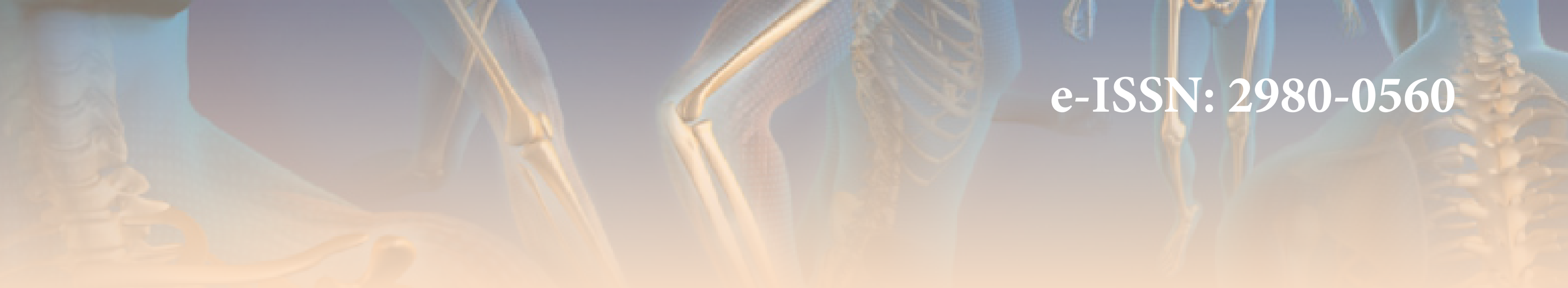

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Journal of Orthopedics Research and Rehabilitation

Original Article

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Comparison of pressure pain threshold and hand grip strength in individuals with and without chronic neck pain

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ABSTRACT

Aims: The aim of this study was to evaluate the pressure pain threshold (PPT), hand grip strength, neck disability, functional status, and quality of life in symptomatic and asymptomatic individuals with and without chronic neck pain, and to determine the differences in these parameters between the groups.

Methods: A total of 47 individuals aged 21 to 49 years, including 24 with at least 3 months of neck pain and 23 without chronic neck pain, were included in the study. PPT of the upper trapezius, sternocleidomastoid (SCM), levator scapula, and suboccipital muscles was assessed using a dolorimeter. Hand grip strength was measured with a Jamar® hydraulic hand dynamometer. Neck disability were evaluated using the Bournemouth Questionnaire (BQ). The disability level associated with upper extremity functional status was assessed with the Disabilities of the Arm, Shoulder, and Hand Questionnaire (DASH). Quality of life was evaluated with the Nottingham Health Profile (NHP).

Results: PPT values, except for SCM, were significantly lower in symptomatic individuals ($p<0.05$). Neck disability, upper extremity function-related disability level, and quality of life were significantly worse in symptomatic individuals ($p<0.05$). There were no significant differences between the groups in hand grip strength, PPT of the SCM, or NHP emotional reactions and social isolation scores ($p>0.05$).

Conclusion: It was found that PPT, neck functions, quality of life, and upper extremity function-related disability levels were more impaired in symptomatic individuals with chronic neck pain without a specific diagnosis compared to asymptomatic individuals. Although hand grip strength was not affected in symptomatic individuals with chronic neck pain, other functional impairments may still be present.

Keywords: Pressure pain threshold, neck pain, hand grip strength, disability, quality of life

INTRODUCTION

Neck pain is a very common musculoskeletal problem after low back pain in terms of causing severe pain, functional loss, and economic burden.[1] The majority of the society experiences neck pain at some point in their lives. Many factors such as repetitive movements, wrong posture, age, gender, body mass index, smoking, personal, behavioral, and ergonomic factors are effective in the etiology of neck pain.[2,3] Although there are many different causes of pain in the cervical region, which is more mobile and open to trauma than other parts of the spine, 90% of the pain is described as mechanical. Mechanical neck pain is defined as pain felt in the anatomical region of the neck without a pathology. The pain does not spread to the upper extremities and can be felt in the cervical, posterior scapular or occipital regions. It has been observed that 22% of neck pain felt in the adult population is an ongoing, persistent pain and therefore turns into a chronic course over time.[4,5] Since neck pain becomes a recurrent complaint and becomes chronic, studies have been conducted on the relationship between the cervical region and the shoulder, back, and scapular regions.[6]

It was thought that individuals with nonspecific neck problems would experience problems in their upper extremity functionality due to neck pain. Therefore, upper extremity functions and neck disorders were evaluated. It has been shown that upper extremity activities increase the severity of neck pain in 80% of individuals. It has been reported that there is a correlation between the results of upper extremity functions and neck disorders and that there are deficiencies in upper extremity functions in individuals with neck pain.[7]

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Considering that the cervical region and the shoulder region affect each other, it is thought that the pain in the cervical region may cause avoidance of movement in the shoulder joint, limitations in daily living activities, problems in the long-term use of the arm, limitations in normal joint movement, and loss of strength in the muscles in this region. Considering that the loss of strength and endurance may affect the stability of the upper extremity together with the increase in pain severity, it is inevitable that the loss of stability in the proximal will impair the quality of mobility in the distal.[8]

Many parameters related to chronic neck pain have been addressed in the literature from different perspectives.[8-12] However, only a limited number of studies have examined its impact on upper extremity strength and function beyond localized symptoms. The cervical region plays a crucial role in postural stability and motor control, which are essential for coordinated upper extremity movements. Considering that pain-related adaptations in the cervical spine may contribute to neuromuscular impairments in the upper extremity, it is important to investigate potential changes in grip strength in individuals with chronic neck pain. Understanding these potential changes could help refine rehabilitation strategies aimed at preserving upper extremity function. To our knowledge, no study has simultaneously examined pressure pain threshold and hand grip strength in individuals with and without chronic neck pain. This study aims to fill this gap by investigating the relationship between these parameters and their potential implications for functional capacity and rehabilitation interventions.

METHODS

This research was planned as a cross-sectional, descriptive, face-to-face evaluation study. Individuals aged 18-65 years, with chronic neck pain complaints for more than three months, without any diagnosed chronic disease or psychological disorder in the past or present, and who volunteered to participate in the study were included in this study. Individuals with any neurological, psychiatric or cognitive impairment were excluded from the study. Individuals were informed about the study and evaluations. The study was performed in accordance with the Declaration of Helsinki. Individuals signed the Informed Consent Form. Necessary permission for the study was obtained from Tokat Gaziosmanpaşa University Clinical Researches Ethics Committee (Date: 24.10.2022, Decision No: 83116987-658). The study was registered on ClinicalTrials.gov (NCT05791292).

Post hoc sample size calculation was performed using the G*Power program based on the pressure pain threshold of the right upper trapezius. Considering the number of individuals in the symptomatic group (n=24) and the asymptomatic group (n=23), with a large effect size (d=1.38) and an error rate (alpha=0.05), the power of the study was determined to be 99%. The upper trapezius muscle was selected for the sample size calculation as it is one of the most frequently evaluated muscles in pressure pain threshold (PPT) assessments related to chronic neck pain. The upper trapezius muscle is commonly assessed in studies investigating PPT in individuals with neck pain because it is a key muscle associated with cervical spine biomechanics and chronic pain syndromes. Previous research has demonstrated its significance in evaluating mechanical sensitivity in musculoskeletal pain conditions.[13] The post hoc sample size analysis was performed using the effect size calculated from the PPT values of the upper trapezius muscle obtained in present study. This muscle was chosen for this analysis due to its robust effect size and its frequent evaluation in musculoskeletal pain research.

After individuals filled out the form that included sociodemographic information questions, the following measurements were made;

Pain Intensity

The intensity of individuals' pain was assessed using the Numerical Pain Rating Scale (NPRS). The NPRS is a measurement tool that can be either self-reported or administered by a clinician, featuring a numerical scale anchored by "no pain" at one end and "extreme pain" at the other. This scale is generally presented as a horizontal or vertical line, most often ranging from 0-10 or 0-100, and can be delivered in either written or verbal formats. Patients are asked to evaluate their pain intensity within a specific time frame or context.[14]

Pressure Pain Threshold

The PPT was measured by Baseline® dolorimeter (Fabrication Enterprises, White Plains, NY, USA). During the PPT measurement, individuals sat on the chair in a relaxed and neutral position. The feet were in full contact with the ground. PPTs of the upper trapezius, sternocleidomastoidus (SCM), levator scapula and suboccipital region muscles (semispinalis capitis and splenius capitis) were evaluated. For each measurement (before and after the treatment), two measurements were taken from all muscles in the same order and at five-minute intervals. The average of the measurements was recorded as kilogram/centimeter^2 (kg/cm^2). The procedure was explained to the individuals by showing them with manual palpation before the test started. Pressure pain threshold measurement with dolorimeter has been reported as a valid and reliable method.[15]

Hand Grip Strength

Jamar® Hydraulic Hand Dynamometer was used to assess hand grip strength. The measurements were made while the individuals were sitting upright in a chair without elbow support, with the feet fully touching the floor, the shoulder in adduction, the elbow in 90° flexion, and the forearm and wrist in a neutral position. Bilateral (right-left) measurement was made. Three separate measurements were made by giving rest intervals during the measurements, and the average of these measurements was taken and recorded in Newton (N).[8]

Bournemouth Questionnaire (BQ)

Neck disability was assessed with the Bournemouth Questionnaire (BQ). BQ consists of 7 questions that examine pain intensity, activities of daily living, social activities, anxiety, emotional aspects of depression, kinesiophobia, and ability to control pain. The items in the questionnaire are specific to patients with neck pain, and each question evaluates a different parameter. A high score indicates a high degree of disorders. The Turkish version of the BQ has been proven to be valid and reliable.[16]

Disabilities of the Arm, Shoulder and Hand Questionnaire (DASH)

Arm, shoulder, and hand problems were evaluated with the Quick Disabilities of the Arm, Shoulder and Hand Questionnaire (DASH). Quick DASH is an abbreviated version of DASH for measuring physical function and symptoms in patients with upper extremity musculoskeletal disorders. The questionnaire consists of a disability/symptom scale (11 items) and two optional scales: work (four items) and sports/performing arts (four items). In the disability/symptom scale, each item questions the severity of pain, activity-related pain, tingling, weakness and stiffness, difficulty in performing physical activity due to upper extremity problems, and the effect of upper extremity problems on social activities, work, and sleep. Two optional modules measure the ability to work and play sports and/or musical instruments. Answers are given on a scale of one to five, and each question is scored from 1 to 5. Scores on the three subscales of the DASH, disability/symptom scale, work scale, and sports/performing arts scale all range from 0 (no disability) to 100 (most severe disability). The Turkish version of DASH has been reported to be valid and reliable.[17] In the current study, only the disability/symptom scale of DASH was used.

