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The Postural Balance of Elderly Men Is Enhanced by Islamic Prayer

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ABSTRACT

Introduction: Islamic prayer has several components that enhance physical and mental health. This study aimed to evaluate the impact of prayer on balance control.

Materials and Methods: Thirty healthy elderly men were divided into two groups in the study: One group (n=15) consisted of people who regularly prayed (WP). Another group (n=15) who did not pray (WOP) was matched on various factors with the praying group, such as demographics, lifestyle, physical and psychological abilities, cognitive abilities, and heart rate variability (HRV) indices. Biodex recorded the balance indexes under simple and dual-task conditions. Mann-Whitney and Pearson chi-square tests were used for non-parametric analyses, while t-test and analysis of covariance (ANCOVA) were used for parametric analyses and to balance variables. The tests were conducted from 9:00 to 13:00.

Results: ANCOVA showed that the overall, Ant-Post, and Med-Lat balance index values in simple and dual-task conditions were significantly lower in the WP group than in the WOP group ($P<0.05$). Age was considered a covariate. Other variables that influence balance control, such as demographics, lifestyle, psychological and physical health, cognitive abilities, and changes in HRV during tests, did not differ significantly between the groups.

Conclusion: Islamic prayer is associated with improved balance control in elderly men, independent of other effective factors. It can be used as a physiotherapy intervention for the elderly.

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Introduction

Balance control and falls in the elderly population are significantly affected by physical performance and mental health (MH) within the lifestyle context [1, 2]. Maintaining and improving balance control as people age requires an active lifestyle that includes regular physical activity, especially exercises that target strength, balance, coordination, and flexibility [3].

Islamic prayer can provide balance training for the elderly and others through its physical postures and movements, which are repeated several times a day. Prayer posture changes act as slow, moderate exercises that help strengthen muscles, improve flexibility, especially in the spine and lower limbs, and enhance dynamic balance by promoting better displacement of the center of gravity around the base of support [4, 5]. The risk of falls and related injuries in the elderly can be reduced by improving their balance.

A case-control study consisted of 81 elderly participants in two groups: one group who regularly performed prayer in all positions compared to an age and body mass index (BMI)-matched group without performing prayer, showed that regular prayer involves a series of movements, such as standing, bowing, prostrating, and sitting, which stimulate and challenge the body's balance systems, including the visual, vestibular, and proprioceptive systems. They found that prayer improves functional balance scores on the Berg scale and reduces fear of falling [6]. Unfortunately, this study did not consider other confounding factors, such as physical, mental, and general health levels, psychological status, and cognitive functions, and did not examine the device's balance responses with high precision. Another study showed that the 17 participants who regularly performed Islamic prayer did not have a high or medium risk of falling based on the Berg Balance Score, compared to 10 participants who did not pray (WOP) regularly [7]. Although these studies did not control for lifestyle factors and cognitive abilities, they may influence balance performance. Cognitive function and balance are linked to physical performance in middle-aged and older adults [8].

Furthermore, Islamic prayers incorporate physical and meditative components that enhance physiological functions related to balance and fall prevention. According to Hatef et al. Islamic prayer can improve cortisol concentration and heart rate variability (HRV) to optimal levels after four rakats of prayer in participants who regularly pray [9, 10]. Therefore, Islamic prayer has several potential benefits for improving mental and physical health [11] that require more controlled studies.

This study aimed to compare the Biodex balance indices in simple and dual tasks between elderly men who pray and those who do not pray, matching them by age, BMI, lifestyle, psychological and physical health factors, cognitive abilities, and HRV state. The study's hypothesis was that, although many interaction factors were controlled, prayer still affected balance control.

Materials and Methods

Study design

The study design was a matched observational study. Two groups of elderly men were compared. The men who regularly perform Islamic prayer (WP) and men who do not perform prayer (WOP). Dependent variables included the amount of angular displacement of subjects on the Biodex device in the medial-lateral, anterior-posterior, and overall planes, as well as the duration of stay in each quadrant of the plane. Confounding variables that were controlled for included age, weight, height, marital status, employment status, income, physical activity level, dietary habits, recreational use of the Internet, recent stressors, common diseases of aging, stress, anxiety, and depression levels, health subscales based on short form health survey-36 (SF-36), cognitive ability scores of flexibility, attention, and inhibition, control, and HRV before and after cognitive tests. This study was performed in accordance with the principles of the Declaration of Helsinki. All participants entered the study with consent and signed a consent form after being informed about the experimental procedures.

