ORIGINAL RESEARCH

DOI: 10.4274/ejgg.galenos.2023.2023-1-4
Eur J Geriatr Gerontol 2023;5(3):189-195

Comparison of Physical Activity, Functional Fitness and Fatigue According to Gender in Young-old

Tuba Maden[1], Erkin Oğuz Sarı[2], Begümhan Turhan[3], Çağtay Maden[4]

[1]Gaziantep University Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, Gaziantep, Turkey
[2]Hasan Kalyoncu University Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, Gaziantep, Turkey
[3]Başkent University Faculty of Medicine, Department of Anatomy, Ankara, Turkey
[4]Gaziantep Islamic Science and Technology University Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, Gaziantep, Turkey

Abstract

Objective: The aim of this study was to compare physical activity, functional fitness and fatigue levels according to gender in young-old.

Materials and Methods: The International Physical Activity Questionnaire-short form was administered to a total of 55 young-old. Muscle strength, functional capacity, and fatigue were respectively evaluated with the Lafayette manual muscle tester, a 6-minute walking test, and the fatigue severity scale.

Results: It was observed that there was no difference in terms of physical activity, functional capacity, and the percentage of normal values in the proximal muscles ($p>0.05$). The proximal muscle force of males was higher than female individuals ($p<0.05$). The scores of female individuals on the fatigue severity scale were higher than male individuals ($p<0.05$).

Conclusion: The young-old stage, a major transition period for old adults, is an adoption process to the changing work and family life. The similarity of parameters may be due to the fact that major health differences reflected by gender were not observed in this period.

Keywords: Young-old adults, fatigue, physical fitness, gender role, muscle strength

Introduction

Aging is a chronic and universal process that is seen in every living thing, starts in intrauterine life and continues until death, is irreversible, and affects all body systems (1). The aging can be divided into different stages. The young-old population (YOP) consists of people aged 65-74 years (2). In this stage, people adapt to aging and lifestyle transitions. YOP have often retired from jobs (3). Thus, this stage includes dramatic changes for YOP, such as work and family life (4). Work and family life, and leisure time activities generally differ during daily life activities for the young-old stage, a major transition period (4). The young-old stage is the first step for healthy and successful aging (5). The changing proportion of activities can affect physical activity, functional fitness, and fatigue.

Physical activity is any bodily movement produced by skeletal muscle that results in energy expenditure (6). It is the most important factor for physical and mental well-being in the elderly. Regular physical activity in the elderly has multiple effects on physical fitness and health (7). There are benefits of physical activity on physical, cognitive, and psychosocial levels in the elderly (2). Physical activity is a health determinant and preventive factor against cognitive decline and functional limitations. It may exert neuroprotective effects by bolstering the cardiovascular, immune, and metabolic systems, which might be especially important in cardiovascular-based degenerative conditions (8). It helps older adults to improve their flexibility and strength (9). Muscular strength and cardiorespiratory fitness are essential for physical functioning in the elderly (10). As higher levels of both functional capacity

Address for Correspondence: Tuba Maden, Gaziantep University Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, Gaziantep, Turkey
E-mail: tuba.kmaden@gmail.com **ORCID:** orcid.org/0000-0001-8713-0825
Received: 24.01.2023 **Accepted:** 25.04.2023

Cite this article as: Maden T, Sarı EO, Turhan B, Maden Ç. Comparison of Physical Activity, Functional Fitness and Fatigue According to Gender in Young-old. Eur J Geriatr Gerontol 2023;5(3):189-195

and muscular strength are related to improve functional performance, these physical components are key targets for intervention (11). Muscle weakness is a major cause of recurrent falls, morbidity, and mortality in the elderly. The physiological mechanisms of old muscles contribute to function and mobility (12). Functional fitness is a comprehensive term that consists of physical functions, independence of life, muscle strength, flexibility, and cardiorespiratory endurance (13). Besides, fatigue which is a common complaint among adults aged 50 years, may affect physical activity, and complaint-related fatigue causes a low level of physical performance (14). Therefore, all these components (physical activity, functional performance, muscle strength, fatigue, functional capacity, etc.) are interrelated in the elderly. Many studies investigate physical activity, functional fitness, and fatigue in the elderly (2,7,13,15). These studies focus on the oldest age. There is a gap in the literature related to the young-old stage. YOP is a major transition period; thus, older adults change activities in daily life. The situation can affect the physical status and fatigue levels. Thus, this topic has become of major scientific and clinical importance.

