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THE EFFECTS OF CALISTHENIC EXERCISES ON SLEEP QUALITY, FATIGUE, AND DEPRESSION IN ELDER ADULTS

ORIGINAL ARTICLE

ABSTRACT

Purpose: The physical, psychological, even economic and environmental changes emerged with age cause problems in sleep. The lack of exercise habits could increase the incidence of unfavorable sleep disorders with depression and fatigue. The aim of this non-randomized controlled study was to investigate the considerable effects of calisthenic exercises on sleep disorders, depression, and fatigue in elder adults.

Methods: The study was conducted at Pamukkale University and Hatay Mustafa Kemal University. Sixty-two individuals participated in the study between May 2018-October 2019. While the Calisthenic Group (n=32) performed calisthenic exercises for 30-45minutes/session and 3days/6weeks, and Control Group (n=30) did not performed. Fatigue, depression, and sleep quality levels were assessed using the Fatigue Severity Scale (FSS), Beck Depression Scale (BDI), and Pittsburgh Sleep Quality Index (PSQI), respectively.

Results: Statistically significant differences among FSS (p≤0.001), BDI (p=0.022), and PSQI (p=0.006) scores were found in the Calisthenic Group after the intervention, while there were differences only in fatigue (p=0.035) and total sleep quality (p=0.035) for the Control Group. We found that the Calisthenic Group's PSQI latency, PSQI sleep duration and PSQI total scores decreased in post-treatment. Both fatigue severity (p≤0.001) and depression levels (p≤0.001) were highly correlated with PSQI-subscores, except for sleep duration subscore (FSS p=0.934, BDI p=0.276).

Conclusion: Regular calisthenic exercise programs may enable elders to better manage changes in the aging process. Physiotherapists should consider including calisthenic exercises in the rehabilitation programs for its effects on all parameters of sleep, fatigue, mental and emotional status in this population.

Keywords: Calisthenics, Depression, Exercise, Fatigue, Older Adults, Sleep

YAŞLI ERİŞKİNLERDE KALİSTENİK EGZERSİZLERİN UYKU KALİTESİ, YORGUNLUK VE DEPRESYON ÜZERİNE ETKİLERİ

ARAŞTIRMA MAKALESİ

ÖZ

Amaç: Yaşla birlikte ortaya çıkan fiziksel, psikolojik, hatta ekonomik ve çevresel değişiklikler uykuda sorunlara neden olmaktadır. Egzersiz alışkanlığının olmaması, depresyon ve yorgunluk ile birlikte olumsuz uyku bozukluğu insidansını artırabilir. Bu randomize olmayan kontrollü çalışmanın amacı, yaşlı erişkinlerde kalistenik egzersizlerin uyku bozuklukları, depresyon ve yorgunluk üzerindeki önemli etkilerini araştırmaktı.

Yöntem: Bu çalışma Pamukkale Üniversitesi ve Hatay Mustafa Kemal Üniversitesi'nde yapıldı. Çalışmaya Mayıs 2018-Ekim 2019 tarihleri arasında 62 kişi katıldı. Kalistenik Grup (n=32) 30–45 dakika/seans ve 3 gün/6 hafta kalistenik egzersizler yaparken, Kontrol Grubu (n=30) yapmadı. Yorgunluk, depresyon ve uyku kalitesi düzeyleri sırasıyla Yorgunluk Şiddet Ölçeği(YŞÖ), Beck Depresyon Ölçeği(BDÖ) ve Pittsburgh Uyku Kalitesi İndeksi(PUKİ) kullanılarak değerlendirildi.

Sonuçlar: Müdahale sonrası Kalistenik Grup'ta YŞÖ(p≤0.001), BDÖ(p=0.022) ve PUKİ(p=0.006) puanlarında istatistiksel olarak anlamlı fark bulunurken, Kontrol Grubu için sadece yorgunluk(p=0.035) ve toplam uyku kalitesinde (p=0.035) bulundu. Kalistenik Grubunun PUKİ latansı, PUKİ uyku süresi ve PUKİ toplam puanlarının tedavi sonrasında azaldığını saptadık. Hem yorgunluk şiddeti (p≤0.001) hem de depresyon düzeyleri (p≤0.001), uyku süresi alt puanı (YŞÖ p=0.934, BDÖ p=0.276) hariç, PUKİ-alt puanları ile yüksek oranda ilişkiliydi.