Nottingham Health Profile (NHP)

The Nottingham Health Profile (NHP) is a general quality of life questionnaire that measures the perceived health problems by individuals and the extent to which these problems affect normal daily activities. It was developed in 1981 by Hunt et al.[18] The questionnaire consists of 38 items. Questions are answered as 'yes' or 'no'. The questionnaire assesses six parameters related to health status. These parameters are; pain (8 items), physical activity (8 items), energy (3 items), sleep (5 items), social isolation (5 items), and emotional reactions (9 items). Each sub-parameter is scored between 0-100. 0 indicates best health, and 100 indicates worst health. The total NHP score is derived from the sum of the subscores. The Turkish adaptation and psychometric properties of NHP were studied by Küçükdeveci et al.[19] in 1997.

Statistical Analysis

Data were analyzed with SPSS® (Statistical Package for Social Sciences) version 22 package program. Continuous variables were expressed as mean±standard deviation, and categorical variables were expressed as numbers and percentages. The conformity of the variables to the normal distribution was examined using the Shapiro-Wilk test. When the parametric test assumptions were met, the significance test of the difference between the two means was used to compare the independent group differences, and when the parametric test assumptions were not met, the Mann-Whitney U test was used to compare the independent group differences. The differences of categorical variables between the groups were examined using the Chi-square test. In all statistical analyses, the level of significance was accepted as $p<0.05$.

RESULTS

Table 1 provides descriptive characteristics of individuals with and without chronic neck pain. There were no significant differences in age, weight, height, or BMI between the symptomatic and asymptomatic groups ($p>0.05$). The duration of complaints in the symptomatic group was 30.42±41.02 months. Regarding marital status, the majority of participants in both groups were single. Smoking and alcohol use were also similar between the groups. However, in the symptomatic group, 70.8% of individuals reported bilateral chronic neck pain.

Table 1. Descriptive informations of individuals with and without chronic neck pain

	Symptomatic group (n=24) mean±SD	Asymptomatic group (n=23) mean±SD	p
Age (years)	31.46±6.14	29.78±7.93	0.421$^{\alpha}$
Weight (kg)	66.21±9.51	69.11±10.33	0.322$^{\alpha}$
Height (m)	1.69±0.09	1.70±0.09	0.531$^{\alpha}$
BMI (kg/m^2)	23.28±2.75	23.80±2.71	0.521$^{\alpha}$
Complaint duration (month)	30.42±41.02	-	0.000$^{\beta}$
	n (%)	**n (%)**	
Gender			
Female	13 (54.2)	13 (56.5)	0.871$^{\$}$
Male	11 (45.8)	10 (43.5)	
Chronic neck pain side			
Right	6 (25.0)	-	-
Left	1 (4.2)	-	
Bilateral	17 (70.8)	-	
Marital status			
Single	16 (66.7)	18 (78.3)	0.374$^{\$}$
Married	8 (33.3)	5 (21.7)	
Educational status			
Primary school	0 (0)	0 (0)	0.051$^{\$}$
Middle school	0 (0)	0 (0)	
High school	6 (25.0)	7 (30.4)	
Associate degree	3 (12.5)	10 (43.5)	
Bachelor degree	11 (45.8)	4 (17.4)	
Postgraduate degree	4 (16.7)	2 (8.7)	
Smoking			
Yes	14 (58.3)	10 (43.5)	0.308$^{\$}$
No	10 (41.7)	13 (56.5)	
Alcohol use			
Yes	10 (41.7)	11 (47.8)	0.671$^{\$}$
No	14 (58.3)	12 (52.2)	

SD: Standard deviation, kg: kilogram, m: meter, kg/m^2: kilogram/meter^2, $^{\alpha}$: Independent samples T test, $^{\beta}$: Mann Whitney U test, $^{\$}$: Chi-squared test

Table 2 compares pain intensity and PPT values. Chronic neck pain intensity was significantly higher in the symptomatic group (6.33±1.09; $p<0.001$). PPT values for the right and left upper trapezius, sternocleidomastoideus (SCM), levator scapula, and suboccipital muscles were significantly lower in the symptomatic group compared to the asymptomatic group ($p<0.05$), except for the left SCM, where the difference was not statistically significant ($p=0.075$). These results indicate increased sensitivity in pressure pain thresholds in individuals with chronic neck pain. However, no significant differences were observed in overall right and left hand grip strength ($p>0.05$).

Table 2. Comparison of pain intensity, PPT and hand grip strength values in individuals with and without chronic neck pain

	Symptomatic group (n=24) mean±SD	Asymptomatic group (n=23) mean±SD	p
Chronic neck pain intensity	6.33±1.09	-	0.000β
Right upper trapezius PPT	3.09±1.13	8.10±4.98	0.000β
Left upper trapezius PPT	3.57±1.10	7.86±4.49	0.000β
Right SCM PPT	2.45±0.78	4.59±3.35	0.015β
Left SCM PPT	2.65±0.88	4.42±3.14	0.075β
Right levator scapula PPT	3.07±1.07	6.61±2.95	0.000β
Left levator scapula PPT	3.18±1.24	6.49±3.09	0.000β
Right suboccipital PPT	3.21±0.95	5.02±2.68	0.008β
Left suboccipital PPT	3.25±0.97	5.09±2.71	0.017β
Right hand grip strength	311.08±96.83	315.52±105.89	0.840β
Left hand grip strength	300.33±96.99	305.17±107.09	0.882β

SD: Standard deviation, PPT: Pressure pain threshold, SCM: Sternocleidomastoideus, β: Mann-Whitney U test

Table 3 highlights differences in neck disorders (BQ), arm, shoulder, and hand problems (DASH), and quality of life (NHP). The symptomatic group had significantly higher BQ and DASH scores, indicating greater neck disability and upper extremity dysfunction ($p<0.001$). Similarly, NHP scores for pain, sleep, physical activity, and energy were significantly higher in the symptomatic group ($p<0.05$), reflecting poorer quality of life. However, no significant differences were observed in NHP emotional reactions or social isolation domains ($p>0.05$).

Table 3. Comparison of neck disorders (BQ), arm, shoulder, and hand problems (DASH), and quality of life (NHP) in individuals with and without chronic neck pain

	Symptomatic group (n=24) mean±SD	Asymptomatic group (n=23) mean±SD	p
BQ	29.25±9.71	3.52±5.03	0.000β
DASH	27.12±12.55	3.08±6.55	0.000β
DASH work	32.81±15.77	2.72±10.63	0.000β
NHP pain	21.53±22.76	3.24±7.99	0.001β
NHP emotional reactions	24.62±23.82	14.57±20.75	0.101β
NHP sleep	47.97±32.10	23.87±38.20	0.006β
NHP social isolation	11.13±18.83	5.92±13.74	0.231β
NHP physical activity	11.62±15.29	2.95±9.77	0.016β
NHP energy	61.17±41.04	13.43±27.84	0.000β
NHP section 1	178.03±109.87	63.98±79.75	0.000β
NHP section 2	2.62±2.04	0.26±0.75	0.000β

SD: Standard deviation, BQ: Bournemouth Questionnaire, DASH: Disabilities of the Arm, Shoulder and Hand Questionnaire, NHP: Nottingham Health Profile, β: Mann Whitney U test

DISCUSSION

This study investigated the differences in pain sensitivity, hand grip strength, functional impairments, and quality of life between individuals with and without chronic neck pain. The findings reveal that chronic neck pain is associated with heightened pain sensitivity, indiffirent hand grip strength, and significantly impaired quality of life. These results provide valuable insights into the multifactorial impact of chronic neck pain and highlight areas for targeted intervention.

In a study examining the PPT of suboccipital muscles and hand grip strength in men and women with chronic neck pain and healthy individuals, these values were observed to be lower in women with chronic neck pain.[12] In individuals with and without cervical radiculopathy, there was similar in grip strength between the dominant and nondominant hand.[10] In the current study, the symptomatic group demonstrated significantly lower PPT across multiple muscle groups, including the upper trapezius, SCM, levator scapula, and suboccipital muscles. This heightened sensitivity may be attributed to central sensitization mechanisms or localized muscle dysfunction often observed in chronic pain conditions. Overall hand grip strength remained unaffected, indicating that specific functional impairments may be more closely tied to chronic neck pain than general hand strength.

In a previous study conducted on men and women with chronic neck pain and healthy individuals, neck disability and quality of life were assessed. The results indicated that health-related quality of life was found to be lower in women with chronic neck pain.[12] In another study evaluating individuals with and without radiculopathy, neck disability, upper extremity functional status-related disability level, and quality of life were compared. It was emphasized that patients with radiculopathy had a lower quality of life and higher disability levels associated with upper extremity function.[10] In the present study, quality of life, assessed through the NHP, was impaired in the symptomatic group. Participants reported greater difficulties in pain, sleep, energy, and physical activity domains, reflecting the pervasive impact of chronic neck pain on daily life. Notably, emotional reactions and social isolation scores did not differ significantly between groups, suggesting that the psychological impact of chronic neck pain may vary among individuals. The study determined that neck and arm, shoulder, and hand functions were also affected in individuals with chronic neck pain. These findings emphasize the physical and functional domains of chronic neck pain, emphasizing reduced quality of life.

Limitations

This study has several limitations that should be acknowledged. First, the cross-sectional design does not allow for causal inferences regarding the relationship between chronic neck pain and observed impairments. Second, the reliance on self-reported measures for pain and functional assessments, without the use of objective diagnostic tools such as imaging or electromyography, may have restricted the scope of the analysis. In addition, a wide age range is a factor that may affect the results of the study. Therefore, it is thought that choosing a narrower age range may make the results more homogeneous. This can be considered as another limitation of the study.

To build on these findings, future studies should: It should be utilized longitudinal designs to explore causal relationships between chronic neck pain, functional impairments, and quality of life. In addition, it should be incorporated objective diagnostic tools, such as electromyography or imaging, to validate the presence of muscle dysfunction and nerve involvement in grip strength deficits. Also, it should be investigated the effectiveness of multidisciplinary interventions that address physical, psychological, and occupational factors contributing to chronic neck pain.