Participants

The participants in this study were men living in Tehran, aged 63-70 years. The inclusion criteria included the ability to perform physical activities and normal cognitive levels. None of the participants had a history of spine or skull surgery. They had no heart disease that required the use of heart medications. They had no spinal or joint pain that prevented them from doing daily activities. They had no psychological disorders that required the use of medications. The WP prayer group performed all prayer movements correctly and completely three times a day. Overall, they performed at least 17 rakats of prayer for 20-30 minutes every day for a year. The WOP group did not perform Islamic prayers for at least a year.

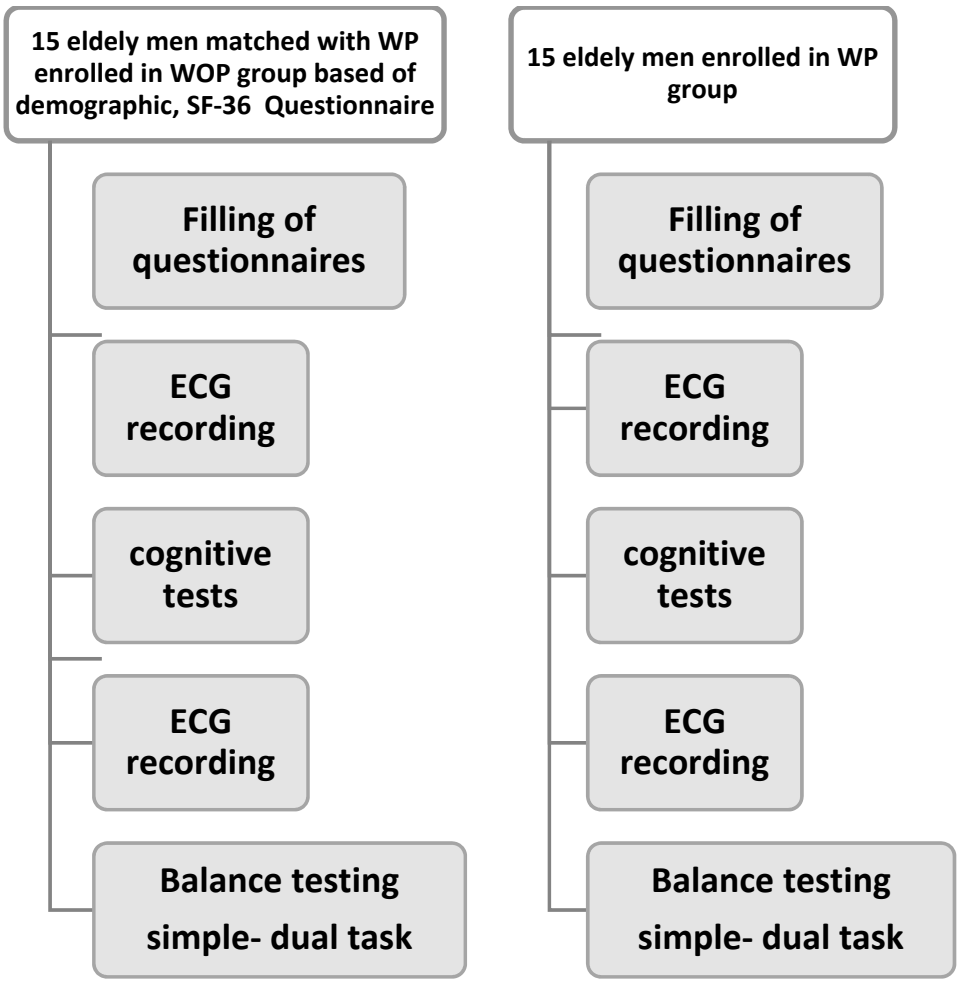

Figure 1. The steps of study in both groups

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Study procedure

To prevent confounding factors, several questionnaires were administered to collect demographic characteristics (age and BMI), lifestyle components, such as employment status, income level, type of diet, new stressful events, common diseases (diabetes, high blood pressure, low back pain, and knee pain), and engagement in activities on the Internet before the participants entered the study. The SF-36 questionnaire was administered to assess physical and MH components; the depression and anxiety stress score-42 (DASS) questionnaire was used to determine levels of anxiety, stress, and depression; and the IPAQ was used to quantify physical activity. Any WOP participant who had a large difference from the average value with respect to age, BMI, physical activity level, SF-36, and DASS scores relative to the WP group was excluded from the study. After that, the subjects began testing. First, their electrocardiogram (ECG) was recorded for two minutes in a sitting position. Then, three computerized cognitive tests (Flanker, Wisconsin Sorting Cards, and Oddball test) were administered. The ECG was recorded for two minutes [10] again in a sitting position. After that, the subjects were placed on the Biodex device. The Biodex tests were conducted after a thorough explanation. The tests were conducted from 9:00 to 13:00. Figure 1 shows the study's process.

