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# A comparison of veteran athletes and sedentary individuals in terms of dynamic-static balance and cognitive functions

Fatma Kizilay[1], Burak Bugday[2]

[1]Inonu University, Faculty of Health Sciences, Department of Physical Therapy and Rehabilitation, Malatya, Türkiye
[2]Inonu University, Vocational School of Health Services, Department of Therapy and Rehabilitation, Malatya, Türkiye

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## Abstract

There is strong evidence that physically active lifestyle has positive effects on healthy aging, primary and secondary prevention of the development of chronic diseases. The physical and cognitive health benefits of having an active past are less well-known. Therefore, this study aimed to compare veteran athletes with an active sports history with their sedentary peers in terms of balance and cognitive function. Fourteen veteran soccer players and 15 sedentary male volunteers aged between 35-55 years participated in the study. The demographic characteristics of the participants were questioned with a case report form. Participants' balance was evaluated statically and dynamically. Static balance was assessed using the Flamingo test and dynamic balance was assessed with the Y Balance test. The Montreal Cognitive Assessment (MoCA) was used to test cognitive functions. There was no difference between Veteran Athletes (VA) and Sedentary Participants (SP) in terms of static balance test scores with both right and left sides ($p>0.05$). The results of the VA group were significantly higher ($p<0.05$) in terms of the total scores of the Y balance test, which consisted of the average of the anterior (ANT), posterolateral (PL), and posteromedial (PM) reaches ($p<0.05$). In terms of MoCA score, the VA group obtained significantly higher results compared to the SP group ($p<0.05$). Veteran athletes were found to be superior to same-aged sedentary in terms of dynamic balance and cognitive function. Having an active sporting background can help to mitigate the loss of physical skills such as balance and cognitive functioning that inevitably occurs during the natural aging process. In addition, active old age is also crucial for the preservation of these skills.

**Key words:** Ageing, balance, cognitive function, physical activity, veteran athlete

## Introduction

Veteran athletes can generally be defined as healthy people who train regularly throughout their lives and try to maintain their performance levels for as long as possible [1]. Although there is no general classification regarding the age of veteran athletes, women aged 35 years and older, men aged 40 years and older, and according to some sources, 'retired athletes' aged 50 years and older are considered veteran athletes [2]. Particular physical health benefits that veteran athletes gain from lifelong activity are well documented. Lifelong habit of regular physical activity presents a strong level of evidence for primary and secondary prevention of diseases such as cardiovascular disease, diabetes, cancer, hypertension, obesity, depression, and osteoporosis [3]. In addition, participation in physical activity in old age is protective against sarcopenia, falls, and many other conditions that prevent healthy aging, and that physical activity in old age improves independent function, mobility, and cognitive function [4]. The protective role of physical activity in old age seems to have a relatively sufficient level of evidence. However, the literature on cognitive benefits of having an active sporting background, like a valuable legacy from the past, and its effects on functions such as

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**Corresponding Author:** Fatma Kizilay, Inonu University, Faculty of Health Sciences, Department of Physical Therapy and Rehabilitation, Malatya, Türkiye
Email: fatma.kizilay@inonu.edu.tr

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balance, which is rapidly declining with aging, seems to be rather inconclusive. It is a natural process that physical performance declines and motor skills such as strength, coordination, balance, and cognitive functions weaken with aging [5]. However, staying physically active can be a powerful strategy for maintaining quality of life and independent functioning in old age by minimizing the loss of these functions as much as possible. To minimize the risk of fall, improve balance performance, and maintain healthy cognitive function are of great importance in reducing morbidities in old age.

Today, a better understanding of the health benefits of regular sports will lead to an increase in the population participating in sports and in the veteran athlete population in the coming years. This special population with a long history of sports should be examined for cognitive function and balance benefits. The main aim of this study was to compare veteran athletes with a lifestyle characterized by regular physical activity with their peers with a sedentary lifestyle in terms of balance and cognitive function. We hypothesized that veteran athletes would have better scores in terms of balance and cognitive functions.

## Material and Methods

### Study design and setting

The research was designed in a methodological cross-sectional, observational study. The study was single-centered. The article was written according to the STROBE guideline.

### Participants

This is a cross-sectional study. The study included 14 veteran athletes (VA) aged 35-55 years with an active sports history, who had actively played soccer in the past, and 15 age-matched sedentary participants (SP). Those with concomitant chronic diseases and those who had undergone surgical operation within the last 1 year were excluded from the study. Study sample size was calculated using the G-Power 3.1.7 package program (Heinrich-Heine-Universität, Dusseldorf, Germany) with type I error 0.05 and type II error 0.2. The power of the test was determined as 0.8. The minimum number of subjects to be included in the study was determined as 12 in each group for a 5-unit difference to be significant.