CONCLUSION

This study highlights the significant impact of chronic neck pain on pain sensitivity, functional abilities, and quality of life. Findings revealed that individuals with chronic neck pain exhibited lower PPT values in multiple cervical region muscles, indicating increased pain sensitivity. However, no significant differences were observed in hand grip strength between symptomatic and asymptomatic individuals, suggesting that grip strength may not be directly affected by chronic neck pain. These results emphasize the need for a comprehensive, multifaceted approach in managing chronic neck pain, with targeted interventions focusing on pain modulation, functional rehabilitation, and quality of life improvement.

ETHICAL DECLARATIONS

Ethics Committee Approval

Ethics committee approval was received for this study from the Tokat Gaziosmanpaşa University Clinical Researches Ethics Committee (Date: 24.10.2022, Decision No: 83116987-658).

Informed Consent

Verbal consent was obtained from individuals participating in the study.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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Original Article

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The effects of Yin yoga on physical, emotional and breathing parameters in healthy adult women: a single blind randomized controlled trial

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ABSTRACT

Aims: Yoga is a comprehensive program that incorporates concentration, relaxation, breathing exercises, and physical postures to synergistically affect the mind and body. This study investigates the effects of Yin yoga on physical, emotional, and respiratory parameters in healthy adult women.

Methods: The study included 24 healthy participants (aged 21.13±0.95 years). The Yin yoga group (n=12) participated in two yoga sessions weekly for six weeks, while the control group (n=12) remained unaltered. Data collection employed the Fatigue Severity Scale, Beck Depression Inventory, Beck Anxiety Scale, skinfold calipers, Timed Up and Go test, sit and reach test, and body-mass index.

Results: The six-week Yin yoga program positively influenced balance, functional mobility, anxiety, depression, and flexibility in healthy individuals, although it did not affect respiratory parameters.

Conclusion: Yin yoga may serve as an alternative method to enhance specific physiological and psychological parameters in healthy individuals. Further research is required to validate these preliminary findings and explore its clinical applications.

Keywords: Yin yoga, balance, fatigue

Key Messages: A six-week Yin yoga program positively impacts balance, functional mobility, anxiety, depression, and flexibility in healthy individuals.

INTRODUCTION

Yoga is an ancient practice developed in India, founded on the philosophy of achieving balance and well-being across physical, mental, and emotional dimensions. The practice includes various postures (asanas) that are maintained over time. Additionally, yoga encompasses voluntary breath control (pranayama), meditation (concentration), and the use of mantra repetitions.[1] Yoga is a comprehensive program that integrates concentration, relaxation, breathing, and physical exercises to influence the mind through proper body positioning.[2] In the Western context, particularly in the United States, yoga primarily emphasizes exercises designed to enhance body flexibility and smoothness. This is achieved by combining asanas with advanced stages of relaxation training.[3,4]

Exercises that involve posture, requiring body control and balance, are designed to enhance flexibility and strength. These poses can be performed in various positions: standing, sitting, lying down, leaning forward, twisting, or maintaining equilibrium. Breathing exercises are typically integrated with asanas and meditation.[5] Brief meditation sessions within the yoga class are conducted in a state of relaxation, typically in a supine position with eyes closed.[6,7]

Yoga promotes physiological deactivation and activates the parasympathetic nervous system.[8] Recent studies indicate an increase in the use of yoga, primarily due to its effectiveness in providing core stabilization through mind-body exercises, enhancing flexibility, and managing pain via relaxation techniques.[9,10]

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Yoga encompasses a variety of styles, with the main types including Laya, Tantric, Mantra, Bhakti, Karma, Raja, Yin, Jnana, and Hatha.[11-13] A distinct feature of Yin yoga is its focus on the connective tissues, achieved through long, passive poses. Typically, these seated or lying poses are maintained motionlessly for 3-5 minutes.[14-16] Additionally, the breathing exercises in Yin yoga, coupled with relaxation techniques performed after completing all asanas-particularly during the shavasana pose-dampen the sympathetic nervous system's activity and activate the parasympathetic system.[17]

Although numerous studies on yoga exist, many fail to specify the style of yoga investigated.[18] Hatha yoga and Iyengar yoga are among the most frequently studied styles.[19,20] However, research on Yin yoga remains limited. The objective of this study is to explore the effects of Yin yoga on physical, emotional, and respiratory parameters in healthy adult women.

METHODS

Our study was conducted with 24 healthy adult female participants at Okan University. We designed a randomized controlled single-blind study, forming two groups. The participants were university students aged 18-24 who volunteered for the study. Individuals with neurological, orthopedic, or metabolic disorders were excluded. All volunteers were informed about the study details and signed informed consent forms, as required by ethical guidelines. The Okan University Non-interventional Clinical Researches Ethics Committee approved the study (Date: 08.11.2017, Decision No: 88-20), confirming compliance with the ethical standards laid out in the Helsinki Declaration of 1975.

We recorded the age, height, and weight of all participants and calculated their body-mass index (BMI). Evaluations were conducted before and after the study period.

Sit and Reach Test

Participants were instructed to sit with legs extended straight, feet against a fixed object, and to reach forward with their hands without bending their knees. The distance between the fingertips and the object was measured (Table 1). Distances before reaching the object were recorded as negative, and those beyond as positive.[21]

Table 1. Yin yoga poses

Pose	Time (minute)
Butterfly	5
Half frog	4
Square	4
Twisted root	4
Sphinx	4
Baby's pose	2
Child's pose	2
Caterpillar	5
Saddle	5
Happy baby pose	2
Shavasana	10

Timely and Walk Test

The participant was instructed to rise from a seated position, walk three meters, turn around, walk back, and then sit down again. The duration taken to complete this sequence was timed in seconds. The Timed Up and Go (TUG) test serves as an objective, reliable, and straightforward criterion for assessing balance and functional mobility.[22]

Skinfold Caliper

When the participant assumed an upright position, measurements were taken from the right side of the body. The procedure involved pinching the subcutaneous fat layer between the thumb and forefinger, ensuring no muscle tissue was included, approximately 1 cm away from the measurement point. The fingers maintained consistent pressure throughout, and the measurement was recorded two seconds after the caliper pressure was applied. Measurements were taken from the triceps, abdominal, thigh, and subscapular regions.[23]

Beck Depression Scale

In Turkiye, the validity and reliability of this scale for measuring the sentimental, cognitive, and motivational symptoms of depression were established by Hisli. The scale ranges from 0 (least severe) to 63 (most severe).

Beck Anxiety Inventory

This self-assessment scale, validated and reliable, assesses the frequency of anxiety symptoms experienced by participants. It is suitable for use with adolescents and adults and can be administered in group settings without time constraints. The scale comprises 21 items, each scored from 0 to 3.

Fatigue Severity Scale (FSS)

The Turkish validity and reliability of this scale, used to assess fatigue, have been confirmed. It consists of 9 items, each scored on a 7-point scale. The overall FSS score is the average of these items. Scores below 4 indicate 'not tired' and scores above 4 indicate 'tired'.[24]

Methodology

Prior to the sessions, participants were randomized into two groups by a blinded second investigator. The Yin yoga group underwent sessions twice a week for six weeks, led by trained physiotherapists specializing in Yin yoga. No interventions were made with the control group. Evaluations were conducted by other researchers at the start and six weeks after the intervention, and a home program was established for the control group.

Statistical Analysis

Data were analyzed using the SPSS 24.0 software. Continuous variables were expressed as mean±standard deviation and median (minimum-maximum values); categorical variables were expressed as number and percentage. The Shapiro-Wilk test was used to analyze data distribution. The Mann-Whitney U test and Wilcoxon paired two sample test were used to compare independent and dependent groups, respectively, based on the suitability of parametric test assumptions. A p-value of less than 0.05 was considered statistically significant for all analyses.

RESULTS

The study encompassed 24 healthy subjects aged 20-23 years. The mean age of the participants was 21.13±0.95 years, the mean height was 165.42±5.47 cm, the mean weight was 57.46±7.33 kg, and the BMI was 21.01±2.51 kg/m^2 (Table 2).

Statistically significant changes were observed in several measures: TUG (p=0.0001), sit and reach (p=0.003), sub-axillary inspiration (p=0.015), abdominal skinfold (p=0.006), and thigh skinfold (p=0.006). Additionally, the Beck Anxiety Scale showed significant changes (p=0.036), as did the Fatigue Severity Scale (p=0.05). When comparing the differences between groups, significant disparities were noted in the sit and reach values (p=0.021), Beck Depression Scale (p=0.001), Beck Anxiety Scale (p=0.01), and Fatigue Severity Scale (p=0.023). Although there was an increase in FEV1 values in the intervention group compared to the control group, these changes did not reach statistical significance (Table 3).

DISCUSSION

While the literature encompasses a variety of related topics, fatigue, depression, anxiety, and balance are extensively interconnected.[25] In the current study, physical and emotional parameters were jointly evaluated before and after a yoga intervention. Assessing balance and mobility in healthy individuals is crucial, as balance is fundamental to daily living activities and significantly influences mobility.[26] Impairments in balance can lead to increased immobilization, difficulty in ambulation, and the potential replacement of muscle tissue with adipose tissue.