Questionnaire DASS-42

The DASS-42 questionnaire was completed in the calm atmosphere of the exam room. The participants completed the questionnaire after careful instruction tailored to their living conditions. In three sections, the form contained 14 questions that reported levels of depression, anxiety, and stress based on scores obtained on a 4-point scale [12].

SF-36 questionnaire

The SF-36 is a self-administered questionnaire with 36 items. It measures health across eight multi-item scales, covering functional status, well-being, and overall health. Physical functioning (PF) consists of PF, role limitations (physical) (RP), pain (P), and general health (GH). Mental functioning consists of social functioning (SF), emotional role limitations (ER), MH, and energy (E). The Cronbach's α for each summary measurement was 0.79. In addition, Cronbach's α for the 8 scales was 0.87 for the Persian version of SF-36 [13].

International physical activity questionnaire

The international physical activity questionnaire (IPAQ) was used to assess habitual PA during the past 7 days. The short form contains seven items, including the number of days per week, the amount of time spent on moderate, vigorous, and walking activities, and the time spent on moderate and vigorous activities. The questionnaire asks two questions regarding sitting time as an indicator of sedentary behavior. The IPAQ data were transformed into metabolic equivalent scores (metabolic equivalent of task [MET]-min-week) by combining the minutes dedicated to each activity category with the specific MET score for that activity. The MET score measures the energy expenditure of each type of activity. In adults, one MET is equivalent to the energy expenditure at rest and is approximately 3.5 mL O_2/kg/min. The IPAQ's scoring system classified physical activity levels into three groups: Inactive, minimally active, and health-enhancing physically active. The Iranian version of IPAQ is consistently based on Cronbach's α coefficient (0.7). The Spearman-Brown correlation coefficient (0.9) also demonstrated excellent reliability in test-re-test [14].

Cognitive tests

Three cognitive tasks were performed in this study: Flanker, Oddball, and the Wisconsin card sorting test (WCST). They were conducted using the Psychology Experiment Building Language Battery in a randomized order for participants. Figure 2 shows the screen for each test. To measure attention and inhibition control, the Flanker test is a psychological assessment tool. The Flanker test, which psychologist B.A created. Eriksen in the 1970s, serves as the foundation for it [15]. The participants were presented with a central stimulus (typically an arrow) that was flanked by distractor stimuli on either side. Responding to the central arrow requires them to ignore the surrounding distractors. The Flanker test in this study consisted of 200 trials in four blocks. In each block, three randomly chosen conditions were shown to detect the direction of the arrow. Types of trials:

1) congruent trials-the flankers point in the same direction as the target. Example: Respond to the middle arrow; 2) incongruent trials–The flankers point in the opposite direction of the arrow. Example: Respond to the middle arrow and ignore; 3) neutral trials-the flankers are not present.

The score for this task was derived by dividing the average reaction time for incongruent trials by the average reaction time for congruent trials with correct responses.

Executive functions, particularly cognitive flexibility, abstract reasoning, and set-shifting ability, are measured by the widely used neuropsychological assessment tool, the WCST [16]. The structure of the test is:

Stimuli: Participants were shown four reference cards that differed in color (red, blue, green, yellow), shape (triangle, star, cross, circle), and number of symbols (1–4). 1) Task: Participants must sort response cards under the reference cards based on an unstated rule (e.g. color, shape, or number). Feedback ('correct' or 'incorrect') is given after each trial. 2) Rule Shifts: After 10 consecutive correct sorts, the sorting rule changes without warning, requiring the participant to adapt. In this study, a 64-card version was utilized.

The test generates performance indices:

1) The number of perseverative errors: Continuing to use an old rule after it changes (a marker of inflexibility). 2) Time of test: total time used to complete the 64 sorting cards.

