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Determination of Physical Activity Levels, Quality of Life, Depression and Fatigue Severity of Individuals with Metabolic Syndrome

Büşra Sarıkaya[1], Meral Sertel[2]

[1]*Physiotherapy and Rehabilitation Department, Health Sciences Faculty, Kirikkale University, Kirikkale, Turkey*
[2]*Physiotherapy and Rehabilitation Department, Health Sciences Faculty, Bursa Uludag University, Bursa, Turkey*

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Corresponding author:
Meral Sertel.
E-mail: msertel@uludag.edu.tr.
ORCID: 0000-0002-7575-9762.

ABSTRACT

Aim: The aim of this study is to assess the levels of physical activity, quality of life, depression, and fatigue severity in individuals with metabolic syndrome (MetS) and compare them with those of healthy individuals.

Methods: Participants diagnosed with MetS from the Department of Endocrinology and Metabolic Diseases and healthy individuals were included in the study. A total of 107 individuals with MetS and 107 healthy individuals participated in the study. Sociodemographic data of the individuals were queried using a prepared case form. The International Physical Activity Questionnaire (IPAQ) was used to determine the physical activity levels of the individuals, the SF-36 was used to assess their quality of life, the Beck Depression Scale (BDI) was used to determine their depression levels, and the Fatigue Severity Scale (FSS) was used to assess their fatigue levels.

Results: The mean age of individuals with MetS was 50.80±7.78 years, while healthy individuals had a mean age of 45.16±9.60 years. Statistical differences were found in IPAQ total scores, all SF-36 subscales, BDI, and FSS between individuals with MetS and healthy individuals ($p<0,001$). Individuals with MetS had higher depression and fatigue levels, with mean BDI scores of 23.79±4.50 compared to 5.48±3.00 in controls, and mean FSS scores of 4.99±1.13 versus 2.40±0.89, respectively.

Conclusion: According to the data obtained in our study, individuals with MetS have low levels of physical activity and quality of life, and they experience depression and fatigue problems. We believe that treatment protocols for this patient group should include studies on physical activity levels, quality of life, depression, and fatigue.

Keywords: Metabolic syndrome, Physical Activity, Quality of Life, Depression, Fatigue, ClinicalTrials.gov with ID NCT05184634.

Introduction

Metabolic syndrome (MetS) is defined as a cluster of conditions characterized by the coexistence of obesity with at least two of the following: high blood pressure, impaired glucose metabolism, and elevated non-high-density lipoprotein (non-HDL) cholesterol levels [1]. It represents a multifactorial syndrome in which these components interact and increase overall cardiometabolic risk.

The prevalence of MetS varies depending on geographical region, diagnostic criteria, age, and gender, and has shown a notable increase in recent years [2]. Data from the Centers for Disease Control and Prevention indicate a 35% rise in prevalence up to 2012 in the United States [3]. Similarly, findings from the Turkish Adult Heart Disease and Risk Factors (TEKHARF) study highlight that MetS has become a major public health concern in Turkey, with a prevalence of 32.8% among individuals aged 30 years and older [4].

MetS is influenced by factors such as hypertension, hyperglycemia, dyslipidemia, and abdominal obesity, along with environmental and genetic determinants [5].

Effective management requires identification and control of these components through comprehensive strategies, including pharmacological treatment, physical activity, and nutritional interventions [6,7]. Physical activity plays a key role by improving lipid profiles, glycaemic control, and blood pressure, while its deficiency is strongly associated with obesity and MetS development [8]. In addition, MetS negatively affects quality of life through impairments in physical and mental health, increases the risk of depression via neuroendocrine mechanisms, and contributes to fatigue due to reduced physical function [9–14]. These factors collectively lead to decreased daily functioning and increased risk of chronic conditions such as diabetes and cardiovascular diseases [15–17].

A review of the literature indicates that studies addressing MetS with a multidimensional perspective—incorporating physical activity, quality of life, depression, and fatigue—are limited. Therefore, this study aims to evaluate these parameters in individuals with MetS and compare them with healthy controls.