To the best of our knowledge, there are several studies on Yin yoga globally. This study aims to enrich the literature

Table 2. Demographic and physical characteristics of study participants*

Variables	Total group (n=24) mean±SD	Yin yoga group (n=12) mean±SD	Control group (n=12) mean±SD	p
Age (year)	21.13±0.95	21±0.95	21.25±0.97	0.53 (t=-0.638)
Weight (kg)	57.46±7.33	55.08±6.08	59.83±7.94	0.114 (t=-1.645)
Height	165.42±5.47	165.67±4.31	165.17±6.62	0.828 (t=0.219)
BMI	21.01±2.51	20.06±2.03	21.95±2.66	0.065 (t=-1.946)

*Demographic variables at baseline for all participants divided into Yin yoga and control groups, SD: Standard deviation, BMI: Body-mass index

Table 3. Pre- and post-intervention measurements and statistical analyses*

	Yin yoga group			Control group			TS intergroup p
Variables	Before, mean±SD	After, mean±SD	Intragroup p	Before, mean±SD	After, mean±SD	Intragroup p	
RightGripForce	21.58±3.92	21.28±4.29	0.704 (t=0.391)	20.93±4.86	19.84±4.46	0.088 (t=1.87)	0.429 (t=0.806)
LeftGripForce	19.38±2.76	17.99±4	0.063 (t=2.072)	18.47±4.54	17.35±4.01	0.05* (z=-1.963)	0.699 (t=0.392)
TUG	7.9±0.69	6.49±0.91	0.0001* (t=10.136)	7.82±1.55	6.43±0.99	0.002* (t=4.095)	0.872 (t=0.163)
SitAndReach	11.13±17.3	30.78±7.18	0.003* (t=-3.785)	18.9±8.87	23.05±8.07	0.084 (z=-1.726)	0.021* (t=2.482)
FVC	2.81±0.8	2.56±0.57	0.084 (z=-1.726)	2.73±0.52	2.66±0.69	0.394 (t=0.887)	0.721 (t=-0.362)
FVC %	73.42±19.93	73.25±13.72	0.208 (z=-1.258)	72.42±14.17	67.75±18.98	0.156 (t=1.521)	0.713 (z=-0.404)
PEF	6.01±2.28	5.65±2.26	0.117 (z=-1.569)	6.24±2	5.43±1.77	0.095 (t=1.827)	0.791 (t=0.269)
PEF %	87.42±32.12	92.08±20.09	0.561 (t=-0.599)	91.08±30.7	84.5±22.35	0.402 (t=0.872)	0.391 (t=0.874)
FEV1	2.56±1.15	3.35±2.03	0.724 (z=-0.353)	2.72±0.52	2.31±1.71	0.343 (t=0.991)	0.189 (t=1.355)
FEV1 %	77.42±34.04	76.92±29.47	0.722 (z=-0.356)	86.5±13.73	61.92±40.18	0.092 (z=-1.687)	0.378 (z=-0.897)
TC.under axilla.Ekspirasyon	83.83±5.01	84.75±6.38	0.582 (z=-0.551)	84.67±6.69	86.04±5.6	0.147 (t=-1.56)	0.604 (t=-0.527)
TC.under axilla İnspirasyon	89.92±4.68	88.92±4.42	0.015* (t=2.872)	90.75±6.2	89.96±5.08	0.959 (z=-0.051)	0.598 (t=-0.536)
TC under.axilla.Normal	86.08±4.83	85.75±5.25	0.663 (t=0.448)	86.33±6.3	86.46±5.29	0.917 (t=-0.106)	0.745 (t=-0.329)
TC.xiphoid.Ekspirasyon	73.17±5.54	75.67±5.26	0.085 (z=-1.89)	74.42±7.09	75.92±6.76	0.06 (t=-2.098)	0.92 (t=-0.101)
TC.xiphoid.İnspirasyon	78.42±4.81	79.58±4.27	0.368 (t=-0.939)	78.5±6.54	79.38±6.14	0.205 (z=-1.266)	0.924 (t=0.096)
TC.xiphoid.Normal	74.42±5	70.67±20.93	0.529 (t=0.651)	75.58±6.56	76.67±6.41	0.129 (t=-1.643)	0.932 (z=-0.087)
TC.Subcostal.Ekspirasyon	69.25±6.3	69.33±5.26	0.935 (t=-0.083)	72.17±7.49	74.25±7.33	0.05* (t=-2.163)	0.072 (t=-1.887)
TC.Subcostal.İnspirasyon	72.17±4.65	72.71±4.65	0.579 (t=-0.571)	74.17±8.17	75.79±6.92	0.11 (t=-1.74)	0.214 (t=-1.28)
TC.Subcostal.Normal	69.83±4.97	70.71±5.22	0.282 (t=-1.131)	73.33±7.82	74.25±7.02	0.258 (z=-1.131)	0.175 (t=-1.402)
Skinfold.Triceps	20.55±6.92	19.83±7.86	0.582 (t=0.567)	22.08±5.81	18.75±5.85	0.102 (z=-1.632)	0.705 (t=0.383)
Skinfold.Abdominal	21.13±7.87	17.5±7.06	0.006* (t=3.394)	23±6.95	16.08±5.52	0.017* (t=2.797)	0.799 (z=-0.262)
Skinfold Femur	34.25±7.12	28.5±10.53	0.006* (z=-2.767)	27.58±4.14	21.75±6.93	0.007* (t=3.272)	0.077 (t=1.855)
Skinfold.Subskapular	16.17±3.93	17.67±4.68	0.653 (z=-0.449)	29.17±54.09	14.25±3.36	0.752 (z=-0.316)	0.068 (z=-1.828)
Beck.Anxiety Scale	9.08±6.93	5±4.07	0.036* (t=2.391)	14.5±10.74	12.25±7.96	0.222 (t=1.295)	0.01* (t=-2.811)
Beck.depression	7.58±4.72	5.75±2.67	0.154 (t=1.529)	14.25±6.76	16.33±4.52	0.175 (t=-1.449)	0* (t=-6.986)
Fatigue Severity Scale	3.72±1.09	2.96±1.12	0.05* (t=2.205)	4.25±1.47	4.05±1.06	0.456 (t=0.773)	0.023* (t=-2.449)

*Comparison of change in primary and secondary outcomes in Yin yoga and control groups, SD: Standard deviation, TUG: Timed Up and Go, PEF: Pulsed electric field, FEV: Forced expiratory volume, TC: Trunk circumference on the provincial implementation of Yin yoga. Notably, the recent development of the YOMI program, which integrates psychotherapy, awareness practice, and Yin yoga, has garnered attention. Hylander et al.[27] have demonstrated that this 5-week YOMI program significantly reduces stress and anxiety while enhancing mindfulness. Daukantaitė et al.[28] explored the effects of Yin yoga and the YOMI program on plasma adrenomedullin levels and psychological health in stressed adults. They found that adrenomedullin levels, anxiety, and sleep issues were significantly reduced. Furthermore, Yin yoga was shown to decrease both physiological and psychological risk factors associated with non-communicable diseases. It is noted that adrenomedullin levels may be elevated years before the onset of non-communicable diseases (e.g., cardiovascular disease) and could be linked to stress, anxiety, and depression, which are risk factors for these diseases.

Compared to the control group, the yoga group demonstrated greater improvements in balance and functional mobility, aligning with findings from recent studies. For example, Stephens et al.[29] study explored the potential benefits of group yoga for adults with chronic brain injury, building on evidence that one-on-one yoga can improve functional deficits. Nine participants were recruited, with seven completing the study. The research utilized performance measures of balance and mobility, as well as self-reported metrics of balance confidence, pain, and occupational performance. Data were collected at three points: baseline, pre-yoga, and post-yoga, following 8 weeks of bi-weekly yoga sessions led by a trained instructor/occupational therapist. The findings indicated significant improvements post-yoga in balance, mobility, and occupational performance, with no adverse effects leading to withdrawal. de Oliveira et al.[30] observed in their study of patients with multiple sclerosis-particularly those with a lower level of disability-that a post-yoga program significantly enhanced balance and postural stability, positively affecting daily life activities and reducing imbalances. In another study examining patients with multiple sclerosis, yoga therapy yielded statistically significant improvements in fatigue, balance, step length, and walking speed.[31] Additionally, a study aimed at assessing the feasibility of 14-week modified tai chi or yoga programs for frail elderly individuals in residential care found that yoga significantly decreased fall incidence, whereas tai chi notably enhanced quality of life.[32] Furthermore, in research focusing on yoga-based rehabilitation interventions post-stroke, significant enhancements in balance were noted, along with a reduction in the fear of falling.[33]

The strength of this study lies in the detailed assessment of flexibility and fatigue, and the demonstrated positive impact of yoga on these parameters, both within and between groups. Parallel findings from a recent study show that Iyengar yoga effectively increases the flexibility of the erector spinae and hamstring muscles.[34] Additionally, a 10-week yoga program involving university athletes assessed joint angles in three yoga positions (downward dog, right foot lunge, chair) and recorded significant improvements in flexibility and balance due to increased joint angles.[35] Grabara et al.'s[36] research further corroborates these results, indicating that yoga exercises enhance spinal mobility, hamstring strength, and spinal flexibility in women over 50 years of age. Furthermore, studies involving patients with breast cancer and multiple sclerosis support our findings by demonstrating that yoga reduces the intensity of fatigue.[31,37]

In the presented study, significant improvements in depression and anxiety were observed following Yin yoga sessions. A comparative study on the effects of yoga and social support in managing prenatal and postpartum depression showed reductions in depression, anxiety, anger, back and leg pain, as well as decreases in estriol and progesterone levels. Additionally, both groups exhibited reduced cortisol levels after each session.[38] Another study focusing on COPD patients in the coal mining sector reported improvements in physical health, daily living activities, depression, and anxiety as a result of yoga intervention.[39] Similarly, a one-to-one yoga program consisting of 30 asanas applied to children with cystic fibrosis significantly reduced anxiety and joint pain.[40]

It has been observed that Sudarshan Kriya yoga (intensive breath-training yoga) improves anxiety and/or depressive disorders, as well as autonomic control and cardiorespiratory synchronization in patients with these disorders.[41] In the study by Lau et al.,[42] Hatha yoga was found to significantly increase maximum oxygen uptake (VO2max), muscle strength, endurance, and the flexibility of the back and hamstrings. Contrarily, in our study, yoga showed no effect on respiratory parameters. Considering the literature, yoga appears promising for developing and improving respiratory parameters;[43,44] therefore, further research in this area is warranted.

Our study underscores the importance of using skinfold measurements to evaluate physical parameters following yoga training. Notably, prior studies did not utilize skinfold assessments post-yoga for fat measurement. While no significant differences were observed between groups, reductions in abdominal and thigh fat measurements were noted in the intervention group compared to pre-treatment levels. Similarly, Patel et al.[45] reported decreases in body mass index and fat cholesterol levels in young individuals with obesity.

A study involving 40 yoga instructors and 378 students found a negative correlation between depression, anxiety, and stress scores and months of yoga practice; higher awareness and self-compassion scores were associated with shorter durations of yoga practice.[46] Consequently, our yoga training program was designed to last six weeks.

Limitations

Despite the study's significant aims and outcomes, limitations exist in clinical application. The small sample size and the absence of an ideal double-blind methodology restrict the study's implications. Awareness of the yoga intervention among participants in the intervention group could have induced a positive response bias, potentially resulting in a significant Hawthorne effect.