When the elderly population is examined, activities are more negatively affected than men as women age (16). Although it has been shown that women do less physical activity than men (17) there is also a study in the literature that proves that women are more active in other activities such as housework and walking (16,18). Compared to women, men are more physically active and have higher body strength (19). While research has shown gender differences in physical activity separately, it is not known whether there are differences in physical activity, functional capacity, and fatigue in the young-old population. Both physiological and psychological conditions in old age differ according to gender. It is thought that the health status of men and women is different at every stage of old age (20). Since the young-old period is the beginning of aging, it is seen as the forerunner of other levels, and the comparison of functionality by gender in this period will be descriptive.

In light of this knowledge, as the world population ages, it is important to understand aging and how to increase physical activity with the goal of healthier aging. The effect of gender on physical activity, functional capacity, and fatigue should be investigated in the young-old population. The aim of this study was to compare physical activity, functional fitness and fatigue according to gender in young-old.

Materials and Methods

Participants and Study Design

The study was planned as cross-sectional. To reduce bias, the statistician in the study was blinded. Patients were 22 recruited at Kalyon Medicine Center. The study was reviewed prospectively between May 2021 and September 2021. In our study, a total of 55 individuals, 28 male, and 27 female, aged 65-74 were evaluated. Individuals aged 65-74 years, with a standardized mini mental test score of 24 and above, without neurological and musculoskeletal problems that may affect walking and balance, and who did not need a walking device for ambulation were included in the study. Individuals with psychiatric or severe cognitive dysfunction, vision or hearing problems, and acute the disease and acute pain were excluded from the study. The flowchart is shown in Figure 1. Sixty individuals were included in the study. Five subjects were excluded from the study (female 3, male 2) due to acute pain, out of age range, and cognitive dysfunction. Twenty-seven women and 28 men were analyzed.

Measurement Tools

Data Collection Form

In the data collection form; demographic information, physical activity levels, muscle strength, physical performance, and fatigue levels were questioned. The procedure chart is shown in Figure 2.

International Physical Activity Questionnaire-short Form (IPAQ-SF)

Physical activity levels were evaluated using the IPAQ-SF Turkish version of Saglam et al. (21,22). IPAQ-SF is a questionnaire that determines the duration and frequency of different types of activities by questioning the last 7 days. Physical activities in this survey; it is divided into 4 categories: High-intensity, medium-intensity, walking, and sitting. In the calculation of the questionnaire, the total number of hours and days for each physical activity level was calculated. IPAQ has been validated for use in adults, and older adults (22).

Manual Muscle Testing

Muscle strength, one of the physical fitness parameters, was evaluated with the Lafayette manual muscle tester (Lafayette manual muscle tester 01165, USA digital handheld dynamometer) (23). The muscle test was measured for the middle part of the deltoideus muscle and the quadriceps muscle. Measurements will be made by a single researcher and each muscle test was recorded bilaterally by making 3 repetitive measurements. The peak force obtained from isometric muscle contraction was recorded. The expected percentage was obtained by taking the arithmetic mean of both sides and dividing it by the norm values (24).

6-Minute Walk Test

Functional capacity, which is another parameter of physical fitness, was evaluated with the 6-minute walk test. The distance traveled by the individuals by walking in a 30-meter corridor for 6 minutes was calculated. The test under the control of the physiotherapist was performed once and the distance covered