Methods

Participant

Gülhane Training and Research Hospital between December 2021 and May 2022. Participants diagnosed with MetS from the Department of Endocrinology and Metabolic Diseases and healthy individuals were included in the study. 107 individuals with MetS and 107 healthy individuals participated in the study. A total of 107 healthy volunteers who met the study criteria were recruited as the control group through a snowball sampling method from patients, their relatives, and researchers. The study initially included 221 individuals. 112 individuals with MetS and 109 healthy individuals were interviewed for the study. 5 individuals diagnosed with MetS were excluded from the evaluation due to thyroid disease. 2 healthy individuals declined to participate in the study (Figure 1).

G*Power (version 3.1.9.7, University of Düsseldorf, Germany) was used for post-hoc power analysis, and the effect size was calculated from the total score of the physical activity scale (IPAQ) between individuals with MetS and healthy individuals. According to the analysis, the alpha level for a two-sided hypothesis test was 5%. The confidence interval was 95%, the effect size was 0.60, and the study's power (1- β) was 99%.

The study received approval from the Kırıkkale University Non-Interventional Research Ethics Board on September 16, 2021 (Decision Number: 21/09/07). Additionally, permission was obtained from the Gülhane Training and Research Hospital Directorate on October 6, 2021. The purpose of the study was explained to the individuals included, informed consent forms were obtained after providing information about the questionnaires to be used, and the study was conducted in accordance with the principles of the Helsinki Declaration. The clinical trial was registered at ClinicalTrials.gov with ID NCT05184634. Clinical trial conforms to the CONSORT 2010 Statement (Consolidated Standards of Reporting Trials). Additionally, this study was produced from the master's thesis.

Individuals aged 25-65 with a diagnosis of MetS, willing to participate in the study, independently ambulatory, and literate were included, along with individuals aged 25-65 without a diagnosis or complaints related to diseases constituting MetS who served as the healthy group. Exclusion criteria for the study included being outside the 25-65 age range, being on bed rest for