CONCLUSION

This 6-week Yin yoga program demonstrated positive effects on balance, functional mobility, anxiety, depression, and flexibility in healthy individuals. Therefore, Yin yoga may serve as an alternative therapeutic approach due to its multifaceted benefits. Further research is necessary to verify these preliminary findings and enhance their application in clinical settings. Additionally, future studies aim to explore the effects of Yin yoga on different disease populations and investigate its impact on disease activity.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was carried out with the permission of the Okan University Non-interventional Clinical Researches Ethics Committee (Date: 08.11.2017, Decision No: 88-20).

Informed Consent

All participants signed and free and informed consent form.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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Association between respiratory muscle strength with fall risk, fear of falling, and quality of life in sarcopenic older adults: a retrospective preliminary study

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ABSTRACT

Aims: Elderly patients with sarcopenia are known to have lower respiratory muscle strength compared to non-sarcopenics. The main aim of this study was to assess the relationship between maximal inspiratory and expiratory pressures with fall risk, fear of falling, and quality of life in sarcopenic elderly patients.

Methods: Twenty participants [12 women, 8 men; median (IQR) age: 81 (73-83.50)] who were diagnosed with sarcopenia enrolled in this retrospective study. Respiratory muscle strength assessment [maximum inspiratory and expiratory pressure (MIP and MEP, respectively)] with an electronic pressure measuring device; fall risk assessment with modified clinical test for sensory interaction and balance (m-CTSIB) under eyes open and closed on firm and foam surfaces; fear of falling with Falls Efficacy Scale International (FES-I), and quality of life with Sarcopenia Quality of Life Questionnaire (SarQoL) were performed for all participants. Spearman correlation analyses were used to determine the relationship between respiratory muscle strength with fall risk, fear of falling, and quality of life.

Results: Moderate positive association between SarQoL and MIP ($p=0.527$, $p=0.017$) and, SarQoL and MEP ($p=0.473$, $p=0.035$) was observed. On the other hand, there was no correlation between respiratory muscle strength with fall risk and fear of falling ($p>0.05$).

Conclusion: These results allow us to suggest that assessing respiratory muscle strength among sarcopenic older adults may assist physiotherapists to maintain appropriate rehabilitation strategies to improve quality of life.

Keywords: Respiratory muscle strength, sarcopenia, quality of life

INTRODUCTION

The proportion of the elderly population compared to the total population is increasing worldwide. While this rate was 8.3% in 2015, it is predicted to reach 17.8% by 2060.[1] The European Working Group on Sarcopenia in Older People (EWGSOP) is defined sarcopenia as a syndrome characterized by a loss not only in muscle mass but also in muscle strength or physical performance, leading to functional capacity impairment, dependence, falls and fractures, decreased quality of life, hospitalization and, death. In order to make a diagnosis of sarcopenia, the current situation of the patient should be analyzed in terms of muscle mass, muscle strength, and physical performance.[2]

Fear of falling is a common problem in countries with a fast aging population and is associated with poor quality of life and falls, but it is also common in those without falls.[3] In older people who have experienced falls, previous studies have confirmed that quality of life and physical function deteriorate because of fear.[4] It was reported that sarcopenia induces a reduction in functional capacity, activities of daily living, and quality of life[5] and increases the risk of falling.[6,7] In addition, it was found that the frequency of falls in sarcopenic people was higher than in non-sarcopenics.[8]

The respiratory system may exhibit reduced functional capacity during the aging process. This may negatively

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affect the ability to perform physical activity and exercise[5] or activities of daily living and also affect the quality of life.[9] The diaphragm, the main inspiratory muscle, acts in a feed-forward manner in response to rapid limb movements, stabilizes the spinal column and contributes to postural control.[10] It has been reported that, like the other muscles, the diaphragm can degenerate and lose its function throughout sarcopenia.[11,12] Therefore, reduced inspiratory muscle strength can deteriorate postural balance and increase fall risk.[6] Sarcopenic elderly patients had lower inspiratory muscle strength (MIP) and expiratory muscle strength (MEP) values when compared to non-sarcopenics.[13,14]

It has been found that MIP was positively correlated with skeletal muscle mass index[15], hand grip strength, and gait speed[15,16], and MEP was positively correlated with hand grip strength [12,16] in sarcopenic elderly individuals. Although the association between respiratory muscle strength and skeletal muscle mass index, hand grip strength, and gait speed has previously been studied in sarcopenia, little information is available concerning the association between respiratory muscle strength and fall risk, fear of falling, and quality of life. This present study aimed to investigate the relationship between respiratory muscle strength with fall risk, fear of falling, and quality of life among sarcopenic older adults.

METHODS

Participants

Twenty participants with sarcopenia who were diagnosed by the relevant physician in Gazi University Faculty of Medicine, Department of Internal Medicine, Geriatrics Division Outpatient Clinic between March 2023 and October 2024 were enrolled in this study approved by Gazi University Rectorate Ethics Committee (Date: 22.11.2022, Decision No: 2022-19/12.12.2022). All participants included in the study have read and signed the written informed consent form prior to assessment according to the principles of the Declaration of Helsinki. The rights of participants were fully protected during the study. The inclusion criteria were (a) scoring above twenty-one on the Mini-Mental State Scale and (b) volunteering to participate in the study; the exclusion criteria were (a) being an active smoker or quitting smoking in less than five years, (b) having undergone abdominal, thoracic or lower extremity surgery, (c) having a fracture within the last year, (d) having a disease such as pulmonary artery hypertension, glaucoma, an aneurysm that prevents the Valsalva manoeuvre, (e) having hypertension that cannot be controlled with antihypertensive medication, (f) having a neurological disease that affects mobility (g) having a chronic inflammatory disease that affects muscle metabolism, including uncontrolled diabetes (HbA1c>9) and rheumatoid arthritis, (h) having any acute and/or chronic cardiovascular and/or pulmonary disease, and (i) having a history of cancer.

Outcome Measures

Participant Assessment Form: In addition to the socio-demographic characteristics of the participants [age (years), weight (kg), height (cm), body-mass index (kg/m^2), gender, marital and educational status], whether they use the assistive device, chronic diseases diagnosed in the past; smoking and alcohol use; the presence of nutritional support and if they have fallen in the last year was collected.

Sarcopenia definition: Diagnostic algorithm was applied to define sarcopenia based on muscle mass, muscle strength, and physical performance. For the muscle strength assessment, hand grip strength was measured three times in the dominant hand using a digital handheld dynamometer (T.K.K.5401; Takei Scientific Instruments, Tokyo, Japan) while the participants were standing and their arms at a position parallel to the floor. The highest of the three repeated measurements was used in the analysis. Grip strength for females <16 kg and for males <27 kg were taken as cut-off points to assess muscle strength in the definition of sarcopenia.[2] For the muscle mass assessment, ultrasound with a linear probe at 9-12 MHz frequency (LOGIQ 5; General Electric, Northville, MI) was used to evaluate anterior thigh thickness/body mass index (STAR index). Muscle mass for females <1 and males <1.4 were considered as low.[17]Additionally, low physical performance was defined as gait speed ≤0.8 m/s during a 4-m walking test using a manual stopwatch.[2]

Respiratory muscle strength: Maximal inspiratory pressure (MIP) and maximal expiratory pressure (MEP) was used to assess respiratory muscle strength.[18] Standard guidelines set by the American Thoracic Society/European Respiratory Society were followed during the assessment. Measurements were performed with a mobile and easy-to-use electronic pressure measuring device (MicroRPM, Vyaire Medical, Mettawa, IL) while the participant was sitting on a chair, using a mouthpiece placed in the mouth to prevent air leakage from the mouth and a clip on the nose from preventing nasal air leakage. The test-retest reliability of maximum mouth pressure measurements with the MicroRPM, intraclass correlation coefficient (ICC) was reported to be between 0.86 and 0.90 for a healthy population.[19] For hygiene precautions, each participant was given a mouthpiece. For the MIP assessment, the participant was asked to perform a maximal expiration manoeuvre followed by maximal inspiration for 1-3 seconds (Müller manoeuvre). For the MEP assessment, the participant first performed a maximum inspiration manoeuvre, followed by maximum expiration for 1-3 seconds (Valsalva manoeuvre).[20] Between each test, the difference between the two highest values of three to five acceptable maneuvers is ≤10%, with an interval of one minute provided that the best measurement result was obtained.[21] MIP and MEP values were calculated as the percentage (%) of expected values according to age and gender variables using Evans and Whitelaw's[22] reference equations. These reference values are 'MIP=108-(0.61xage) and MEP=131-(0.86xage)' in females, and 'MIP=120-(0.41xage) and MEP=174-(0.83xage)' in males.

Fall risk: The fall risk was determined via the modified clinical test for sensory interaction and balance (m-CTSIB) using the Biodex Balance System® (Biodex Medical Systems, Inc., NY). The m-CTSIB is designed to test the sensory selection process by compromising available somatosensory, visual, and vestibular senses while measuring the ability to minimize postural sway. The test consists of four different testing conditions while the participants stand at the center of the balance system platform with their feet shoulder width apart: a) eyes open firm surface; b) eyes closed firm surface; c) eyes open foam surface and; d) eyes closed foam surface. A sway index score is objectively calculated by the balance platform for each test condition. The sway index score is a measurement of the average sway movement from the center position, ranging from 0 (no movement) to 4 (extreme movement), with higher sway index scores indicating a greater degree of instability and increased risk of falling.[23]

Fear of falling: Falls Efficacy Scale International (FES-I) developed by Yardley et al.[24] to assess the fear of falling, how confident older people are in their activities of daily living and indicates the level of fall concerns. The scale consists of 16 items, each rated on a 4-point scale. The total score range is from 16 (no worry about falling) to 64 (extreme worry about falling).[25] A score between 16-19 indicates a 'low fear of falling'; a score between 20-27 indicates a 'moderate fear of falling'; a score between 28-64 indicates a 'high fear of falling'.[26] Cronbach's α of the Turkish FES-I was 0.94 and the individual item ICC ranged from 0.97 to 0.99.[25]

Quality of life: Sarcopenia Quality of Life Questionnaire (SarQoL) was used to evaluate the quality of life. The questionnaire was developed by Beaudart et al. (2015) and consists of 22 questions with 55 items. It comprises seven sub-parameters, including 'physical and mental health, movement, body composition, functionality, activities of daily living, leisure time activities and, fears'. The total score ranges from 0 (worst health) to 100 (best health),[27] but there is still no cut-off score to define a low quality of life[28]. The Turkish version of the ICC was reported as 0.97, with high internal consistency (Cronbach's alpha: 0.88).[29]

Statistical Analysis

The normal distribution of the variables, to determine whether to carry out parametric or non-parametric tests, was analysed using the Shapiro-Wilk test. Quantitative variables were analysed using descriptive statistics [median (interquartile range-IQR)]. Frequencies (n) and percentages (%) were used to describe the qualitative variables. Spearman correlation analysis was used to evaluate the relationship between quantitative variables (coefficient of <0.1 negligible correlation; 0.1-0.39 weak correlation; 0.4-0.69 moderate correlation; 0.7-0.89 strong correlation and ≥0.9 very strong correlation).[30] Significance was set at p≤0.05. All statistical analyses were performed using IBM SPSS Statistics 26.0 software (IBM Japan Corp., Tokyo, Japan).