Tartışma: Düzenli kalistenik egzersiz programları, yaşlıların yaşlanma sürecindeki değişiklikleri daha iyi yönetmelerini sağlayabilir. Fizyoterapistler uykunun tüm parametreleri, yorgunluk seviyeleri, mental ve emosyonel durum üzerindeki etkileri nedeniyle bu popülasyonda kalistenik egzersizleri rehabilitasyon programlarına dahil etmeyi düşünmelidirler.

Anahtar Kelimeler: Kalistenik egzersizler, Depresyon, Egzersiz, Yorgunluk, Yaşlı Erişkinler, Uyku

INTRODUCTION

Aging is a natural process that causes physiological, biological, and psychological decline. Muscle weakness, sensorial problems, cardiovascular diseases, cognitive impairment, and psychological problems affect elder adults in the aging process (1). These changes cause decreased physical activity and performance, poor sleep quality, and deterioration in the emotional state more frequently aged 65 years and older. Although depression can be seen in all ages, prevalence and severity of depression increase with aging, negatively affecting the quality of life (QoL) of both elders and their relatives. It reduces the pleasure of life and causes social communication disruptions; therefore, depression and fatigue make it difficult to cope with changes during the aging process (2).

Fatigue is a chronic and multidimensional problem in older adults. Its' complicated content could be related to short-term memory, insufficient concentration, and sleep disorders (3). Besides these, the energy of elder adults and tolerance to daily activities decrease, too. Almost half of the elders complain of moderate-to-severe fatigue (4). Muscle fatigue and weakness could be seen, especially in the lower extremity and trunk extensor muscles. Muscle weakness can lead to overuse of the remaining muscle strength. An earlier onset of fatigue causes an increased need for support and a dependent life (5). These physical, psychological, economic, and environmental changes along with aging, cause sleep-related problems, such as falling asleep, being unable to maintain sleep, waking up early in the morning, and excessive daytime sleepiness (6). Sleep disturbances can cause increased mortality risk, metabolic problems, headache, fatigue, perceptual disorders, drowsiness, learning disabilities, concentration problems, cognitive problems, increased health problems, and accidents. Furthermore, medicine is the commonly chosen solution to promote sleep. In addition to these, sleep disturbances, and the medicine used to sleep, increase the fall risk. Additionally, owing to adverse and diffuse reflection of sleep, balance, cognitive and emotional problems, the overall QoL of elder adults diminishes dramatically (7).

Exercise plays a key role in the healthy aging process. In recent literature, studies have focused on the effects of resistive, aerobic, endurance, flexibility, and balance exercises on elder adults. The most highlighted results showed that elder adults should do regular physical activity and exercises to manage the changes in physical, psychological, and social aspects of aging (8). Aerobic calisthenic programs could provide the maintenance of healthy physical, mental, and cognitive status in elder adults (9). The aerobic calisthenic exercises, which are performed in sitting and standing positions in addition to squatting, could increase exercise tolerance.

Calisthenics causes improvements in balance, muscle strength, mobility, cognition, sleep disorders, aerobic capacity, and emotional problems (9, 11–13). While the effects of different kinds of exercises on depression, fatigue, and sleep disorders in elders have been widely discussed (1, 14–16), it has been recorded that calisthenic exercises for elders are not as focused on young adults. It is well known that those, especially the elders, without exercise habits, have depression and fatigue as a causal effect (17, 18). Furthermore, inactivity generally causes sleep disturbances, which could affect physical, mental, and psychological health negatively (15). Calisthenic exercises are among the most effective, cheap, easy-to-applicable, and non-pharmacologic treatment approaches with no/little side effects. Because of this reason, the study focused on the effects of calisthenic exercises in elder adults. However, exercise needs to be planned through a comprehensive approach, consisting of aerobic and resistance training to improve aerobic capacity and sleep quality and to decrease fatigue and depression levels (4, 18). Thus, the interaction between depression, fatigue, sleep problems, and exercise should be clarified for the assessment and management of rehabilitation programs for elder adults. This study aimed to determine the effects of calisthenic exercises on sleeping problems, and emotional and fatigue levels in the elderly adult population multi-dimensionally.