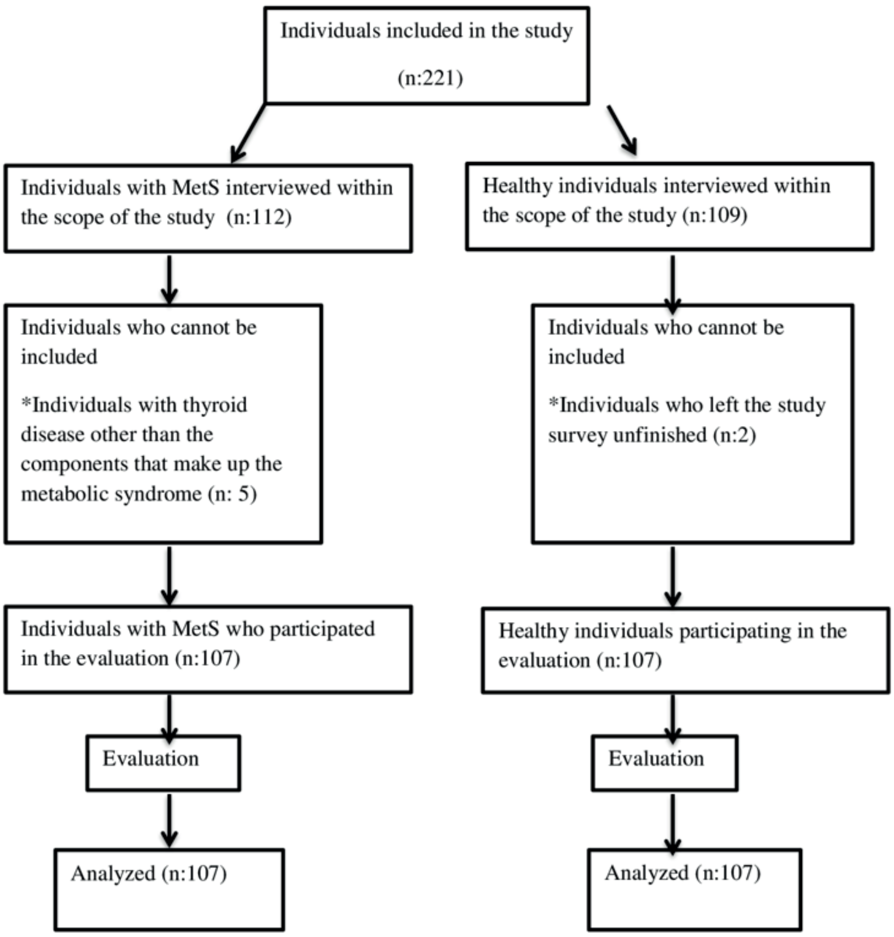

Figure 1 – Flow Diagram

at least one month prior to the study, having contraindications to physical activity, having any orthopedic, neurological, or psychiatric disorders, and also having chronic conditions other than those constituting MetS (Chronic disorders such as asthma, thyroid etc. were excluded because they could affect parameters such as physical activity, quality of life and fatigue). The study did not include individuals with visual, auditory, speech, cognitive, or understanding problems that hinder evaluation (Figure 1).

Tools for Measuring

All assessments were conducted face-to-face by an experienced clinician and an equally experienced physiotherapist in the clinic. The evaluations applied to the individuals included in the study are provided below. The assessment form was administered to each participant once.

The assessment form aimed to determine individuals' characteristics and included recording demographic and disease-related information, such as birth date, height, weight, gender, marital status, education level, medical history, medications, smoking status, and alcohol use.

International Physical Activity Questionnaire (IPAQ)

The level of physical activity (PA) was assessed using the short version of the International Physical Activity Questionnaire (IPAQ). The walking durations of the subjects in the last week, whether they engaged in moderate or vigorous physical activity, and, if so, the number of days per week and the total minutes spent were determined in terms of MET-minutes/week. As a result, all values were summed to determine the IPAQ total score, and patients were categorized as inactive, minimally active, or very active. The short Turkish version, validated and reliable according to Sağlam [18], was used. An increased score indicates higher physical activity and energy expenditure, representing a positive health outlook; a low score suggests a sedentary lifestyle and associated increased metabolic and cardiovascular risks.

Quality of Life Scale (SF-36)

The individuals' quality of life was assessed using the SF-36. The SF-36 quality-of-life scale, a generic scale, has been continuously updated by Ware and colleagues since 1988 and has evolved into its current form [19]. The SF-36 scale consists of 36 multiple-choice questions. Examining eight dimensions of health-related quality of life, high scores indicate a better level of health, while low scores indicate a deterioration in health. The dimensions of the scale include Physical Functioning (PF) (restriction in physical activities due to health problems), Physical Role (RP) (restriction in daily life activities due to health problems), Bodily Pain (BP), General Health (GH) (individual's overall health assessment), Vitality (VT), Mental Health (MH), Social Functioning (SF), and Emotional Role (RE) (restriction in daily life activities due to mental health problems) [19].

Beck Depression Inventory (BDI)

This is a self-assessment scale applied to healthy individuals and psychiatric patient groups. Its purpose is to determine the risk of depression and measure the level and severity of depressive symptoms. This form, which includes 21 self-assessment scales, uses a four-point Likert scale. Each item receives an increasing score between 0-3; the total score is obtained by summing these scores. A high total score indicates a high severity of depression. Developed by Beck and colleagues, the Inventory has undergone validity testing in Turkish, and the cutoff score was determined as 17 in the reliability article [20].

Fatigue Severity Scale (FSS)

The Fatigue Severity Scale was used to assess individuals' fatigue levels. The validity and reliability study of the scale for Turkey was conducted by Armutlu and colleagues [21]. The scale consists of a total of 9 items. Individuals indicate their agreement with each item by selecting a value from 1 to 7. The scale uses expressions such as "1: I do not agree at all" to "7: I completely agree". The scale ranges from 9 to 63, with scores of 36 or higher indicating severe fatigue.