### Ethical considerations

The ethics committee approval required for the conduct of the study was obtained from Inonu University Health Sciences Non-Interventional Clinical Research Ethics Committee (2022/4054). The study was conducted in accordance with the principles of the Declaration of Helsinki. The volunteers included in the study were informed about the study and their written informed consent was obtained.

### Evaluations

### Evaluations of sociodemographic and sport spesific characteristics

The same researcher took the measurements of veteran athletes and their sedentary peers. Demographic characteristics and sport-specific information of the participants were questioned with a 16-question case report form prepared by the researchers. A stadiometer with an accuracy of 0.1 m (Seca 213) was used to measure the participants' height. Body weight of the participants were measured using an electronic scale (Tanita TBF 401 A, Japan) with an accuracy of ±100 gr. The resulting value was recorded in kg. Body Mass Index (BMI) calculated using the formula weight/height$^2$ (kg/m$^2$). After determining the descriptive characteristics of the VA and SP groups, the cognitive function of the participants was evaluated first. Then, they completed the static balance test. After a 15-minute rest, they performed the dynamic balance test.

### Evaluation of cognitive function

Cognitive function of the volunteers included in the study was assessed with the Montreal Cognitive Assessment (MoCA) [6]. Permission to use the MoCA for academic purposes was obtained. MoCA is a rapid screening test that can assess mild cognitive impairments. This test assesses 8 different cognitive functions: attention and concentration, executive functions, memory, language, visual structuring skills, abstract thought, calculation, and orientation. The maximum total score that can be obtained from the test is 30. Above 21 points is considered normal. The test was developed by Nasreddine et al. (2005) and Turkish validity studies have been conducted for its use in different fields [7,8]. The Turkish version of the test was answered face-to-face and in physical format by the participants under the supervision of the researchers.

### Evaluation of static-dynamic balance

Participants' balance measurements were evaluated statically and dynamically. The Flamingo balance test was used for static balance assessment and the Y balance test was used for dynamic balance assessment.

For the Flamingo balance test, which is used to measure static balance, a balance board made to EuroFit's standard dimensions was used. The balance board is made by mounting two wooden beams (2cm x 15cm), spaced and perpendicular under two wooden beams (4cm x 3cm x 30cm). The duration of the participants' ability to stand on one leg on the balance board was tested. The participant stood on the balance board with one foot and held their free foot hand on the same side and their free hand was supported by the person performing the test. As soon as the participant felt that they had achieved balance, they let go of the tester's hand and the stopwatch was started at that moment. If the foot was released or the balance was disturbed and the foot left the balance board, the stopwatch was stopped and the time was recorded. The test was terminated if the tested person did not lose balance for 60 seconds [9].

The Y balance test was used for dynamic balance assessment [10,11]. This test was performed on the Y balance test platform. Before the test, the participants' leg length was measured and recorded in centimeters in the supine position bilaterally from

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the anterior superior-iliac point to the distal part of the medial malleolus. During the Y balance test, reaches were tested barefoot, in 3 directions, with anterior reach (ANT) being the distance between the farthest point the participant could reach from the toe of the central foot, and posteriolateral (PL) and posteriomedial (PM) being the distance between the heel of the foot and the farthest point the participant could reach. During the trial, participants were asked to keep their hands on the iliac crest and their heels on the floor and to lightly touch the farthest point with the toe of the reaching foot. Before the measurement, they were taught by the researcher how to apply the test and they were allowed to perform the exercises 6 times [12]. Each participant was given a 2-minute rest period between trials and then asked to perform 3 reaches in each direction. During the measurement, it was considered an error if the participants transferred their body weight to the reaching foot, separated the heel of the stance foot from the floor, or separated their hands from the hips, and the measurement was repeated after the participant was verbally informed. All reaching distances were recorded in centimeters [13]. The scores were normalized for each direction using the formula "(Best Reach Distance/Leg Length) x 100=% best reach distance" to eliminate the leg length factor [14]. The total score value was calculated by averaging the normalized ANT, PL, and PM scores.

### Statistical analysis

The analysis of the data included in the research was carried out with the SPSS-25 (Statistical Program in Social Sciences- IBM, Armonk, NY, USA) package program. The Shapiro Wilk was used to check the normal distribution of the data. The significance level (p) for comparison tests was set as 0.05. Since the variables did not have a normal distribution ($p>0.05$), the analysis was made with non-parametric test methods. In comparisons in independent pairs, since the assumption of normality was not provided, the Mann-Whitney U test was used.