METHODS

All participants gave written informed consent before participation by themselves, and the study

protocol conformed to the standards for human experiments set by the Declaration of Helsinki. Approval for the study was also obtained from the Pamukkale University Non-Interventional Clinical Studies Ethics Committee (4298783–050/26).

Participants

The study was conducted at Pamukkale University and Hatay Mustafa Kemal University,. Sixty-two elder adults participated in the study between May 2018-October 2019. The inclusion criteria were being ≥65 years old, having no regular exercise habits, having the cognitive level to follow commands and exercises, and being a resident in a nursing home. Exclusion criteria were having a severe systemic, orthopedic, neurologic disease, or cognitive disorder. The elder adults who could not perform the orders were also excluded from the study. Participants were categorized into the Calisthenic (n=32) and Control (n=30) Groups in a non-randomized sequencing manner. A non-randomized sequencing could not be done for the study, as physiotherapists followed elder adults in different cities of Türkiye. Physiotherapists included the elder adults according to the order of participation into the firstly Calisthenic Group, and than the Control Group. In this way, it was ensured that before the intervention, the Calisthenic and Control Groups had similar mean age and gender.

Outcome Measures

Each participant was evaluated at baseline and at the end of the 6th week. Sociodemographic data were recorded, followed by the assessment of fatigue level with the Fatigue Severity Scale (FSS), emotional status with the Beck Depression Inventory (BDI), and sleep quality with the Pittsburgh Sleep Quality Index (PSQI).

FSS was used to assess fatigue severity and its effects on daily living activities. The scale consists of nine items and each item scores 1–7 points. Lower scores show a low level of fatigue severity. The total score can be calculated by dividing total points by nine. The cut-off value for pathological fatigue was accepted as 4 (19, 20).

BDI was developed to quantitatively assess the depressive findings that participants perceive. The BDI includes 21 questions. Each item scores 0–3 points. The maximum score of the inventory is 63. A score ≥17 points is suggested to be a risk factor in terms of depressive symptoms (21, 22).

PSQI was developed to evaluate sleep quality and obtain a quantitative measurement of sleep. The scale consists of 7 components (subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and day dysfunction) with 24 questions. Total score (0–21) increases as the sleep quality decreases. A total score ≥5 indicates poor sleep quality (23, 24).

Intervention

The Calisthenic Group (n=32) participated in a regular six-week calisthenic exercise program. The program consisted of three sessions in a week, 30–45 min/session, and 10 sets/each exercise. Elder adults rested 5 minutes between the calisthenic exercise sets.

The program included warm-up exercises at the beginning and a cool-down period at the end of the session. The warm-up and cool-down program included posture, breathing and gentle stretching exercises, respectively. The Calisthenic Group performed breathing exercise and large muscle group exercises (including gross muscles such as upper and lower muscle groups and trunk muscles) combined with breathing patterns in the work-out period. Calisthenic exercises were performed in the standing and long-sitting position. The elder adults in the Calisthenic Group reached out forward to their thumbs and backward in the sitting position. The second exercise was in the standing position. The Calisthenic Group started by grabbing their waist on either hand. They opened their arms wide and squatted stepping forward. Then, they stood back from squatting and stepped back while grabbing their waist again. All exercises were done with the supervision of the physiotherapist. The physiotherapists particularly selected the mentioned two exercises to improve balance, core strength, and coordination. The beginning criteria for the exercise program were being a volunteer for the program and not having any systemic, cardiovascular, or pulmonary disease. The physiotherapists set up the exercise load according to the exercise tolerance of the elder adults. The exercise program was

Table 1. Demographics of the Participants

		Calisthenic Group		Control Group			
		n	%	n	%	x^2	p
Gender	**Female**	14	43.75	13	43.30	0.001	0.974
	Male	18	56.25	17	56.70		
Marital Status	**Married**	24	75.00	21	70.00	0.195	0.659
	Widowed	8	25.00	9	30.00		
Occupation	**Housewife**	13	40.60	12	40.00	0.413	0.813
	Officer	6	18.80	4	13.30		
	Worker	13	40.60	14	46.70		
Chronic Disease	**Cardiovascular**	13	40.625	16	53.33	3.090	0.521
	Type2 DM	10	31.25	7	23.33		
	Osteopenia	0	-	2	6.67		
Educational Level	**Illiterate**	11	34.38	6	20.00	3.010	0.698
	Elementary	14	43.75	19	63.33		
	High school	4	12.50	3	10.00		
	University	3	9.37	2	6.67		