Statistical analysis

Descriptive statistics for categorical variables (demographic characteristics) were presented as frequencies and percentages. The normal distribution of continuous variables was checked using the "Shapiro-Wilk Test." The homogeneity of variances was tested using Levene’s test where appropriate. Descriptive statistics for continuous variables were reported as mean ± standard deviation for normally distributed data and as median (min-max) for non-normally distributed data.

For the comparison of two independent groups with a normal distribution, the "Independent Samples T-Test" was performed. Analysis of Covariance was used to examine differences between the two groups while controlling for age. Pearson Chi-Square and Fisher’s exact tests were used to compare categorical variables. Multivariable stepwise linear regression was used to determine whether MetS, IPAQ Total, and eight SF-36 dimensions could predict BDI and FSS, while controlling for confounding factors such as age, gender, and BMI.

Also, a mediation analysis was conducted using the PROCESS macro (Model 4) in SPSS statistical software (version 4.2) to evaluate whether the effect of the independent variable (MetS) on the dependent variable (BDI) was transmitted through a mediator variable (IPAQ) [22]. This approach allowed for the examination of the independent variable's direct and indirect effects on the dependent variable via the mediator.

In all calculations and interpretations in the study, significance levels of "$p<0.05$, $p<0.01$, $p<0,001$" were used, and hypotheses were formulated as two-sided. Statistical data analysis was performed using IBM SPSS v26 (IBM Inc., Chicago, IL, USA).

Results

This study included 214 participants: 107 with MetS and 107 healthy individuals.

The age and BMI of the individuals included in the study are presented in Table 1. The mean age of individuals with

Table 1 Physical characteristics of individuals

Physical characteristics of individuals	Individuals with Metabolic Syndrome (n=107)	Healthy Individuals (n=107)	t	P
	Mean±SD	Mean±SD		
Age (years)	50,80±7,78	45,16±9,60	t=4,726	<0,001***
BMI (kg/m2)	30,54±6,20	23,59±2,49	t=10,761	<0,001***

*BMI: Body Mass Index, SD: Standard Deviation, t: Independent Sample T Test, ***p<0.001.*

Table 2 BMI and Sociodemographic Characteristics of Individuals

BMI and Sociodemographic Characteristics		Individuals with Metabolic Syndrome (n=107)		Healthy Individuals (n=107)		F-K	P
		n	%	n	%		
Normal weight		20	18,7	77	72,0	K=81,366	**<0,001*** **
Pre Obese		34	31,8	28	26,2		
Obese		53	49,5	2	1,9		
Gender	Male	45	42,1	47	43,9	K=0,076	0,782
	Woman	62	57,9	60	56,1		
Marital Status	Single	12	11,2	18	16,8	K=1,396	0,237
	Married	95	88,8	89	83,2		
Educa-tional Status	Primary school	25	23,4	9	8,4	F=17,005	**<0,001*** **
	Middle school	18	16,8	9	8,4		
	High school	41	38,3	42	39,3		
	Licence	21	19,6	46	43,0		
	Degree	2	1,9	1	0,9		
Smoking	No	78	72,9	89	83,2	K=3,299	0,069
	Yes	29	27,1	18	16,8		
Alcohol Use	No	107	97,2	101	94,4	F=1,039	0,308
	Yes	3	2,8	6	5,6		

*K: Chi-square test, *p<0.05, ***p<0.001, BMI: Body Mass Index.*

MetS was 50.80±7.78 years, with a Body Mass Index (BMI) of 30.54±6.20 kg/m2. In contrast, healthy individuals had a mean age of 45.16±9.60 years and a BMI of 23.59±2.49 kg/m2. Statistical differences were observed between individuals with MetS and healthy individuals in age and BMI. A statistically significant difference was explicitly found at the primary school and Bachelor's degree levels. The percentage of individuals with MetS who graduated from primary school was higher, whereas the percentage with a Bachelor's degree was lower (Table 1).