## Results

A total of 29 healthy men with a mean age of 43.86±5.07 years participated in the study. Fourteen individuals in the VA group and 15 individuals in the SP group were compared. There was no statistical difference between the groups in terms of demographic characteristics (age, height, weight, and BMI) between VA and SP groups ($p>0.05$). There was a significant difference in the mean duration of sports participation between veteran athletes and sedentary athletes with no sports history (Table 1, $p<0.05$).

There was no statistically significant difference between VA and SP groups in terms of Flamingo test scores used for static balance evaluation ($p>0.05$). In the Y balance test used for dynamic balance assessment with both right and left extremities, there was a significant difference in the VA group compared to the SP group in terms of reaching scores in all 3 directions (ANT, PL, and PM) and Y-Balance Test-Total scores consisting of the average of 3 reach tests (Table 2, $p<0.05$).

There was a statistically significant difference in the MoCA test score applied to evaluate cognitive function in favor of the VA group compared to the SP group (Table 3, $p<0.05$).

**Table 1.** Comparison of demographic characteristics of veteran athletes and sedentaries

| Variables | VA Group (n=14) | SP Group (n=15) | Test (U) | P value |
|---|---|---|---|---|
| | x±sd<br>med (min–max) | x±sd<br>med (min–max) | | |
| **Age (years)** | 42.71±5.48<br>42.5 (32-52) | 44.93±4.58<br>45 (37-52) | 81.000 | 0.294 |
| **Weight (kg)** | 84.5±6.91<br>85 (74-101) | 87.0±9.06<br>89 (72-100) | 82.000 | 0.312 |
| **Height (cm)** | 178±3.65<br>178 (173-184) | 177.33±5.86<br>177 (164-185) | 99.000 | 0.792 |
| **BMI (kg/m²)** | 26.65±1.81<br>26.31 (23.36-30.07) | 27.65±2.47<br>28.4 (23.51-32.11) | 74.000 | 0.176 |
| **Duration of participation to sport (years)** | 28.07±6.76<br>28.5 (15-39) | 0<br>0 | 00.000 | **0.000** |

VA: veteran athletes, SP: sedentary participants x: main, sd: standard deviation, BMI: body mass index, n: number of participants *Mann Whitney U test

**Table 2.** Comparison of balance parameters of veteran athletes and sedentaries

| Variables | VA Group (n=14) | SP Group (n=15) | Test (U) | P value |
|---|---|---|---|---|
| | x±sd<br>med (min–max) | x±sd<br>med (min–max) | | |
| **Flamingo test (R) (sec.)** | 11.5±2.40<br>12 (7-16) | 11.20±2.11<br>12 (7-14) | 99000 | 0.790 |
| **Flamingo test (L) (sec.)** | 10.71±6.91<br>11 (7-15) | 11.46±1.80<br>12 (8-14) | 82000 | 0.307 |
| **Y-balance test-ANT (R) (cm)** | 73.07±4.79<br>73.5 (64-81) | 65.73±3.36<br>66 (60-71) | 24500 | **0.000** |
| **Y-balance test-PL (R) (cm)** | 110.57±4.38<br>110 (104-120) | 104.33±3.65<br>105 (98-110) | 26500 | **0.001** |
| **Y-balance test-PM (R) (cm)** | 111.21±4.59<br>111.5 (102-119) | 104.26±4.30<br>104 (98-115) | 27500 | **0.001** |
| **Y-balance test-Total (R)** | 98.28±4.33<br>98.33 (90-106) | 91.44±3.27<br>92 (86-96) | 19500 | **0.000** |
| **Y-balance test-ANT (L) (cm)** | 73.42±4.97<br>75 (63-80) | 66.20±3.44<br>66 (62-72) | 25500 | **0.000** |
| **Y-balance test-PL (L) (cm)** | 111.71±4.61<br>112.5 (103-119) | 104.13±2.89<br>104 (100-110) | 18000 | **0.000** |
| **Y-balance test-PM (L) (cm)** | 111.5±4.27<br>112.5 (103-118) | 104.40±4.13<br>103 (99-114) | 27000 | **0.001** |
| **Y-balance test-total (L)** | 107.16±4.29<br>108 (98-114) | 99.99±3.19<br>99 (95-106) | 18500 | **0.000** |

VA: veteran athletes, SP: sedentary participants x: main, sd: standard deviation, R: right, L: left, ANT: anterior, PL: posteriolateral, PM: posteriomedial, n: number of participants,*Mann Whitney U test

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**Table 3.** Comparison of cognitive function of veteran athletes and sedentaries

| Variables | VA group (n=14) x±sd med (min–max) | SP group (n=15) x±sd med (min–max) | Test (U) | P value |
|---|---|---|---|---|
| **MoCA score** | 25.71±2.36<br>25.5 (21-30) | 22.60±2.06<br>22 (21-28) | 33000 | **0.001** |