DM: Diabetes Mellitus, x^2: Chi-Square Test.

terminated when the elder adults started to wind while counting forward while they were exercising. The other termination criteria for the program were feeling palpitations more and different from usual and tired. The physiotherapists informed all participants to give information if they had started a new rehabilitation or physical activity program. The elder adults were free to give up the program when they would like to. The Control Group did not participate in any rehabilitation program, but they were enrolled in a rehabilitation program with calisthenic exercises at the end of the study.

The Calisthenic Group started the program with five repetitions for each exercise in the first week. They performed each exercise seven times in the second and third weeks, and ten times in the following weeks from the fourth week. Physiotherapists conducted all programs.

Statistical Analysis

Statistical analysis was performed with SPSS-IBM Statistics 21 (SPSS Inc., Chicago, Illinois, USA). As a result of the power analysis, when the alpha value was set to 0.05, it was calculated that 95% power would be obtained when 38 people were included in the study (25). - The sample size was calculated with the Pittsburgh Sleep Quality Index-sleep quality subscore.

The mean, standard deviation (X, SD), frequency (n) and percentile (%) were used for the descriptive analysis. The Kolmogorov-Smirnov Test was used to decide if the data followed a normal distribution. Significant differences in qualitative data of demographics between groups were analyzed using the Chi-Square Test. The Mann–Whitney U test was used to analyze significant differences in pre- and post-treatment results between groups. Significant differences between pre- and post-treatment results of each group were analyzed through the Wilcoxon signed-rank test. Analysis of covariance was performed to analyze the difference between groups at the 6th week of assessment for the data, which were significantly different at the baseline assessment. Correlations between fatigue, depression, and sleep quality scores were analyzed through the Spearman correlation test. A correlation coefficient (r) higher than 0.40 was accepted as a moderate correlation, while higher than 0.70 was accepted as a strong correlation.

RESULTS

The mean age of the Calisthenic and Control Groups were 69.50±3.53 (range 65–76) years and 69.87±4.81 (range 65–81) years, respectively (t=-0.12, p=0.904). There were no differences in gender, marital status, chronic disease, occupation, and education level between the two groups (Table

Table 2. Comparison of Pre- and Post-Treatment Scores of Fatigue, Depression and Sleep Quality in and between the Groups

	In Groups								Between Groups			
	Calisthenic Group				Control Group				Pre-treatment		Post-treatment	
	Pre-treatment X ± SD	Post-treatment X ± SD	z	p	Pre-treatment X ± SD	Post-treatment X ± SD	z	p	z	p	z	p
FSS	4.81 ± 1.65	4.33 ± 1.57	3.64	**0.001****	4.61 ± 1.28	4.51 ± 1.30	2.11	**0.035***	-0.78	0.434	0.06	0.955
BDI	20.59 ± 11.76	17.66 ± 11.56	2.30	**0.022***	18.37 ± 12.32	17.37 ± 12.03	1.66	0.097	-0.61	0.540	-0.09	0.927
PSQI-Total	8.63 ± 3.38	6.84 ± 2.87	2.75	**0.006***	6.00 ± 3.97	6.33 ± 3.92	2.11	**0.035***	-2.81	**0.005****	6.06[a]	**0.017***
PSQI-Use of sleeping medication	1.06 ± 0.91	0.88 ± 0.75	1.60	0.109	0.67 ± 0.96	0.73 ± 0.98	1.00	0.317	-1.86	0.063	-1.15	0.249
PSQI-Sleep latency	2.31 ± 1.31	0.69 ± 1.12	2.91	**0.004****	1.40 ± 1.30	1.50 ± 1.31	1.34	0.180	-2.62	**0.009***	6,79[a]	**0.012***
PSQI-Sleep duration	0.47 ± 0.84	0.31 ± 0.69	2.24	**0.025***	0.13 ± 0.43	0.13 ± 0.43	0.00	1.000	-2.04	**0.042***	2.14[a]	0.149
PSQI-Habitual sleep efficiency	0.00 ± 0.00	0.00 ± 0.00	0.00	1.000	0.00 ± 0.00	0.00 ± 0.00	0.00	1.000	0.00	1.000	0.00	1.000
PSQI-Sleep disturbances	2.06 ± 0.67	1.75 ± 0.62	2.50	**0.012***	1.73 ± 0.69	1.77 ± 0.73	1.00	0.317	-1.89	0.059	-0.02	0.981
PSQI-Subjective sleep quality	1.53 ± 0.72	1.16 ± 0.57	2.83	**0.005****	1.30 ± 0.65	1.37 ± 0.61	1.00	0.317	-1.23	0.218	-1.44	0.149
PSQI-Day dysfunction	1.19 ± 0.90	1.06 ± 0.80	0.92	0.356	0.77 ± 0.97	0.83 ± 0.91	1.00	0.317	-1.95	0.052	-1.19	0.235