RESULTS

The demographic and clinical characteristics of the participants are presented in Table 1. None of the participants used alcohol or were smoking.

Results of respiratory muscle strength (MIP-MEP), fall risk (m-CTSIB sway index), fear of falling (FES-I), and quality of life (SarQoL) scores are given in Table 2. All MIP and MEP values were less than the expected values (n=20). The Highest Sway Index in fall risk assessment tests was the highest degree of difficulty (eyes closed on foam surface). Fear of falling was at a moderate level. The quality of life score was neither low nor high, but average.

Correlations between parameters are seen in Table 3. We observed a moderate positive association between SarQoL and MIP (ρ=0.527, p=0.017) and SarQoL and MEP (ρ=0.473, p=0.035). There was no statistical correlation between m-CTSIB Sway Index and FES-I scores with respiratory muscle strength.

Table 1. Characteristics of the participants (n=20)

Variable		Median (IQR=25-75%)
Age (years)		81 (73-83.5)
Weight (kg)		70.50 (60-78.50)
Height (cm)		160 (153.50-171)
BMI (kg/m²)		27.08 (23.59-30.48)
		n (%)
Gender	Female	12 (60)
	Male	8 (40)
Marital status	Married	20 (100)
Educational status	Undergraduate	14 (70)
	Postgraduate	6 (30)
Using assistive device	Yes	8 (40)
	No	12 (60)
Other chronic diseases	Yes	16 (80)
	No	4 (20)
Nutritional support	Yes	5 (25)
	No	15 (75)
Falls in the last year	Yes	7 (35)
	No	13 (65)
Fear of falling	Low	5 (25)
	Modarate	10 (50)
	High	5 (25)

Quantitative variables were analysed using descriptive statistics [median (interquartile range-IQR)]. Frequencies (n) and percentages (%) were used to describe the qualitative variables. BMI: Body-mass index, IQR: Interquartile range

Table 2. Outcome measures of the participants (n=20)

Variables		Median (IQR=25-75%)
Respiratory muscle strength	MIP (cmH_2O)	43 (31-61)
	MIP (%)	65 (59.59-85.97)
	MEP (cmH_2O)	50.50 (39-76.50)
	MEP (%)	70.37 (61.34-105.11)
Fall risk (0-4)	m-CTSIB Sway Index Score: eyes open on firm surface	0.61 (0.43-1.07)
	m-CTSIB Sway Index Score: eyes closed on firm surface	0.93 (0.73-1.30)
	m-CTSIB Sway Index Score: eyes open on foam surface	1.28 (0.98-2.68)
	m-CTSIB Sway Index Score: eyes closed on foam surface	3.80 (2.16- 4)
Fear of falling (16-64)	FES-I	24 (19-27)
Quality of life (0-100)	SarQoL	53.22 (44.86-62.53)

Quantitative variables were analysed using descriptive statistics [median (interquartile range-IQR)]. MIP: Maximal inspiratory pressure, MEP: Maximal expiratory pressure, m-CTSIB: Modified clinical test for sensory interaction and balance, FES-I: Falls Efficacy Scale International-I, SarQoL: Sarcopenia Quality of Life Questionnaire, IQR: Interquartile range

Table 3. Correlation coefficient (ρ) and p-value between respiratory muscle strength with, fear of falling, fall risk, and quality of life (n=20)

			Respiratory muscle strength	
			MIP	MEP
m-CTSIB Sway Index Score	Eyes open on firm surface	ρ	-0.382	-0.314
		p-value	0.097	0.177
	Eyes closed on firm surface	ρ	-0.172	-0.037
		p-value	0.469	0.877
	Eyes open on foam surface	ρ	-0.031	0.028
		p-value	0.897	0.906
	Eyes closed on foam surface	ρ	-0.055	-0.035
		p-value	0.817	0.882
FES-I	Fear of falling	ρ	-0.207	0.050
		p-value	0.381	0.833
SarQoL	Quality of life	ρ	0.527	0.473
		p-value	0.017*	0.035*

Spearman correlation analysis was used to evaluate the relationship between quantitative variables. m-CTSIB: Modified clinical test for sensory interaction and balance, FES-I: Falls Efficacy Scale International-I, SarQoL: Sarcopenia Quality of Life Questionnaire, MIP: Maximal inspiratory pressure, MEP: Maximal expiratory pressure, p-values ≤0.05 indicate statistically significant correlation

DISCUSSION

This study aimed to investigate the association between respiratory muscle strength with fall risk, fear of falling, and quality of life in sarcopenic older adults. Although the association between respiratory muscle strength and sarcopenia-related factors, including hand grip strength, gait speed, and skeletal muscle mass index, has been studied previously, to our knowledge, this is believed to be the first study to examine the association between respiratory muscle strength with fall risk, fear of falling, and quality of life in sarcopenic older adults. Our findings indicated that values of MIP and MEP in sarcopenic older adults are significantly associated with quality of life but not fall risk and fear of falling.

Age-related sarcopenia potentially reduces strength production.[31] One of the important physiological changes in the respiratory system that is accompanied by aging is the decline in respiratory muscle strength[32] due to geometric changes in the thoracic cage, the reduction of costo-vertebral joint mobility, the degradation of neuromuscular recruitment patterns, as well as the loss of muscle fiber-type.[34] Respiratory muscle strength declines at a rate of 8-15% per decade of life after 50 years of age.[21] Similarly, in our study, respiratory muscle strength was lower than the expected value according to age and gender reference equation.[22] Decline in muscle strength may affect the ability to perform activities of daily living and potentially affect quality of life.[9] This notion was also confirmed in our study with correlation analysis revealing a significant positive, albeit moderate, relationship between respiratory muscle strength and quality of life. Therefore, it could be expected that sarcopenic elderly with higher respiratory muscle strength can have better results in their quality of life.[5]

The m-CTSIB assesses how well individuals can use sensory information (vision, proprioception, and vestibular inputs) to maintain balance. This approach focuses on the nervous system's ability to process and integrate sensory signals for balance control.[34] In this study, the m-CTSIB test was used to assess the fall risk of the sarcopenic elderly. As expected, the worst score was in the test with the highest degree of difficulty (eyes closed on foam surface). However, m-CTSIB scores showed no significant correlation with MIP and MEP. Respiratory muscles, such as the diaphragm and intercostals, primarily facilitate breathing but can also contribute to trunk stability through intra-abdominal pressure modulation during dynamic tasks.[10] But under m-CTSIB conditions, the balance is challenged by sensory feedback rather than physical tasks that heavily recruit the respiratory muscles. For instance, in a study on respiratory muscle function and balance, the contribution of respiratory muscle strength to static balance was minimal compared to its role in dynamic or high-intensity tasks.[35] Thus, the lack of a significant relationship between m-CTSIB outcomes and respiratory muscle strength can be attributed to the sensory-based m-CTSIB, which does not demand substantial physical engagement from the respiratory muscles. One of the studies in the literature has shown that single-leg standing time could be more accurate in predicting fall risk, especially for the falling elderly who could not stand for over 10 seconds on a single leg.[36] Similar to the present study, Hyodo et al.[12] also did not find any correlation between single-leg standing time scores and respiratory muscle strength in sarcopenic group for fall risk assessment.

Fear of falling causes the patient to become more cautious and slower in all movements.[12] In this present study, fear of falling scores were at a moderate level, but these scores did not show any correlation with respiratory muscle strength values. It is possible that fear of falling is more directly influenced by the strength and function of lower-limb muscles[37] and psychological factors like anxiety and depression[38] rather than respiratory muscle strength. Additionally, a history of falling is a well-known risk factor for fear of falling, as persons who have experienced falls are more likely to develop fear.[3] However, 65% of the participants had never experienced a fall in our study. Similarly to our results, it has been reported that 50% of the elderly have not experienced fear of falling.[39] Larger studies should be conducted to determine the rate of fear of falling in elderly people with sarcopenia who have not fallen.

The strengths of this study are, first, to our knowledge, this is the first study to identify the relationship between respiratory muscle strength with fall risk, fear of falling, and quality of life in sarcopenic older adults. Clinically, our results could help physiotherapists to maintain appropriate respiratory muscle training strategies to improve the quality of life of sarcopenic older adults. Second, the recently published sarcopenia-specific tool -SarQoL- whose Turkish version was used to assess quality of life.

Limitations

There are also several limitations to the current study that should be acknowledged. One of the limitations is that this study was a preliminary study with a small sample size. A small sample size could lead to inconclusive results. Future studies should focus on a greater number of sarcopenic elderly may be necessary. Another limitation is that it was limited to a single group at a single facility, and there was no control group. Comparing all parameters in this study with a healthy elderly group without sarcopenia will make the study more valuable.

CONCLUSION

This study investigated the relationship between respiratory muscle strength and fall risk, fear of falling, and quality of life in sarcopenic older adults. These results suggest that the respiratory muscle strength of sarcopenic older adults is significantly correlated with quality of life but not with fall risk and fear of falling. Therefore, respiratory muscle strength among sarcopenic older adults may assist physiotherapists in maintaining appropriate rehabilitation strategies. However, the body of research into the effects of respiratory muscle training is inconclusive. This training may be beneficial in improving the quality of life of the sarcopenic elderly.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was carried out with the permission of the Gazi University Ethics Committee (Date: 12.12.2022, Decision No: 2022-19).

Informed Consent

All participants signed and free and informed consent form.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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Original Article

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The comparison of changes in fatigue, physical activity and mood in different phases of menstrual cycle

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ABSTRACT

Aims: The aim of this study is to compare fatigue, physical activity and mood among the menstrual, early luteal and follicular phases of menstrual cycle.