The comparison of IPAQ total scores, SF-36 subfactors, BDI, and FSS total scores between the study participants is presented in Table 2. A statistically significant difference in IPAQ total scores was found between individuals with MetS and healthy individuals (p<0,001). Upon examination of the results, the average IPAQ scores of healthy individuals were statistically higher than those of individuals with MetS. A statistically significant difference in SF-36 scores was found between individuals with MetS and healthy individuals (p<0,001). A statistically significant difference was found in the BDI and FSS total scores between individuals with MetS and healthy individuals (p<0,001). Upon examination of the results, it was observed that the median BDI and FSS scores for individuals with MetS were statistically higher than those for healthy individuals (Table 2).

The evaluation of IPAQ levels for the study participants is presented in Table 4.5. It was found that 10.3% of individuals with MetS were inactive, 24.3% were minimally active, and 65.4% were highly active; whereas 3.7% of healthy individuals were minimally active, and 96.3% were highly active. A statistically significant difference was found in the IPAQ total scores among the individuals participating in the study (p<0,001) (Table 3).

According to the stepwise linear regression analysis results, MetS, FSS, education level (primary school graduate), and BMI significantly affected BDI scores. MetS was found to be the independent variable with the strongest positive effect on depression levels (Standardized Beta = 0.700, p < 0,001), FSS (Standardized Beta = 0.242, p < 0,001), and BMI (Standardized Beta = 0.078, p = 0.008). These factors were other important factors that increased BDI scores. On the other hand, primary school graduation showed a significant effect on reducing depression scores (Standardized Beta = -0.068, p = 0,005) (Table 4, see the next page).

The FSS was used as the dependent variable, and the effects of the independent variables on BDI, the SF-36 Social Functioning sub-dimension, and the IPAQ total score were evaluated. According to the results, BDI scores were the variable with the strongest positive effect on FSS (Standardized β = 0.570, p<0,001), indicating that fatigue increases significantly with increasing depression levels. The SF-36 Social Functioning sub-dimension significantly reduced FSS scores (Standardized β = -0.270, p<0,001), indicating that increasing social functioning may reduce fatigue. The IPAQ total score also showed a significant but weaker negative effect on FSS (Standardized β = -0.107, p = 0,007), suggesting that increased physical activity may alleviate fatigue (Table 4, see the next page).

Table 3 Comparison of IPAQ total and SF-36 Scale subparameter scores of individuals with metabolic syndrome and healthy individuals

Parameter	Individuals with Metabolic Syndrome (n=107)		Healthy Individuals (n=107)		ANCOVA	
	Mean±SD	Median (min-max)	Mean±SD	Median (min-max)	F	P
IPAQ Total	3744,71±1753,51	3606 (477-8670)	4618,73±1029,00	4626 (2037-7206)	12,660	<0,001***
Physical Function	41,40±26,47	45 (0-100)	90,98±8,78	90 (70-100)	294,910	<0,001***
Physical Role Difficulty	19,19±26,64	0 (0-100)	87,85±17,29	100 (25-100)	435,914	<0,001***
Emotional Role Difficulty	20,86±29,49	0 (0-100)	86,27±21,48	100 (33,3-100)	296,671	<0,001***
Energy / Vitality / Vitality	38,74±12,81	40 (5-65)	77,50±10,98	80 (45-90)	496,027	<0,001***
Spiritual Health	45,08±10,92	44 (12-88)	78,02±9,76	80 (48-92)	482,546	<0,001***
Social Functionig	42,07±12,79	37,5 (12,5-75)	82,13±11,53	87,5 (50-100)	501,337	<0,001***
Pain	36,19±14,69	35 (0-100)	83,64±11,58	87,5 (45-100)	602,471	<0,001***
General Health Perception	36,17±11,09	35 (10-65)	74,81±7,68	75 (60-90)	773,504	<0,001***

*IPAQ: International Physical Activity Scale, SF-36: Quality of Life Scale, SD: Standard Deviation, F: Results of Analysis of Covariance (ANCOVA) by controlling the age variable, ***p<0.001.*