FSS: Fatigue Severity Scale, BDI: Beck Depression Inventory, PSQI: Pittsburgh Sleep Quality Index, z: Wilcoxon Signed Ranks Test, [a]: Analysis of Covariance (ANCOVA), * p<0.05; ** p≤0.005.

1). The number of medicines used did not also differ (t=- 0.54, p=0.063).

There were no significant differences in pre-treatment FSS and BDI scores between the groups (Table 2). Although, PSQI-total score (p=0.005), PSQI-sleep latency (p=0.009), and PSQI-Sleep duration (p=0.042) subscores were higher in Calisthenic Group in pre-treatment assessment. To eliminate the pre-treatment differences between the groups in these scores we conducted an Analysis of Covariance. We found significant differences in PSQI-Total (P=0.017), PSQI- Sleep latency (p=0.012) between the groups.(Table 2). Although there was a slight decrease in the post-treatment score, Control Group's depression level was recorded as borderline clinical depression for both pre- and post-treatment results. Meanwhile, Calisthenic Group's depression level changed significantly from middle-level depression (20.59±11.76) to borderline-clinical depression (17.66±11.56). Other considerable improvements recorded were FSS and PSQI-total scores in the Calisthenic Group. Interestingly, almost all PSQI-subscores slightly deteriorated in the Control Group, this deterioration was not statistically significant, except for PSQI-total score. There was a slight decrease in FSS (p=0.035) in addition to the deterioration recorded for sleep quality with a slight increase in PSQI-total score (p=0.035) for the Control Group (Table 2). Consequently, statistically significant differences between pre-and post-treatment scores of Calisthenic Group for FSS (p<0.001), BDI (p=0.022), sleep latency (p=0.004), sleep duration (p=0.025), sleep disturbances (p=0.012), and subjective sleep quality (p=0.005) subscores and total score of PSQI (p=0.006) (Table 2) showed the considerable improvement in fatigue, emotional status, and sleep quality level after calisthenic exercises.

We compared results of difference between pre-treatment and post-treatment (post-treatment scores minus pre-treatment scores) of Calisthenic Group and control group to eliminate the statistical significance results in the pre-treatment results. We found that the Calisthenic Group's latency, sleep duration, sleep disturbances, and subjective sleep quality subscores and total score of PSQI significantly decreased than the Control Group's at the 6th week of assessment (Table 3).

Significantly moderate correlations were found between fatigue, depression, and sleep quality (Table

Table 3. Comparison of the Difference between Pre-Treatment and Post-Treatment PSQI Results of the Calisthenic and Control Groups

	Calisthenic Group	Control Group		
PSQI	**X ± SD**	**X ± SD**	**z**	**p**
Total	-1.7812 ± 3.09	0.3333 ± 0.99	-4.395	**0.001****
Use of sleeping medication	-0.1875 ± 0.64	0.0667 ± 0.37	-1.823	0.068
Sleep latency	-0.6250 ± 1.01	0.1000 ± 0.40	-3.728	**0.001****
Sleep duration	-0.1563 ± 0.37	0.0000 ± 0.00	-2.240	**0.025***
Habitual sleep efficiency	0.0000 ± 0.00	0.0000 ± 0.00	0.000	1.000
Sleep disturbances	-0.3125 ± 0.64	0.0333 ± 0.18	-2.881	**0.004***
Subjective sleep quality	-0.3750 ± 0.66	0.0667 ± 0.37	-3.185	**0.001****
Day dysfunction	-0.1250 ± 0.75	0.0667 ± 0.37	-1.487	0.137

PSQI: Pittsburgh Sleep Quality Index, z: Mann–Whitney U Test, *p<0.05, **p≤0.001.