The visual oddball task was employed to evaluate attention. During the task, participants were asked to categorize shapes. Only one circle or square was displayed at a time. In each trial, the participant was required to indicate the shape shown. Then one of the two keys was pressed. When they see a circle, they press the left shift key; when they see a square, they press the right shift key. The amount of oddball cost, which consists of the deviation in reaction time minus the standard reaction time, was considered as an index of this test.

Electrocardiogram recording

A biomedical wireless ECG (Liv Intelligent Technology Co., Iran) was used [17]. The three-lead ECG system

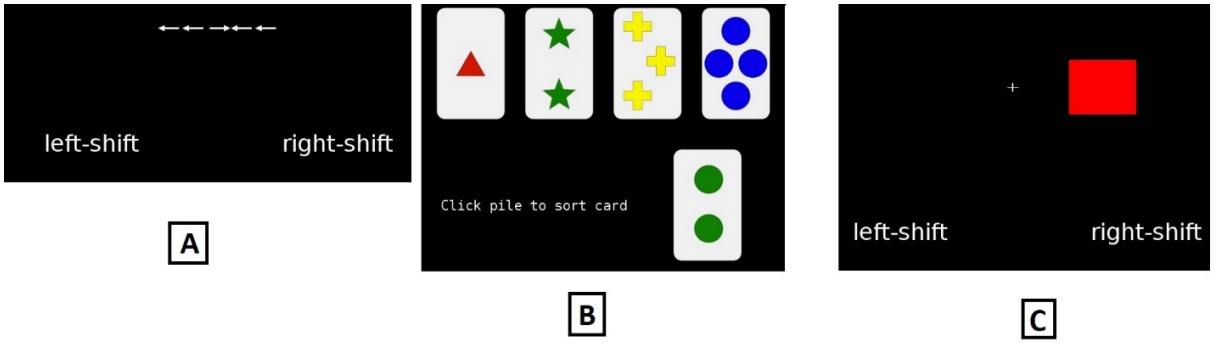

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Figure 2. The screen of three cognitive tasks in this study

A) Flanker, B) Wisconsin card sorting test, C) Oddball

requires one electrode to be placed on the left midclavicular line above the heart position, and the other electrode should be placed on the left sternal border below the heart position. The third electrode was attached to the lower right quadrant of the abdomen [18]. A chest lead and belt were used to fix the electrodes. The data were saved for 2 minutes per test and then transferred to an ADC at a 500 Hz sampling rate. To calculate HRV, we employed the HRV toolbox of MATLAB software, version 2018. Initial processing and signal preprocessing involve removing noise and artifacts (such as body movements and electrical noise), using high-pass (0.5 Hz) and low-pass (30 Hz) filters to remove unwanted frequencies, and finding QRS peaks in the ECG signal, which represent the heart rate. RR intervals were obtained by extracting the time intervals between the detected QRS peaks. The HRV signal was generated using the RR intervals. In the time domain, the mean and SD of the RR series were extracted. In the frequency domain, the percent high frequency (PHF) power (0.15-0.5 Hz), percent low frequency (PLF) power (0.05-0.15 Hz), and percent very low frequency (PVLF) power (0-0.04 Hz) of all power in the frequency domain and the ratio of LF/HF components were measured. The power of each frequency was computed using the Fast Fourier Transform. The nonlinear features extracted were the SD1 and SD2 of the Poincare plot (SD1 PP and SD2 PP), approximate entropy (App_Ent), spectral entropy (Spec_Ent), the alpha and Alpha 1 of the Detrended fluctuation analysis (DFA), Petrosian and Katz fractal dimension (FD) [17-19].

Biodex balance test

Dynamic balance tests were performed using a computerized posturography platform (Biodex Balance System SD Sw 945-300-e627, Canada) with eyes open and arms at the sides of the body. A postural stability test assesses balance index scores, which reflect the subject's weight asymmetry (% time in quadrants) and the extent of anterior/posterior and medial/lateral sway. The analysis used a mean balance index from three trials, and a lower score signified good balance.

