLBS levels of these students are still not at the required level. Awareness should be raised to increase HLBS levels, especially among university students studying in health-related departments, and resulting behavioral changes should be closely monitored. Primarily, it should be noted that these students will be indispensable members of healthcare teams in the future and will take the lead in the protection and promotion of public health by being role models in society.

We planned to use brachial artery doppler USG for endothelial dysfunction in the study. However, we performed only carotid USG because the brachial artery doppler USG procedure took a long time, the hospital had a limited number of available radiologists, and some studies indicated that carotid USG alone was sufficient.

Conclusion

It was found in this study that the examined students were of normal weight according to their BMI scores, most of them were in the low-risk group for type-II DM, their PA levels were noted as inactive, the HLBS value was high, and most students had insulin resistance. It should be ensured that the students in this study group be closely monitored in terms of MetS risk factors and that they should be provided with activities to increase their PA levels. Moreover, it is recommended to conduct further studies in which the relationship between MetS risk factors and healthy lifestyle behavior characteristics of students (smoking, dietary habits, etc.) is examined in detail.

Ethics Committee Approval: The study was approved by the medical ethics committee Clinical Studies Ethical Board of the Hitit University (No: July 11, 2017-2017-47; October 17, 2017-2017-82).

Informed Consent: Written informed consent was obtained from all participants who has taken the survey.

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