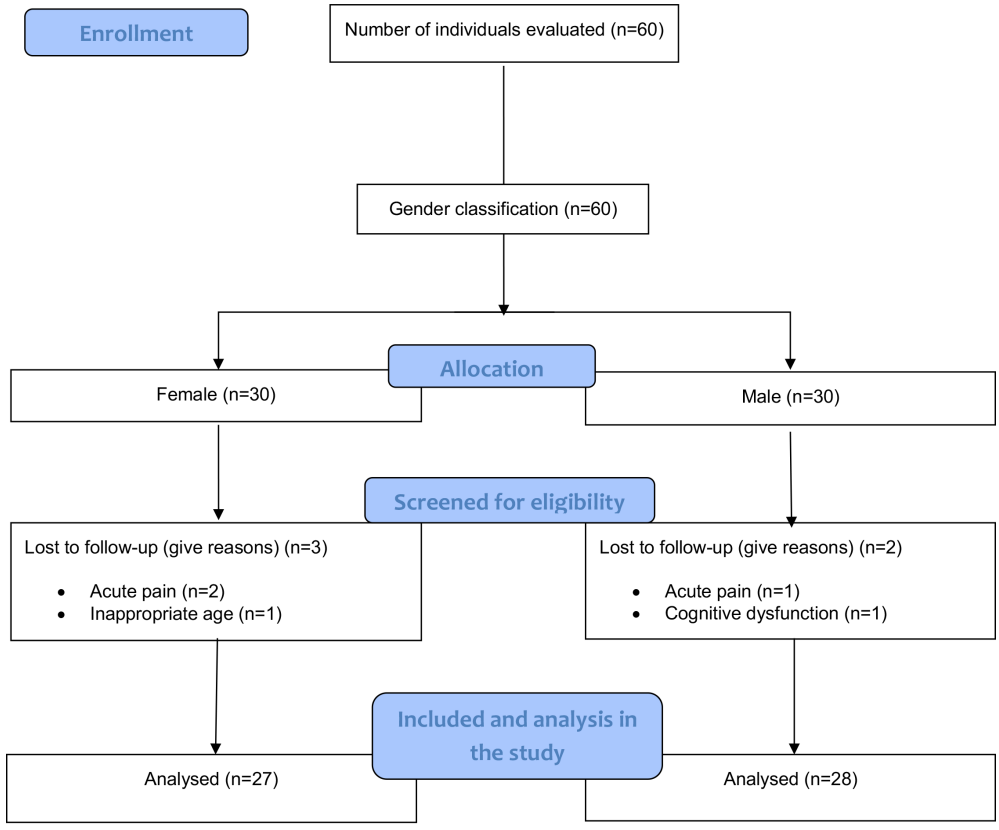

Figure 1. Flow chart

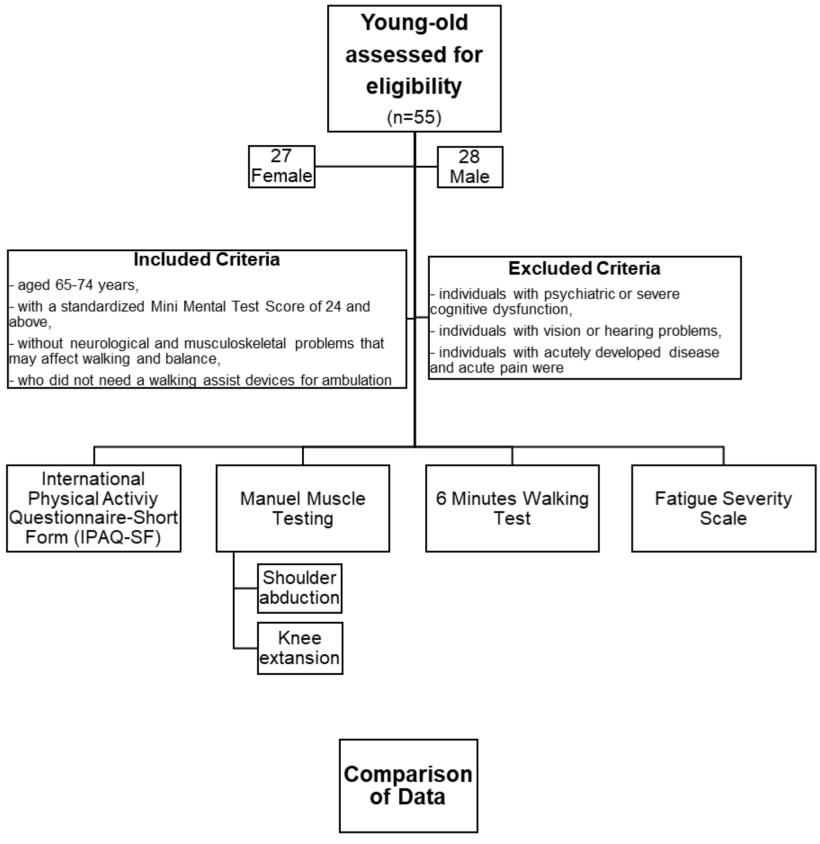

Figure 2. Procedure chart

was recorded. The 6-minute walk test is reliable and valid in adults and seniors (25).