Methods: A total of 32 women (age: 23±2.91 years) with a regular menstrual cycle (26-32 days) were included in the study. Menstrual phase was determined as the 2^{nd}-4^{th} days of bleeding, while early luteal phase was determined based on the positive result seen on the ClearBlue ovulation kit. Follicular phase, on the other hand, was determined 7 days after the early luteal phase. Fatigue level was measured with the modified Borg Scale. Physical activity level was determined with the International Physical Activity Questionnaire (IPAQ), and mood was determined with the Beck Depression Scale.

Results: It was found that fatigue level increased during the early luteal phase and menstrual phase ($p<0.05$). Physical activity and mood did not change among the phases ($p>0.05$).

Conclusion: This study revealed that fatigue level increased, while physical activity and mood did not change. Thus, while health professionals plan sports activities for women, they should consider these changes that occur during the menstrual phase.

Keywords: Menstrual cycle, physical activity, fatigue, depression

INTRODUCTION

The menstrual cycle is basically divided into three phases: the menstrual phase, the follicular phase, and the luteal phase. This natural process ideally lasts 28 days in women and involves fluctuations in hormone levels.[1,2] During these phases, the levels of sex hormones-progesterone, estrogen, and testosterone-change. Estrogen levels are low in the menstrual phase and higher in the follicular and early luteal phases. Progesterone levels are higher in the early luteal phase compared to other phases, while testosterone levels peak in the follicular phase.[3] These hormonal fluctuations are known to affect various parts of the cerebrum (cerebral cortex, hippocampus, corpus callosum), leading to changes in physiological, neurological, and motor functions.[4,5] Consequently, shifts in sex hormone levels in women can influence perceived fatigue, physical activity levels, and mood.

Several studies suggest that physical performance varies throughout the menstrual cycle. It is reported that physical performance is higher in the menstrual phase compared to other phases and lower in the early luteal phase.[6] Doohan et al.[7] noted that menstrual symptoms caused a decrease in physical activity levels. A meta-analysis published in 2020 found that exercise performance decreases in the early follicular phase.[8] Furthermore, physiological symptoms such as mild depression, fatigue, anxiety, and insomnia may occur in the late menstrual phase.[9] Domínguez-Muñoz et al.[10] showed that fatigue was highest in the menstrual phase and lowest in the follicular phase. A meta-analysis conducted in 2023 revealed that fatigue increases in the luteal phase and mood disorders rise in the premenstrual phase.[11] These physiological symptoms are attributed to increases[12] or decreases[13] in progesterone levels.

Examining the literature reveals different results concerning perceived fatigue, physical activity levels, and mood changes across the menstrual cycle's phases. Our study aims to explore these parameters, which we believe will guide activity modifications between phases. We aim to compare fatigue, physical activity levels, and mood changes in the different phases of the menstrual cycle.

METHODS

The study included women between the ages of 20-30 who had regular menstrual cycles (26-32 days) and no diagnosis. In order to conduct this study, the necessary permission and approval were obtained from the Gazi University Faculty

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of Medicine Clinical Researches Ethics Committee (Date: 21.01.2025, Decision No: 2025-72). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki. Those who wanted to participate in the study filled out the voluntary consent form. Changes across menstrual cycle phases is detectable with a sample size of 32 subjects at 85% power and a significance level of 0.05

Participants

The study involved women aged 20 to 30 who had regular menstrual cycles (26-32 days) and did not have any diagnoses that would affect the study focus. Participants provided voluntary consent by completing a consent form.

Exclusion criteria included the use of oral contraceptives, menstrual cycles outside of 26-32 days, musculoskeletal disorders, pregnancy, cardiovascular or neurological diseases, any pain or limitation in the upper extremities, and left-handed dominance. Because left-handed individuals exhibit greater individual differences in brain lateralization and motor control strategies compared to right-handed individuals, only right-handed dominant individuals were included to ensure homogeneity of neuromotor control and hemispheric lateralization. Of the 39 women evaluated, 3 were excluded due to irregular menstrual cycles, and 1 due to wrist instability. Additionally, 3 women whose follicular phases could not be determined were excluded. As a result, 32 women (age 24.3±4.2 years; height 16±0.7 cm; weight 57±10.1 kg) were evaluated across their menstrual, follicular, and early luteal phases for general fatigue, physical activity levels, and emotional states.[14] All participants were sedentary individuals and did not engage in regular sports activities.

Determination of Menstrual Phases

Participants were informed about how to determine the phases of the menstrual cycle, use the ovulation kit, and understand the assessments involved. Two consecutive menstrual cycles were questioned. The phases of the menstrual cycle were determined based on the first day of bleeding, with days 2-4 defined as the menstrual phase. A urine test was conducted with the ClearBlue Ovulation Kit (Clearblue digital ovulation test, SPD Development Company, Bedford, UK), beginning on the 10th day of the cycle. Ovulation was considered to have started when a 'smiley face' appeared on the kit's screen, marking the follicular phase. If no smiley face appeared, the test was repeated on days 11, 12, and 13. The 7th day after a positive result was marked as the beginning of the early luteal phase. All assessments occurred on the 2nd, 3rd, or 4th day of the menstrual phase, within 24-48 hours of the start of the follicular phase, and on the first day of the early luteal phase. The ovulation kit cannot measure hormone levels in different phases and does not provide as accurate results as hormone evaluations in the blood.[2]

Determination of Fatigue, Physical Activity Level, and Mood

The Modified BORG Scale was used to assess general fatigue levels. Participants rated their fatigue on a scale from 0 to 10 at the same time each day. 0 indicates 'not tired at all', 0.5 indicates 'very, very little tired' and 10 indicates 'extremely tired'.[15] The International Physical Activity Questionnaire (IPAQ), consisting of 5 sections and 27 questions including work, transportation, leisure, housework, and sitting time, was used to determine physical activity levels (r=0.81). It is scored with a met-minute score. The duration of vigorous physical activity, moderate physical activity, and walking in all sections is determined in minutes and days. The MET value corresponding to the intensity of each of these activities is calculated.[16] The Beck Depression Inventory, comprising 21 questions with 4 options each, was used to assess mood (r=0.65). Its scoring ranges from 0 to 63. Scores between 10-16 indicate mild depressive symptoms, scores between 17-29 indicate moderate depressive symptoms, and scores between 30-63 indicate severe depressive symptoms.[17]

Statistical Analysis

Data analysis was conducted using the statistical package for social sciences (SPSS) version 22.0 (SPSS Inc., Chicago, IL, USA). A power analysis conducted prior to the study indicated that a minimum of 32 participants was required for 85% power at a 5% margin of error. The normality of data distribution was evaluated using analytical and visual methods. Descriptive statistics for normally distributed numerical variables were presented as mean±standard deviation, while categorical variables were expressed as percentages and frequencies. Measurements from the early luteal, menstrual, and follicular phases were compared using the Friedman test, with statistical significance set at $p<0.05$. The Wilcoxon rank-order sign test with Bonferroni correction was applied in post hoc analysis to identify specific group differences, with statistical significance set at $p<0.017$.

RESULTS

The physical characteristics (age, height, weight, BMI) of the women included in the study are shown in **Table 1**.

Table 1. Physical characteristics and menstruation information of individuals

	Median (IQR)
Age (years)	23 (22-25)
BMI (kg/m²)	21.25 (19.35-22.75)
Age at menarche (years)	12.78±0.83
Menstruation duration (days)	6.15±0.95

IQR: Inter quantile range, BMI: Body-mass index

When the fatigue levels felt by the individuals were compared, a significant difference was found between the 3 phases ($p<0.05$). It was determined that the intensity level felt by the individuals in the ovulation phase was less than in the other phases ($p<0.0170$). Physical activity levels and moods did not differ between the three phases ($p>0.05$) (**Table 2**).

DISCUSSION

In this study, which was planned to compare the changes that occur throughout the cycle between the menstrual phase, follicular phase and early luteal phases, it was determined that the fatigue level decreased in the early luteal and menstrual phases, while the physical activity level and mood did not change.

Fatigue is difficult to evaluate clinically because it gives subjective and imprecise symptoms. Using self-assessment and repeatable measurements gives more accurate clinical results.[18] Therefore, the modified BORG scale was preferred to determine the fatigue severity.

Table 2. Comparison of fatigue, physical activity level, and mood between phases

	Median (IQR)	p*	Measurement	p¥
mBorg menstrual	2 (0.5-3)		1-2	0.052
mBorg early luteal	2.5 (16-21.8)	<0.001	1-3	0.001
mBorg follicular	1 (0.5-2)		2-3	<0.001
UFAA£ early luteal	1786.5 (1189-2850)			
UFAA£ menstrual	1820 (1403-2850)	0.208		
UFAA£ follicular	2203 (1220-3819)			
BDI early luteal	5 (1.25-11)			
BDI menstrual	7.5 (3-12.5)	0.118		
BDI follicular	5 (2.25-8.7)			

*Friedman test, ¥Bonferroni-corrected Wilcoxon test, 1: Early Luteal phase, 2: Menstrual phase, 3: Follicular phase, IQR: Inter quantile range, mBorg: Modified Borg, UFAA: International physical activity level, BDI: Beck depression inventory

In the studies, definitive results about fatigue levels between menstrual phases were not obtained. This situation may be due to the fact that some studies evaluated the general fatigue level, while some studies evaluated muscle strength fatigue, and other studies evaluated the exercise fatigue period. Different results were found in studies where women evaluated the fatigue level themselves, as we applied in our study. In the study of Ziomkiewicz et al.,[19] where they compared the fatigue level in three different phases, they found it to be high in the menstrual phase when progesterone levels were low. Sanders et al.[20] showed that the fatigue level was high in the early luteal phase. Morales et al.[21] have shown that the level of fatigue felt is higher in the premenstrual phase. In our study, the level of fatigue was found to be higher in the follicular and menstrual phases than in the early luteal phase. The reason for the high level of fatigue in the menstrual phase may be the decreased progesterone and estrogen levels. Allopregnanolone, one of the metabolites of progesterone, binds to the GABAA receptor and activates the effect of GABAA. GABAA is an inhibitory transmitter in nerve conduction and has a sedative effect. Therefore, it is thought that the decrease in the level of progesterone in the blood eliminates the sedative effect and increases the level of fatigue felt.[22] In addition, since it has been determined that the estrogen hormone also increases sleep quality by decreasing body temperature,[23] it was decided in our study that low estrogen levels may have decreased sleep quality and as a result, may cause fatigue. In addition, a study has shown that fatigue level increases the risk of injury in sports activities, but this study did not provide information about the phase in which the evaluation was made and the risk of injury.[24] Future studies should investigate the effect of fatigue levels in different phases of the menstrual cycle on injury rates in sports activities.