Table 4 Comparison of IPAQ levels of individuals with metabolic syndrome and healthy individuals

Physical Activity Levels	Individuals with Metabolic Syndrome (n=107)		Healthy Individuals (n=107)		ANCOVA	
	n	%	n	%	K	P
Inactive	11	10,3	0	0,0	K=33,428	<0,001***
Active	26	24,3	4	3,7		
Very Active	70	65,4	103	96,3		

*K: Pearson Chi-Square Test, Covariance Analysis Results (ANCOVA) by controlling the age variable, ***p<0.001.*

Discussion

Our study, designed to compare physical activity, quality of life, fatigue, and depression symptoms in individuals with MetS and healthy individuals, revealed that individuals with MetS, compared to healthy individuals, have lower levels of physical activity and quality of life, and higher levels of fatigue and depression. In addition, the results suggest that MetS and fatigue levels are important determinants of depression and that education level may be a protective factor associated with depression. In addition, our findings suggest that fatigue levels are significantly affected by psychosocial factors such as depression and social functioning, as well as physical activity levels.

Sociodemographic Characteristics

The global prevalence of MetS varies from 12.5% (95% CI: 10.2–15.0) to 31.4% (29.8–33.0) depending on the definition used, with higher rates observed in the Eastern Mediterranean Region and the Americas, and an increase with country income level. The likelihood of developing MetS increases with age, and numerous studies show that it tends to emerge in older populations [23]. In our study, the MetS group had a mean age of 50.80±7.78 years, while the healthy group had a mean age of 45.16±9.60 years, which is consistent with the literature.

Regarding gender distribution, women are reported to have a higher risk of MetS than men. Studies such as METSAR and Farrell have shown higher prevalence rates in women compared to men [24]. Similarly, in our study, 57.9% of individuals with MetS were female, and 42.1% were male, supporting the existing literature. Interestingly, primary school graduation emerged as a protective factor against higher BDI scores. This finding should be interpreted with caution. It may reflect underlying sociodemographic characteristics not fully captured in the present study, such as differences in occupational demands, lifestyle patterns, or social support. Additionally, the distribution of education levels within the sample and potential residual confounding may have influenced this result. Therefore, this observation may be sample-specific and warrants further investigation in larger and more diverse populations.

In terms of body composition, obesity is a major risk factor for MetS alongside a sedentary lifestyle and unhealthy dietary habits. In our study, 49.5% of individuals with MetS were obese, 31.8% were overweight, and 18.7% had normal weight, indicating higher BMI levels compared to healthy individuals. Additionally, education level is an important factor; Çetin et al. reported higher MetS prevalence in individuals with lower education levels [25], and our findings are consistent with this, showing lower education levels in the MetS group. Overall, these findings align with the literature and emphasize the importance of age, gender, obesity, and educational level in the development of MetS.

Physical Activity Level

Physical activity refers to body movements that expend energy and contribute to basal metabolic rate [26]. Regular physical activity is crucial for maintaining and improving health [27]. Numerous studies highlight the protective effects of regular physical activity on various chronic diseases, reducing the risk of premature death [28]. Sedentary lifestyle is a significant risk factor for conditions like MetS, cardiovascular diseases, diabetes, and cancer. In our study, individuals with MetS had lower physical activity scores than healthy individuals, underscoring the importance of promoting regular exercise programs and accounting for this factor in their treatment [29].

Oliveira et al. reported that individuals with MetS have a strong, low level of physical activity and a significant level of physical activity [30]. He et al. found that higher levels of physical activity were associated with a lower risk of MetS [31].

To increase these combined physical activity levels, the short version of the IPAQ was used. It has been observed that individuals with MetS have lower physical activity scores than healthy individuals. In this MetS, there is no relationship between total physical activity scores and any of the sub-factor scores for quality of life, endurance, or fatigue. It was observed that the level of physical activity was lower than that of individuals with MetS. For this reason, we recommend that people with MetS be encouraged to engage in regular exercise programs to increase their physical activity, and that this should be taken into consideration in their treatment. We believe that various exercise protocols are very important for preventive and protective treatment treatments for MetS.