Fatigue Severity Scale

Fatigue was assessed with the Fatigue Severity scale. This questionnaire is a nine-item questionnaire that evaluates the effect of fatigue in the past week on daily functions. Each item is scored between 1-7. "1" indicates strong disagreement, and "7" indicates strong agreement. The total score is calculated by taking the arithmetic average of 9 items. A score of 4 and above usually indicates severe fatigue (26). The Turkish validation of the FSS was conducted by Armutlu et al. (27).

Statistics

Statistical analyses were performed using the SPSS 25 package program. For descriptive analyses, the variables determined by numerical measurement were stated as the arithmetic mean and standard deviation (X ± SD). The data to the normal distribution was assessed using the Shapiro-Wilk test. An Independent t-test was used for the mean comparison of the data between groups. The statistical significance level was set at $p<0.05$. A significance level of 5% and a power (1-b) of 80% were assumed, and medium effect size (d=0.62) in the population was assumed (28). The G*Power analysis was used to estimate the minimum sample size needed. The sample size was calculated to be 26 subjects in each group (29).

Results

There was no significant difference in the demographic characteristics of the individuals but not education and occupation status. Shoulder abduction muscle strength % of women was found to be higher than that of men (see Table 1). In addition, the score of female individuals on the fatigue severity scale was higher than that of male individuals (see Table 1). There was no significant difference in the values of shoulder abduction muscle strength (N), knee extension muscle strength (N), and knee extension muscle strength % (see Table 1). Functional capacity measurement indicator 6 minute walk test distance was found to be similar in both genders $p>0.05$.

Discussion

The present study provides comparative data on the proximal muscle strength, fatigue, functional fitness, and physical activity levels of young elderly according to gender. In the study, which

Table 1. Comparison of demographic information, physical activity, functional fitness, and fatigue levels according to gender

	Female (n=27)	Male (n=28)		
	X ± SD	X ± SD	t	p-value
Height (cm)	158.9±4.6	172.1±5.2	9.787	0.000*
Weight (kg)	73.7±10.9	79.9±12.4	1.968	0.054
BMI (kg/cm²)	26.1±4.7	27.6±4.3	0.960	0.455
Age	70±4.8	70.1±6.8	0.089	0.930
Profession				
Housewife (n)	-	26 (92%)		
Retired (n)	9 (33%)	1 (3%)		0.000**
Working (n)	18 (66%)	1 (3%)		0.000**
Comorbidities				
Diabetes mellitus (n)	13 (48%)	14 (50%)		0.847
Hypertension(n)	12 (44%)	18 (64%)		0.650
Asthma (n)	1 (3%)	7 (25%)		0.001**
Heart failure (n)	5 (18%)	5 (17%)		0.990
Other (n)	6 (22%)	5 (17%)		0.910
IPAQ (MET-h/wk)	837.5±949.2	1236.8±1035.5	0.589	0.446
SAMS (N)	50.8±24.3	86.2±30.4	4.687	0.000*
SAMS (%)	48.6±22.6	43.5±15.8	0.952	0.346
KEMS (N)	61.8±25.5	95.1±32.3	4.184	0.000*
KEMS (%)	25.5±8.9	25.4±9.6	0.045	0.964
6MWT (meter)	241±144.7	285.5±138.7	0.843	0.407
FSS (score)	51.2±11.1	40±14.3	3.250	0.002*

*p<0.05 independent samples t-test, **p<0.05 chi-square, SAMS: Shoulder abduction muscle strength, KEMS: Knee extension muscle strength, FSS: Fatigue severity scale, 6MWT: 6-minute walking test distance, IPAQ: International physical activity questionnaire, SD: Standard deviation

included male and female participants with similar functional capacities and physical activity levels, it was discovered that the severity of fatigue levels of women was greater than that of men. Besides, the percentage of normal values by age and sex in the proximal muscles was similar to both of them. We think that the similarity of physical activity and functional capacity according to the groups is compatible with the similarity of the normalized values in proximal muscles.