Table 4. The Correlation between the Scores of Fatigue, Depression and Sleep Quality

		BDI	PSQI						
		Total	**Total**	**USM**	**SL**	**SD**	**HSE**	**SDist**	**SSQ**	**DD**
FSS-Total	**r**	0.610	0.526	0.620	0.235	-0.011	n/a	0.651	0.623	0.358
	p	**0.001****	**0.001****	**0.001****	0.066	0.934	n/a	**0.001****	**0.001****	**0.004****
BDI-Total	**r**	1	0.694	0.730	0.440	0.140	n/a	0.615	0.623	0.542
	p	-	**0.001****	**0.001****	**0.001****	0.276	n/a	**0.001****	**0.001****	**0.001****
PSQI-Total	**r**	0.694	-	0.719	0.825	0.354	n/a	0.822	0.762	0.779
	p	**0.001****	**-**	**0.001****	**0.001****	**0.005****	n/a	**0.001****	**0.001****	**0.001****

FSS: Fatigue Severity Scale, BDI: Beck Depression Inventory, PSQI: Pittsburgh Sleep Quality Index, USM: Use of sleeping medication, SL: Sleep Latency, SD: Sleep Duration, HSE: Habitual sleep efficiency, SDist: Sleep Disturbances, SSQ: Subjective sleep quality, DD: Day Dysfunction, r: Spearman Correlation Test, *p<0.05, **p≤0.001.

4). Both fatigue severity (use of sleeping medicine r=0.620, sleep disturbances r=0.651, subjective sleep quality r=0.623, day dysfunction r=0.358; p<0.005) and depression levels (use of sleeping medicine r= 0.730, sleep disturbances r=0.615, subjective sleep quality r=0.623, day dysfunction r=0.542; p≤0.001) were highly correlated with PSQI-subscores, except for sleep duration subscore (p>0.05). Additionally, although the sleep latency subscore-PSQI moderately correlated with the depression level, no correlation was obtained with FSS (Table 4).

DISCUSSION

We conducted this study to examine considerable effects of calisthenic exercises on sleeping problems, fatigue and emotional levels in elder adults. Calisthenic exercise was found to have positive effects on sleep quality, fatigue, and emotional levels, although the Control Group only showed improvements in fatigue and total sleep quality. We observed that the sleep quality and latency significantly improved in the Calisthenic Group than the Control Group at the 6th week of assessment. Sleep quality of the Control Group worsened significantly. On the other hand, fatigue results decreased significantly in favor of the Calisthenic Group, which did not reach the significance level between the groups.

A sedentary lifestyle, sleep-related problems, and metabolic dysfunctions have a strong relationship with aging. In a study, calisthenic exercises in sitting and standing positions were applied to the elderly through 12 weeks, two sessions per week. The program, which was focused on the trunk and lower extremities, improved general health and physical functionality (9). Although we applied a similar calisthenic exercise procedure for only six weeks, our study supports the importance of personalized and regular calisthenic exercises in elder

adults and emphasizes a holistic perspective for health professionals working with elders.

The inappropriate sleep process causes cytokine concentration changes, increased energy consumption/metabolic rate, a prominent increase in cortisol level, central nervous system fatigue, changes in heart rate and heart rate variability in addition to the changes in mood and anxiety symptoms (26, 27). It was recorded that the participants in this study had much worse sleep quality, fatigue severity, and depression than expected. The literature indicates a relationship between fatigue and sleep quality (16). Emotional state is associated with sleep quality in older adults, as is the age associated with sleep duration (18). Our results support knowledge about the presence of poor sleep quality, fatigue and emotional problems with aging and the relationship among them. Thus, focusing on these factors with a multi-dimensional approach is important in geriatric rehabilitation (16).

There were some studies in the literature showing significant improvement in total and subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, day dysfunction and total sleep quality subscores after an exercise program implemented for elders (28). It was reported that considerable effects of exercise on sleep quality are maintained for 3 months (29). A six-month follow-up study on aerobic exercise training showed a significant increase in total sleep duration, sleep efficiency and sleep onset latency in older adults (14). We found that there was a statistically significant improvement in sleep latency (p=0.004), sleep duration (p=0.025), sleep disturbances (p=0.012), and subjective sleep quality (p=0.005) subscores and total scores of PSQI (p=0.006) after just 18-sessions of calisthenic exercise program, too.