VA: veteran athletes, SP: sedentary participants x: main, sd: standard deviation n: number of participants, MoCA: montreal cognitive assessment, *Mann Whitney U test

## Discussion

In this study, we compared veteran athletes with a history of active sports life and sedentary individuals of the same age group in terms of balance and cognitive functions. The dynamic balance and cognitive function scores of veteran athletes were superior to those of their sedentary peers. The importance of physical activity in terms of health gains at all ages has been the subject of research [15]. There is strong evidence that regular physical activity participation in adults is effective in the primary and secondary prevention of chronic diseases that lead to mortality and morbidity such as cardiovascular diseases, diabetes, cancer, obesity, depression, and osteoporosis [3]. Participation in physical activity in old age has been shown to be protective against sarcopenia, falls, and many other conditions that prevent healthy aging; again, physical activity in old age has been shown to improve independent function, mobility, and cognitive function [4]. Physical competence decreases during the aging process, even in the presence of lifelong, rigorous, and demanding exercise, but senior athletes are superior to non-athletes in terms of physical competence, but this advantage disappears with increasing age [16]. The age range of the veterans who participated in our study was 35-55 years and all of them were retired soccer players. When we compared veterans with sedentary individuals in terms of balance performance, which is an important element of physical performance and perhaps the most affected skill by aging, there was no statistically significant superiority in the static balance scores of veterans against their sedentary counterparts ($p>0.05$). However, veteran athletes were significantly superior in both right and left sided tests in terms of anterior, posteriolateral, and posteriomedial aspects of the Y balance test and total balance scores ($p<0.05$). Nikolaidou et al. (2023) compared veteran female volleyball players with non-athlete recreationally active women and sedentary women in terms of balance and vertical jump performance. They reported that jump height, maximal power, and one-leg balance performance of the group consisting of veteran volleyball players and active women were superior to sedentary individuals, but there was no difference between the groups in the open/closed balance test performed on two legs. In our study, similar to the results of their study, dynamic balance scores in the group of veteran soccer players were superior to the sedentary group, but similar results were obtained with the sedentary group in terms of Flamingo test scores, which we applied as a single leg static balance test. We already have more literature on the physical performance and cognitive gains of physically active people, but there are really limited studies on the physical and cognitive gains of 'veteran' athletes. Although the preservation of cognitive function in old age is a current topic of study, there are very limited results in the available literature on the cognitive function of people who were active in the past [17]. Rostami and Rezaee (2014) used sport imagery to predict cognitive and motivational functions in veteran basketball players. They reported a negative correlation between age and sport imagery function. This study is important in terms of demonstrating that even veteran athletes experience losses in cognitive function with age, but it does not provide a comparison with sedentary individuals [18]. Tanaka et al. (2011), in a review article on veteran athletes, stated that the decline in cognitive functions with aging may be less in veteran athletes, but this has not been presented as clear results [19]. Tseng et al. (2013) compared veteran master athletes over 70 years of age with their sedentary peers in terms of executive functions and reported that master athletes had better performance. Although executive functions were not tested in our study, it is known that all areas of cognitive function are interrelated [20]. The results of our study support the general hypothesis that the effect of the decline in neurocognitive functions with aging on cognitive function can be reduced by an active sports life. As a matter of fact, we observed that the veteran athletes, whom we examined using the MoCA, a current cognitive function test, received superior results compared to sedentary athletes.

## Conclusion

In conclusion, we compared a group of veteran athletes, who actively played soccer in the past, with their sedentary peers in terms of balance and cognitive function clearly reveal that veteran athletes have superior skill levels in terms of dynamic balance skills and cognitive function than sedentary peers. The two groups had similar scores in terms of the static balance parameter. Lifelong physical activity helps to reduce the decline in both physical function and neurocognitive skills during the natural aging process. In the light of all our study results and the literature reviewed, we can say that having a physically active life in the past and participating in regular physical activity in old age is a very powerful strategy to preserve physical and cognitive skills that are destined to decline.

One of the limitations of our study is that it was conducted with a small number of participants. Another limitation is that only former soccer players could be included in the study as veteran athletes. Future studies that will include more participants and examine veteran athletes from different branches may provide more extensive data about the lifelong gains of veteran athletes through lifelong sports.

**Conflict of interests**
*The authors declare that there is no conflict of interest in the study.*

**Financial Disclosure**
*The authors declare that they have received no financial support for the study.*

**Ethical approval**
*The study was approved by the İnönü University Non-Invasive Clinical Research and Publication Ethics Committee (Decision No: 2022/4054).*

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