Quality of Life

Physical fitness improves health-related quality of life [15]. In individuals with MetS, obesity often results in disappointments related to physical appearance, shortness of breath, weight-bearing joint pain, and decreased mobility, leading to impairments in daily physical function [16]. Furthermore, decreased quality of life is known to be an indicator of high risks for diabetes and cardiovascular diseases [17]. On the other hand, regular exercise programs improve quality of life [32].

In a comprehensive study conducted by Slagter et al. involving 13,686 obese patients aged 18 to 80, a decrease in quality of life was found to be associated with the degree of obesity, inflammatory status, the presence of diabetes, and MetS [33]. In a study by Hassan et al., it was reported that as individuals' BMI increased, their quality of life decreased [34]. This study also demonstrated the presence of obesity, one component of MetS, in individuals with MetS. Additionally, individuals with MetS reported lower quality of life than healthy individuals. We believe that a high BMI is a factor contributing to the low quality of life in individuals with MetS.

In a study by Eren et al., it was reported that complications of Type 2 diabetes negatively affected quality of life [35]. In a study by Gulliford et al., it was found that as the severity of

Table 5 Comparison of Beck Depression Scale between Metabolic Syndrome and Healthy Individuals

Total	Individuals with Metabolic Syndrome (n=107)		Healthy Individuals (n=107)		ANCOVA	
BDI	X̄±SD	Median (min-max)	X̄±SD	Median (min-max)	F	P
	23,79±4,50	24 (15-37)	5,48±3,00	5 (0-12)	1104,367	<0,001***
FSS	4,99±1,13	5,3 (1,3-7,1)	2,40±0,89	2,4 (0,3-5)	300,255	<0,001***

*BDI: Beck Depression Scale, FSS: Fatigue Severity Scale, SD: Standard Deviation, F: Results of Analysis of Covariance (ANCOVA) by controlling the age variable, ***p<0.001.*

diabetic symptoms increased, diabetic individuals' quality of life decreased [36]. We believe that diabetes, as a component of MetS, may also be contributing to the decrease in quality of life in these individuals.

Physical activity improves health-related quality of life. In our study, the SF-36 was used to assess quality of life in individuals with MetS. The results showed that individuals with MetS had lower scores across all SF-36 subscales than healthy individuals, indicating lower quality of life. The lower quality of life in individuals with MetS may be attributed to the physical and psychological difficulties associated with obesity and decreased mobility due to joint pain. Therefore, preventing obesity and promoting regular physical activity can play a crucial role in improving the quality of life for these individuals.

Depression

Individuals experiencing increased levels of depression exhibit heightened hypothalamic activity. This increase leads to the secretion of cortisol into circulation at levels above normal. The elevated cortisol levels disrupt the mechanisms that cause hyperinsulinemia and diabetes. MetS is a risk factor for the psychological conditions that lead to depression [37].

In a study by Demir et al., according to BDI results, the prevalence of depressive symptoms was found to be higher in women (31%) compared to men (9.9%), but statistical analyses did not reveal a significant relationship between MetS and depressive symptoms [38].

In the literature, a study evaluating the depression levels of individuals with MetS using the BDI found no difference in depression levels between those with and without MetS [39]. In another study, where depression and anxiety levels were assessed using the Hospital Depression and Anxiety Inventory, it was shown that individuals with MetS had higher depression and anxiety scores compared to those without MetS [40]. Similar to the literature, this study found that depression was higher in individuals with MetS compared to healthy individuals.

In a study by Leite et al. involving 91 patients, it was reported that 61.3% of the patients screened for depression were found to be positive [41]. Zhao et al. reported a positive relationship between depression levels and individuals who were severely obese [42]. In a study by Eren et al., it was found that obese individuals also had depression and social phobia [35]. This study also indicated that obesity, one of the components of MetS, and depression were higher in individuals compared to healthy individuals.