Before the calisthenic exercise program, the Control Group's sleep latency (p=0.009), and duration subscores (p=0.042) and total scores of PSQI (p=0.005) were significantly lower than those of Calisthenic Group's in our study. The aforementioned sleep quality results were significantly lower in favor of the Control Group. In the Control Group, only a significant difference was observed in the PSQI-total score (p=0.035), which indicated deteriorated sleep quality after a six-week study period. Meanwhile, it was obtained that the sleep quality of elders in Calisthenic Group was significantly improved more than Control Group. In addition to the positive effects of exercise on PSQI-total score, it also significantly increased subjective sleep quality (p=0.005) and shortened sleep latency (p=0.004) in Calisthenic Group.

No difference was found in the baseline scores of FSS and BDI between two groups. Additionally, the post-treatment results were not different between the groups, except for PSQI total and sleep latency subscore. The literature offers a longer exercise period and follow-up than six weeks (9, 11, 14, 30). While the calisthenic exercise program was applied for only 6 weeks, improvement was recorded in PSQI's total and sleep latency scores. Considering the literature, we thought that if a longer exercise program could be applied, the sleep quality of the elderly individuals could be increased further with the positive developments that could be obtained in other parameters of sleep, fatigue and depression. Because, our data showed that Calisthenic Group's FSS ($p \leq 0.001$), BDI (p=0.022), and PSQI (p=0.006) scores significantly improved, whereas only the FSS improved in the Control Group (p=0.035). Meanwhile, the fatigue decreased significantly in both groups. Although the literature supports the effects of any type of aerobic exercise on fatigue and the severity of fatigue was significantly decreased in the Calisthenic Group, there was no difference between the groups at the 6th week assessment in our study.

Together with other factors, fatigue is an important factor, which affects QoL negatively (4). It was observed that both of the groups have considerable fatigue levels in this study. Maintaining an individual's physical capacity is crucial to reduce fatigue severity in elder people. Because of this reason, individualized regular exercise programs were suggested for elders to cope with fatigue experience as a regenerative compensation (16). Unfortunately, no difference was observed between the groups. It is thought that the change in the Control Group, may have been caused by the multidimensionality of fatigue and its relationship with many factors that we did not consider in our assessment protocol. Meanwhile, concordantly with the literature, it was recorded that the FSS score decreased

from 4.81±1.65 to 4.33±1.57 in Calisthenic Group ($p<0.001$), which was significantly higher than that of the Control Group. A meaningful and active life increases the personal subjective vitality, while decreasing the fatigue level, which was an early indicator of aging-related decline (31). Especially, calisthenic exercise could be a kind of suitable physical activity for inactive elder adults. The calisthenic exercises were performed with warm-up and cool-down periods, breathing patterns, and individualized progression protocols in this study. Researchers recommend weight-bearing calisthenic exercises because body weight provides resistance to movement (8). The calisthenic exercise program was individualized according to the participants' conditional status and aimed to improve the total aerobic capacity. We did not assess the aerobic capacity, but the reduction in perceived fatigue severity in ADLs by elders in our Calisthenic Group, as far as we experienced, this indirectly supports the positive effects of calisthenic exercises on aerobic capacity. Exercising, positively affects the emotional status of all individuals, not just in elders. Inactivity is a major problem that causes sleep disturbance, which is thought to be related to depression (32) is also considered in our study. Aerobic exercises, endurance programs, high-intensity progressive resistance training, and Tai Chi and Qi Gong exercises have beneficial effects on the depression in elders (33, 34). Especially, moderate exercise programs could reduce resting plasma concentrations of pro-inflammatory cytokines and increase anti-inflammatory cytokines (35). We recorded that participants in Calisthenic Group had moderate-level depression before the treatment, which improved to borderline-clinical depression after an 18-session exercise program ($p=0.022$). It was recorded that the PSQI's total ($p=0.017$) and sleep latency subscore ($p=0.012$) difference between the groups at the 6th week of assessment reached to significance level. It was stated that exercise is an effective intervention for those who do not experience adequate sleep quantity or quality, and may assist in alleviating symptoms of anxiety, arousal, or poor mood in a recent systematic review (26). Therefore, in parallel with the literature, physiological changes mentioned above, and our results, calisthenic exercises could be chosen as a non-pharmacological treatment to reduce sleepiness, improve sleep quality, fatigue, and emotional levels, especially in elders (36).