It has been emphasized that proximal muscle strength was related to the functional measurements in the elderly (30). Peripheral and proximal muscles affect an individual's quality of life and the level of independence in life. The weakness of muscle strength cause physical incompetence and functional disability. On the other hand, physical immobility causes weakness of muscle strength in the elderly. There is a vicious circle here and it repeats in older individuals (31). It is known that there are many factors affecting this cycle, such as chronic diseases, fatigue, gender, and psychological status in the elderly. There are studies investigating the effects of gender on physical activity, functional capacity, and fatigue (32,33). Outcome parameters were analyzed separately in different age groups and especially in the elderly (34). The investigation of outcome parameters together in YOP is the original aspect of our study.

Gender-related alterations of proximal muscles have been reported with increasing age, such as an earlier and more severe decline in muscular strength has been observed in females as compared to males (35). It shows that the loss of muscle mass and strength in proximal aging-related physical function, mobility, and vitality in old age. Proximal muscle strength is a critical component of physical activity and functional capacity (35). The annualized rates of strength decline (3.6% in males and 2.8% in females) in these relatively healthy older adults were higher than the typical 0.8-2.0% per year previously reported in either cross-sectional studies or longitudinal investigations of relatively younger individuals (36). The fact that female individuals had less muscle strength than males in our sample is compatible with the literature.

Normalized proximal muscle values are found by dividing the muscle strength value of individuals by the expected value according to age and gender (31). It stated that knee extension strength differs as a function of age and gender (37). In another study, Fayet et al. (38) found that muscle activity may reflect an earlier decline in deltoid muscle strength in females. Nevertheless, Bullo et al. (39) emphasized that knee extension strength does not differ between groups in men or women according to age. The reason why there was no difference between normalized proximal muscle strength values according to gender in our study can be explained that the physical activities and functional capacities of the individuals are similar to those of males and females.

There is evidence showing that physical activity and functional capacity are at lower levels in female individuals (40). One of the consequences of the aging process is the decline in muscle strength, and respiratory and functional capacity. The low respiratory capacity and muscle strength cause a decrease in physical activity over time, especially in the female elderly. The endurance of older individuals decreases and they begin to tires more quickly (40). Gender factors in outcome measurement might reflect differences in underlying health conditions, as well as lifestyle and behavioral factors (17). For example, a significant reduction in bone mineral density after menopause has been frequently suggested to predispose women to a higher risk of falling and bone fracture so they decrease the level of physical activity. However, male and female young-old adults did not stay inactive, they just tried to adapt to the changing work and family life during this period. The period changes physical activity type, duration, etc. according to our findings, the similarity of physical activity and functional capacity may be because major health differences reflected by gender were not observed in this period. It is emphasized that the young old age period is a transitional period, and activities vary during this period. When our data, especially on physical activity, is viewed, the high standard deviation supports this variability.

Fatigue has been widely studied in the general population. Several studies found that there was a higher incidence and level of fatigue in women than in men (41,42). Also, fatigue is an important geriatric syndrome and a common complaint among the elderly, which is accompanied by low physical activity (43). Fatigability is known as highly prevalent in older adults and strongly associated with age (41).

Study Limitations

The main limitation of this study was the use of self-reported data to measure the level of physical activity. Also, the diseases that met the inclusion criteria and other existing comorbid diseases were determined according to the statements of the individuals. At the same time, almost 50% of our sample was diabetic and hypertensive. It should be taken into account that this situation may affect the functional status. Furthermore, the sample is nearly 50% housewives and daily housewife physical activities could be characteristics according to culture. The smoking and drinking behaviors of the participants were not recorded.