The prevalence of depression increases with the severity of MetS factors. MetS is considered a risk factor for psychological conditions leading to depression [43]. In our study, individuals with MetS had higher scores on the Beck Depression Inventory (BDI), indicating a higher level of depression compared to healthy individuals. This aligns with previous studies suggesting a link between MetS and increased depression levels. Moreover, the study's mediation analysis revealed that the relationship between MetS and BDI is primarily direct, with no statistically significant indirect effect through IPAQ. While MetS significantly influenced IPAQ (β=−0.5828, p<0,001) and BDI (β=1.8259, p<0,001), the effect of IPAQ on BDI, controlling for MetS, was not significant (β=−0.0279, p=0.312). The indirect effect of MetS on BDI via IPAQ was minimal and not statistically significant, as indicated by the bootstrap confidence interval, which included zero (CI = -0.1369 to 0.4959). These results suggest that the differences in depression levels (BDI) between groups are explained primarily by direct effects rather than being mediated by physical activity levels (IPAQ). Interventions addressing group-specific factors may, therefore, be more effective in mitigating depression levels than focusing solely on increasing physical activity.

Fatigue

In a study conducted by Maloney et al., it was found that as the severity of MetS factors increased, the incidence of chronic fatigue syndrome also rose. Abdominal obesity, hypertension, high triglycerides, elevated fasting glucose, and decreased high-density lipoproteins increased the likelihood of having chronic fatigue syndrome by 37% [44]. Additionally, among individuals with chronic fatigue syndrome, the number of MetS factors was significantly associated with higher levels of fatigue. A similar study found that the prevalence of MetS was higher in individuals experiencing prolonged fatigue [45]. In a study by Bozkaya et al., individuals with Type 2 diabetes reported greater fatigue upon waking as age increased [46]. Seo et al. reported that fatigue levels in individuals with Type 2 diabetes increased with age [47]. Azak et al. found that as fatigue severity increased among individuals with Type 2 diabetes, the impact on daily living activities increased proportionally [48]. Fatigue is also a common symptom in individuals with MetS, and its severity is positively correlated with the severity of MetS factors. Our study found that individuals with MetS had higher fatigue levels compared to healthy individuals. Increasing physical activity levels and managing activities that contribute to fatigue can be essential in reducing fatigue severity. These findings suggest that MetS and fatigue levels are important determinants of depression and that education level may be a protective factor associated with depression. In addition, our findings suggest that fatigue levels are significantly affected by psychosocial factors such as depression and social functioning, as well as physical activity levels.

Conclusion

In conclusion, this study indicates that individuals with MetS have lower physical activity levels and quality of life, and higher levels of fatigue and depression compared to healthy individuals. These findings should be considered in clinical evaluation, emphasizing a multidimensional approach in the management of MetS.

Rehabilitation programs for this population should be comprehensive, including physical activity promotion, patient education, psychological support, and occupational therapy strategies. Physical therapy interventions play a key role in improving physical activity, functional capacity, and mental health outcomes.

In clinical practice, patients should be encouraged to increase daily physical activity through simple lifestyle changes such as walking, using stairs instead of elevators, and engaging in household activities. For individuals at risk of MetS, regular aerobic exercise (at least 3 days per week) and step-based activity targets (e.g., 10,000 steps/day) combined with dietary interventions may help control disease components and improve overall health outcomes.

Limitations

In this study, individuals with MetS aged between 25 and 65 were evaluated. For future studies, we recommend narrowing the age range of MetS components to determine which age group is most affected and to assess how these components affect physical activity levels, quality of life, depression, and fatigue. A further limitation is the significant age difference between the groups, with the healthy individuals being younger than those with MetS. Although ANCOVA was used to adjust for age, residual confounding cannot be ruled out completely. Given that age is an important determinant of physical activity, this difference may have affected the observed outcomes.

In our study, various scales were used to assess physical activity, quality of life, depression, and fatigue. To obtain more objective results, future studies could benefit from using various measurement devices. More detailed and extensive research is needed to determine physical activity, quality of life, depression, and fatigue in individuals with MetS.

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