Performing calisthenic exercises for 30–40 min daily could improve sleep quality by building a bridge between longtime sleep and need a little time to go to sleep, as found in many studies and in our study. We demonstrated that fatigue severity was significantly associated with emotional status, total and subjective sleep quality, use of sleeping medicine, sleep disturbance ($p\leq0.001$), and day dysfunction ($p=0.004$). If elders participate in an exercise program, especially that consisting of calisthenic exercises, they could have better emotional status, sleep quality, and aerobic capacity, which could decrease the experienced fatigue severity level during performing ADLs. Eventually, QoL of elders and their families would increase. Thus, risks of the occurrence of secondary problems that may occur with the aging process could be reduced, with less energy, workforce and financial resources spent. The effects of calisthenic exercises on QoL of elders and their families, and risks of the occurrence of secondary problems associated with aging could be the focus in future studies with long-term follow-up.

Asymptomatic individuals who are physically inactive but otherwise healthy may begin light to moderate-intensity exercise without medical clearance, and in the absence of symptoms, the intensity may gradually progress as recommended in current American College of Sports Medicine's exercise prescription guidelines (37). General exercise testing guidelines, such as exercise testing, are no longer universally offered. Instead, clinicians are encouraged to assess the need for medical examination (a simple checklist that indicates the absence of any acute, severe or uncontrolled medical problems that may put the individual at risk for exercise), a brief physical assessment (especially, cardiovascular, musculoskeletal, balance, falls and fatigue concerns), exercise stress testing, diagnostic imaging or a structured and individualized self-screening, using their clinical judgment and on an individual basis (37, 38). In our study callisthenic exercises were chosen as a safe and an aerobic exercise with light-to-moderate intensity. Fatigue, emotional status and sleep quality were questioned in addition to the medical history. Unfortunately, no

exercise stress test or diagnostic imaging were done before and during the physiotherapy and rehabilitation sessions. In future studies prescreening protocols, and secreening during and after the program could be done to assess the effectiveness with objective methods.

A limitation of this study was that our participants were non-randomly categorized. Secondly, the lack of measurements for vital values was another limitation of the current study. Meanwhile, the main limitation of this study was focusing on the homogeneity of demographic parameters between the groups, no similarity could be achieved between groups in other parameters assessed, such as PSQI-sleep latency, PSQI-sleep duration, and PSQI-total scores. It was noted that there was a significant difference in these parameters between the two groups in favor of the Control Group. Therefore, detailed statistical analyses were performed to eliminate this problem and found that the Callisthenic Group's PSQI's total score and sleep latency subscore improved significantly after the 18 sessions calisthenic exercise program. Lower scores define better sleep quality in PSQI. As a result, we thought that calisthenic exercises have positive effects on sleep quality. One of the strong sides of this study was the inclusion of a sufficient number of older adults. The second one was that calisthenic exercises are easy-to-applicable, cheap, no-risky, and suitable for all age groups. We offer future studies to be conducted with randomized groups with follow-up assessments at 3 months, 6 months, and 1 year after the treatment program to investigate long-term results of calisthenic exercises in elders. Calisthenic exercises could also be combined with physiotherapy and rehabilitation programs, which consist of strengthening programs, such as aerobic and balance exercises, yoga, Pilates, and Tai Chi, and Qi Gong exercises (18, 26, 28, 29).

Maintaining optimum physical activity and functional performance in elder adults is essential during the aging period. Regular and personalized calisthenic exercises could be beneficial for the many aspects of health, such as sleep quality, depression, and fatigue levels. Physiotherapists should assess these parameters while planning an effective rehabilitation program. Improvements in sleep problems, emotional status, and fatigue levels could increase the participation of elder adults in ADLs. Follow-up studies and randomized-controlled trials are needed to determine the long-term effects of the calisthenic exercise program on sleep quality, fatigue, and depression levels in this population.

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