Our study included young adult sedentary women and did not evaluate the changes in menstrual cycle caused by age and physical activity level. Studies in the literature show that these variables may have effects on fatigue and mood. For example, It is reported that PMS symptoms may change with age, and mood disorders may increase in older ages.[25] Similarly, studies have shown that increasing physical activity levels have a mitigating effect on fatigue and mood disorders in the menstrual phases.[26,27] Therefore, future studies may consider that changes in fatigue and mood during the menstrual cycle may be affected by age and physical activity level.

According to our literature review, although studies are comparing the relationship between hormone levels and physical activity levels,[28,29] limited studies are comparing physical activity levels in the cycle (6).[7] Ahrens et al.[30] found no significant difference between phases in their study. Similarly, in our study, physical activity levels were similar between phases.

In the study of Ross, Coleman, and Stojanovska, it was observed that mood disorders were higher in the premenstrual and menstrual phases compared to the follicular phase.[31] Rubinow and Schmidt showed that depression levels increased in the menstrual phase.[32] Garcia et al.[33] also showed that mood was more impaired in the menstrual phase. Pletzer and Noachtar[11] showed that mood was more impaired in the menstrual phase. In this study, unlike other studies; mood was found to be similar between phases. Therefore, our results differ from the literature. The cut-off point for depression in the beck depression inventory is 17. Scores above 10 are interpreted as the presence of depression symptoms. The reason for the different results in our study is thought to be that the median score of the beck depression inventory is 5-7.5 and that no depressive symptoms were detected in any of the women.

Limitations

Limitations of this study include a relatively small sample size and reliance on self-report instruments, which may introduce response biases and limit the accuracy of the outcomes. Additionally, the severity of menstrual symptoms was not evaluated. Menstrual symptoms, which vary in intensity among women, may influence fatigue and depression levels. As a result, the impact of menstrual symptoms on fatigue, physical activity, and depression levels remains undetermined. The mood during the menstrual cycle may be influenced by age and physical activity levels. Furthermore, we did not assess participants' daily life habits (e.g., sleep quality, dietary habits, caffeine or alcohol consumption), which could potentially affect fatigue and mood.

CONCLUSION

Our study showed that fatigue levels increased, and physical activity and mood did not change in the menstrual phase compared to the other phases. Since fatigue levels are known to increase the risk of injury in women's sports activities, these changes in the menstrual phase must be taken into consideration while planning sports activities for women.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was carried out with the permission of the Gazi University Faculty of Medicine Clinical Researches Ethics Committee (Date: 21.01.2025, Decision No: 2025-72).

Informed Consent

All participants signed and free and informed consent form.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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Case Report

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Rib flare of an adolescent: case report

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ABSTRACT

We evaluated a seventeen-year-old male patient due to a protrusion at the level of the left costal arch. He stated that he had no disease and was even involved in a heavy sport like amateur football. The study aimed to examine the cause of rib dislocation and treatment options of the operated patient in light of the literature, as she did not accept other types of treatment due to periodic pain in the protruded body area and cosmetic discomfort.

Keywords: Flare, rib, surgery

INTRODUCTION

Mobility in the cartilage joints of ribs can cause pain.[1] The name of the condition is slipping rib syndrome. The cartilage joints in the left costal arch are among the joints most affected in this case. Most of the time, even a hooking maneuver is not necessary to detect this condition in people. This examination also has a pain-inducing effect.[1,2]

Rib dislocations can occur for various reasons, such as infection and tumoral pathologies, but they can also develop as deformities for unexplained reasons. The most common are deformities defined as pectus excavatum (PE) or pectus carinatum (PC). Treatment methods have been determined for PE and PC, but a definitive approach for flare ribs has yet to be.

This paper aims to present our treatment process for our patient with a flared rib in the light of the literature.

CASE

A seventeen-year-old male patient came with a complaint of dislocation of the left costal arch. He stated that he had been aware of it for a long time (Figure 1, 2). According to the information received from his family, we learned that he did not have a history of trauma or a previous disease in the location where the dislocation occurred. He said that he occasionally had pain that did not last long and that he was mostly visually disturbed. Blood tests were routine. There was no noticeable feature in the computed tomography examination except for the asymmetric appearance of the rib (Figure 3). We recommended to the patient compressive external bracing. We explained it in article that external bracing is proposed. However, after some other hospital evaluation, containing physiotherapy and related branches, it turned out that he wanted surgical treatment. However, he stated that he did not want to use it. Although we stated that keeping it this way would not cause a functional problem, he requested surgical removal for cosmetic reasons. Thereupon, we operated on through a transverse incision made over the rib dislocation (Figure 4). He was discharged on the third postoperative day. During the follow-up, we detected that he was cosmetically satisfied and had no complaints (Figure 5, 6). He was banned from heavy training and competitions for two months. After two months, he was asked to use protective bandages in competitions.

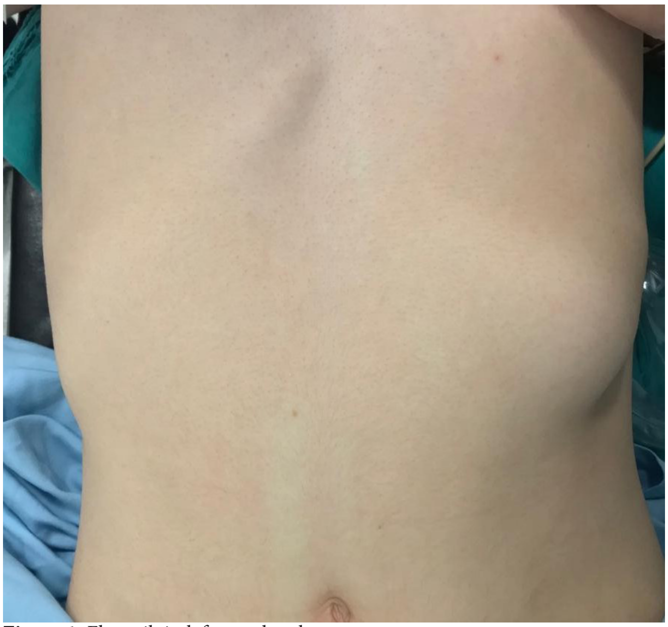

Figure 1. Flare rib in left costal arch

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Figure 2. Flare rib from side position

Figure 5. Side position of left costal margin after operation

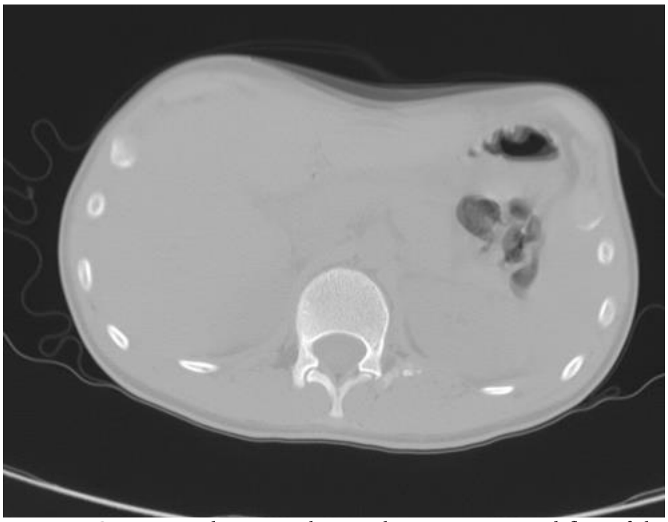

Figure 3. Computerized tomography revealing asymmetry and flare of the costal arch. Internal organs are normal

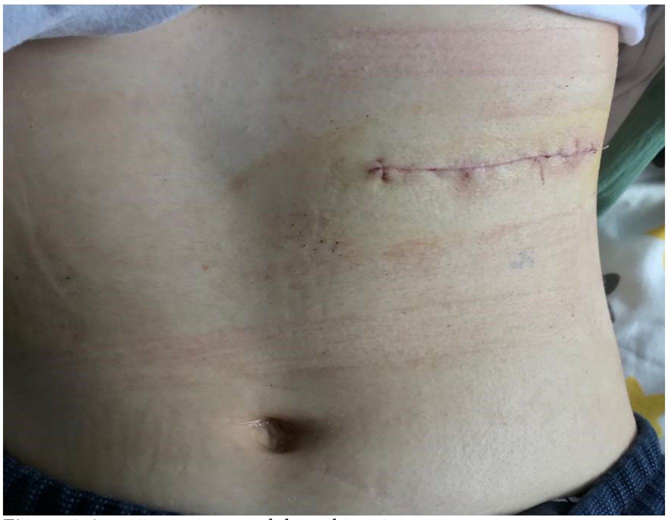

Figure 6. Anterior position with lateral incision

Figure 4. Resected deformed parts of rib

DISCUSSION

In people with rib deformity who do not have functional, that is, respiratory or cardiac problems, surgery can be done or minimal surgical intervention can be preferred. However, other than surgical procedures, more harmless treatment methods such as compression and vacuum have been developed recently. Bracing materials have many different features and techniques for compression.[3] Regardless of their features, these devices can achieve a high cure rate of up to 97% in pectus carinatum patients, provided they have been placed appropriately.[3] The treatment method in question is in the form of flared ribs, as in our patient, and the probability of success is lower in cases that create asymmetry.[3,5] However, it may be preferable to use it before surgery.[3]

Flare rib condition may occur together with PE.[4] In these cases, the bars to be placed during minimally invasive repair for PE can correct this protrusion by applying pressure.[4]

Another form of treatment for flare rib is surgical excision. However, if surgery is preferred, it must be is performed at the cartilage level because there is a high probability of recurrence of 26%.[1,6] Stabilizer plates can be placed to avoid recurrence on the rib parts where cartilage tissue has been removed.[1] In our patient, resection was performed from more posterior to the distance where the asymmetry occurred, not from the cartilage level, and the open bone end was closed with bone wax. No problems were encountered in this application.

CONCLUSION

Treatment may not be planned for people with flare rib problems and no other rib deformities, as there will be no functional problems. However, external bracing may be considered if a pain complaint suggests slipping rib syndrome or cosmetic problems. In cases where the patient does not prefer any other treatment, a surgical procedure can be planned as excision or bar placement.

ETHICAL DECLARATIONS

Informed Consent

The patient's parents signed a free and informed consent form.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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