Conclusion

The young-old period is a major transition period over their life for males and females. Although females' muscle strength is lower than men's, they experience the young-old period similarly in terms of normalized muscle strength values, physical activity, and functional capacity but not fatigue. We believe that the major health differences caused by gender due to aging do

not occur in young-old age. However, our findings need to be supported by further studies. In terms of parameters that do not vary by gender, they can be examined in clinical studies in larger samples regardless of gender. A more detailed examination of the parameters that vary according to gender from different perspectives will provide a better understanding of the young-old period. There is a need for studies in which factors such as skill areas, individual differences and comorbid diseases are homogenized. Considering the gender factor in exercise and physical activity training in elderly individuals may be important in terms of both fatigue and muscle strength development.

Ethics

Ethics Committee Approval: Ethics committee approval was obtained from Hasan Kalyoncu University Faculty of Health Sciences Non-Interventional Research Ethics Committee on 18.05.2021 (decision no: 2021/068) and it was done according to the Helsinki Declaration criteria.

Informed Consent: Before the study, individuals were informed about the purpose and content of the study. The consent form was obtained from the individuals.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Concept: T.M., B.T., Ç.M., Design: T.M., B.T., Data Collection or Processing: T.M., Ç.M., Analysis or Interpretation: E.O.S., Ç.M., Literature Search: T.M., E.O.S., B.T., Writing: T.M., E.O.S., B.T., Ç.M.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

References

1. Özsoy G, Özsoy İ, İlçin N, Tekin N, Savcı S. Yaşlı bireylerde denge, fonksiyonel egzersiz kapasitesi ve periferal kas kuvveti arasındaki ilişki. SDÜ SBE 2017;8:28-32.
2. Talmage CA, Coon DW, Dugger BN, Knopf RC, O'Connor KA, Schofield SA. Social Leisure Activity, Physical Activity, and Valuation of Life: Findings from a Longevity Study. Act Adapt Aging 2020;44:61-84.
3. Ferraro KF. Self-ratings of health among the old and the old-old. J Health Soc Behav 1980;21:377-383.
4. Becchetti L, Giachin Ricca E, Pelloni A. The relationship between social leisure and life satisfaction: Causality and policy implications. Soc Indic Res 2012;108:453-490.
5. Pruchno R, Carr D. Successful Aging 2.0: Resilience and Beyond. J Gerontol B Psychol Sci Soc Sci 2017;72:201-203.
6. Health Do, Human Services UJNCfCDP, Promotion H. Physical activity and health: a report of the Surgeon General. US Department of Health and Human Services, Centers for Disease Control and ...; JAMA 1996.
7. Ayvat E, Kilinç M, Kirdi N. The Turkish version of the Physical Activity Scale for the Elderly (PASE): its cultural adaptation, validation, and reliability. Turk J Med Sci 2017;47:908-915.
8. Carta MG, Cossu G, Pintus E, Zaccheddu R, Callia O, Conti G, Pintus M, Aviles Gonzalez CI, Massidda MV, Mura G, Sardu C, Contu P, Minerba L, Demontis R, Pau M, Finco G, Cocco E, Penna MP, Orr G, Kalcev G, Cabras F, Lorrai S, Loviselli A, Velluzzi F, Monticone M, Cacace E, Musu M, Rongioletti F, Cauli A, Ruggiero V, Scano A, Crisafulli A, Cosentino S, Atzori L, Massa E, Mela Q, Fortin D, Migliaccio G, Machado S, Romano F, Preti A. Moderate Exercise Improves Cognitive Function in Healthy Elderly People: Results of a Randomized Controlled Trial. Clin Pract Epidemiol Ment Health 2021;17:75-80.
9. Yarmohammadi S, Mozafar Saadati H, Ghaffari M, Ramezankhani A. A systematic review of barriers and motivators to physical activity in elderly adults in Iran and worldwide. Epidemiol Health 2019;41:e2019049.
10. Hairi NN, Cumming RG, Naganathan V, Handelsman DJ, Le Couteur DG, Creasey H, Waite LM, Seibel MJ, Sambrook PN. Loss of muscle strength, mass (sarcopenia), and quality (specific force) and its relationship with functional limitation and physical disability: the Concord Health and Ageing in Men Project. J Am Geriatr Soc 2010;58:2055-2062.
11. Hurst C, Weston KL, McLaren SJ, Weston M. The effects of same-session combined exercise training on cardiorespiratory and functional fitness in older adults: a systematic review and meta-analysis. Aging Clin Exp Res 2019;31:1701-1717.
12. Layec G, Trinity JD, Hart CR, Le Fur Y, Zhao J, Reese V, Jeong EK, Richardson RS. Impaired Muscle Efficiency but Preserved Peripheral Hemodynamics and Mitochondrial Function With Advancing Age: Evidence From Exercise in the Young, Old, and Oldest-Old. J Gerontol A Biol Sci Med Sci 2018;73:1303-1312.
13. Ho HH, Fang IY, Yu YC, Huang YP, Kuo IL, Wang LT, Tsai MC, Chang SH, Hsueh MC. Is functional fitness performance a useful predictor of risk of falls among community-dwelling older adults? Arch Public Health 2021;79:108.
14. Wanigatunga AA, Simonsick EM, Zipunnikov V, Spira AP, Studenski S, Ferrucci L, Schrack JA. Perceived Fatigability and Objective Physical Activity in Mid- to Late-Life. J Gerontol A Biol Sci Med Sci 2018;73:630-635.
15. Copeland JL, Good J, Dogra S. Strength training is associated with better functional fitness and perceived healthy aging among physically active older adults: a cross-sectional analysis of the Canadian Longitudinal Study on Aging. Aging Clin Exp Res 2019;31:1257-1263.
16. Sjögren K, Stjernberg L. A gender perspective on factors that influence outdoor recreational physical activity among the elderly. BMC Geriatr 2010;10:34.
17. Leslie E, Fotheringham MJ, Owen N, Bauman A. Age-related differences in physical activity levels of young adults. Med Sci Sports Exerc 2001;33:255-258.
18. Bernstein MS, Costanza MC, Morabia A. Physical activity of urban adults: a general population survey in Geneva. Soz Praventivmed 2001;46:49-59.
19. Stahl ST, Albert SM. Gender differences in physical activity patterns among older adults who fall. Prev Med 2015;71:94-100.
20. Hwang J, Park S. Gender-Specific Risk Factors and Prevalence for Sarcopenia among Community-Dwelling Young-Old Adults. Int J Environ Res Public Health 2022;19:7232.
21. Saglam M, Arikan H, Savci S, Inal-Ince D, Bosnak-Guclu M, Karabulut E, Tokgozoglu L. International physical activity questionnaire: reliability and validity of the Turkish version. Percept Mot Skills 2010;111:278-284.
22. Craig CL, Marshall AL, Sjöström M, Bauman AE, Booth ML, Ainsworth BE, Pratt M, Ekelund U, Yngve A, Sallis JF, Oja P. International physical activity questionnaire: 12-country reliability and validity. Med Sci Sports Exerc 2003;35:1381-1395.
23. Nicholas SJ, Lee SJ, Mullaney MJ, Tyler TF, Fukunaga T, Johnson CD, McHugh MP. Functional Outcomes After Double-Row Versus Single-Row Rotator Cuff Repair: A Prospective Randomized Trial. Orthop J Sports Med 2016;4:2325967116667398.

24. Bohannon RW. Reference values for extremity muscle strength obtained by hand-held dynamometry from adults aged 20 to 79 years. Arch Phys Med Rehabi 1997;78:26-32.
25. Guerra-Balic M, Oviedo GR, Javierre C, Fortuño J, Barnet-López S, Niño O, Alamo J, Fernhall B. Reliability and validity of the 6-min walk test in adults and seniors with intellectual disabilities. Res Dev Disabil 2015;47:144-153.
26. Herlofson K, Larsen JP. Measuring fatigue in patients with Parkinson's disease - the Fatigue Severity Scale. Eur J Neurol 2002;9:595-600.
27. Armutlu K, Korkmaz NC, Keser I, Sumbuloglu V, Akbiyik DI, Guney Z, Karabudak R. The validity and reliability of the Fatigue Severity Scale in Turkish multiple sclerosis patients. Int J Rehabil Res 2007;30:81-85
28. Cohen J. A power primer. Psychol Bull 1992;112:155-159.
29. Kostka T, Rahmani A, Berthouze SE, Lacour JR, Bonnefoy M. Quadriceps muscle function in relation to habitual physical activity and VO2max in men and women aged more than 65 years. J Gerontol A Biol Sci Med Sci 2000;55:B481-B488.
30. Çakartaş S, Deniz I, Savcı S, Iskit AT, Varday Yağlı N, Sağlam M, Boşnak Güçlü M, Arıkan H, Kütükçü EÇ. Functional Independence and Muscle Strength in Acute Respiratory Failure with and without Non-Invasive Mechanical Ventilatory Support. Turk J Physiotherapy and Rehab 2020;31:247-254.
31. Calik-Kutukcu E, Arikan H, Saglam M, Vardar-Yagli N, Oksuz C, Inal-Ince D, Savci S, Duger T, Coplu L. Arm strength training improves activities of daily living and occupational performance in patients with COPD. Clin Respir J 2017;11:820-832.
32. Orfila F, Ferrer M, Lamarca R, Tebe C, Domingo-Salvany A, Alonso J. Gender differences in health-related quality of life among the elderly: the role of objective functional capacity and chronic conditions. Soc Sci Med 2006;63:2367-2380.
33. Katsiaras A, Newman AB, Kriska A, Brach J, Krishnaswami S, Feingold E, Kritchevsky SB, Li R, Harris TB, Schwartz A, Goodpaster BH. Skeletal muscle fatigue, strength, and quality in the elderly: the Health ABC Study. J Appl Physiol (1985) 2005;99:210-216.
34. Okecka-Szymanska J, Hübner-Wozniak E, Piatkowska I, Malara MJBHK. Effects of age, gender and physical activity on plasma lipid profile. Biomedical Human Kinetics 2011;3:1.
35. Goodpaster BH, Park SW, Harris TB, Kritchevsky SB, Nevitt M, Schwartz AV, Simonsick EM, Tylavsky FA, Visser M, Newman AB. The loss of skeletal muscle strength, mass, and quality in older adults: the health, aging and body composition study. J Gerontol A Biol Sci Med Sci 2006;61:1059-1064.
36. Frontera WR, Hughes VA, Fielding RA, Fiatarone MA, Evans WJ, Roubenoff R. Aging of skeletal muscle: a 12-yr longitudinal study. J Appl Physiol (1985) 2000;88:1321-1326.
37. Pradhan A, Malagon G, Lagacy R, Chester V, Kuruganti U. Effect of age and sex on strength and spatial electromyography during knee extension. J Physiol Anthropol 2020;39:11.
38. Fayet G, Rouche A, Hogrel JY, Tomé FM, Fardeau M. Age-related morphological changes of the deltoid muscle from 50 to 79 years of age. Acta Neuropathol 2001;101:358-366.
39. Bullo V, Roma E, Gobbo S, Duregon F, Bergamo M, Bianchini G, Doria E, Cugusi L, Blasio AD, Bocalini DS, Ermolao A, Bergamin M. Lower Limb Strength Profile in Elderly with Different Pathologies: Comparisons with Healthy Subjects. Geriatrics (Basel) 2020;5:83.
40. Simões LA, Dias JM, Marinho KC, Pinto CL, Britto RR. Relação da função muscular respiratória e de membros inferiores de idosos comunitários com a capacidade funcional avaliada por teste de caminhada [Relationship between functional capacity assessed by walking test and respiratory and lower limb muscle function in community-dwelling elders]. Rev Bras Fisioter 2010;14:24-30.
41. LaSorda KR, Gmelin T, Kuipers AL, Boudreau RM, Santanasto AJ, Christensen K, Renner SW, Wojczynski MK, Andersen SL, Cosentino S, Glynn NW. Epidemiology of Perceived Physical Fatigability in Older Adults: The Long Life Family Study. J Gerontol A Biol Sci Med Sci 2020;75:e81-e88.
42. Tornero-Aguilera JF, Jimenez-Morcillo J, Rubio-Zarapuz A, Clemente-Suárez VJ. Central and Peripheral Fatigue in Physical Exercise Explained: A Narrative Review. Int J Environ Res Public Health 2022;19:3909.
43. Taheri M, Irandoust K, Moddaberi SJ. The effects of weight-bearing exercise on postural control and fatigue index of elderly males IAHS 2019;6:122.