Dynamic balance involves the free tilting of the circular foot plate depending on weight shift. The device's stability level was 8, and it was tested three times, each lasting 20 seconds, with a one-minute rest between tests. The model plate was divided into quadrants, and a green line was traced to indicate body weight shifts. Each distance (degree) of the overall, anterior/posterior, and medial/lateral body weight shifts was also measured. The results were recorded as the overall stability index (overall index), the anterior/posterior stability score (AP index), and the medial/lateral stability index (ML index). The AP index is a measure of the difference in platform displacement, in degrees, during sagittal-plane motion. The ML index represents the variance in platform displacement for motion in the frontal plane, and the overall index was determined from the AP and ML indices. A line was drawn on the model plate to indicate body weight shifts, and the time spent in each zone was recorded as a percentage (% of time). The percentage of time in the left with the right and in the anterior with the posterior was measured and compared [20]. The dual task consisted of trying to control balance on the Biodex device and calculate simultaneously. To increase cognitive load, the individual was instructed to add three numbers from one and continuously provide the answer.

Statistical analysis

Different variables were used in this study. Quantitative continuous variables were used to measure time spent on cognitive tests, Biodex balance testing, and HRV indices. The questionnaire scores and number of errors were quantitatively discrete variables. To determine normality, the One-Sample Kolmogorov-Smirnov Test was performed on quantitative continuous data. Parametric tests, such as t-test and analysis of covariance (ANCOVA), were utilized if the data distribution was normal, such as balance indices. Quantitative discrete variables and HRV indices were analyzed using the nonparametric Mann-Whitney test. Although the two groups did not

Table 1. The Mean±SD, and P for comparing two groups, WP and WOP, based on demographic, cognitive abilities, physical, and psychological properties (n=15)

	Variables	Mean±SD/No.		P
		WP	WOP	
General properties	Age	65.6±1.6	66.9±2.2	0.074
	BMI	0.27±0.3	0.27±0.1	0.918
	Job status N (employee/retired)	7/8	5/10	0.35
	Monthly income N (poor/moderate/good/very good)	0/5/10/0	0/10/1/4	0.001*
	Stressful events N (economic/family and emotional/ both)	0/2/1	1/3/0	0.35
	Disease N (diabetes/blood pressure/both)	2/2/2	3/3/2	0.94
	Diet style N (fast food more than once a week/high consumption of high-fat and salt foods/low consumption of dairy products and fruits Loss of appetite)	3/0/1/2	2/1/1/2	0.75
	Internet use for entertainment N (less than 20 hours in the week/more than 20 hours in the week)	12/3	10/5	0.34
Cognitive tests	Flanker index	87.88±42	99.56±40	0.44
	Wisconsin error percent	11.56±3.1	12.9±3	0.2*
	Wisconsin time (s)	197.62±70	207.81±61	0.34
	Oddball error	1.4±1.1	1.2±0.9	0.74
	Oddball cost	40.3±109	49.65±326	0.21
Psychological and physical factors	DASS-42	14.73±9.4	16.13±8	0.46
	DASS-stress	7.86±5.5	8.26±5.1	0.53
	DASS-anxiety	1.93±3.3	2.26±1.6	0.16
	DASS-depression	4.93±3.3	5.6±3.3	0.87
	SF36-total	84.55±6.7	78.92±10.6	0.13
	SF36-PF	88±6.2	79.33±9.7	0.02
	SF36-RP	93.33±11.4	88.33±15.9	0.48
	SF36-P	82.66±15.4	84.5±14.5	0.71
	SF36-GH	74.66±11.2	77.66±16.3	0.48
	SF36-ER	95.55±11.7	84.44±24.7	0.34
	SF36-MH	78±13.7	80.66±11.3	0.59
	SF36-E	85.86±15.4	87±9.5	0.74
	SF36-SF	92.5±12.3	83.33±16.8	0.30
	IPAQ	37±8.8	29.65±12.9	0.11
	IPAQ_sitting	5.2±1.8	4.46±0.9	0.17

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Abbreviations: DASS: Depression anxiety stress score; SF36: Short form health survey; PF: Physical functioning; RP: Role limitations (physical); P: Pain; GH: General health; ER: Emotional role limitations; MH: Mental health; E: Energy; SF: Social functioning; IPAQ: International physical activity questionnaire; BMI: Body mass index.

*Significant.

Table 2. The Mean±SD of HRV indices in two groups, WP and WOP, before and after cognitive tests

Variables	Mean±SD			
	WP		WOP	
	B	A	B	A
MEAN R-R	0.9±0.311	0.888±0.305	0.859±0.136	0.862±0.11
SD R-R	0.153±0.062	0.153±0.06	0.179±0.06	0.206±0.077
PVLF	78.883±40.861	82.213±29.754	95.462±35.82	90.648±29
PLF	31.479±6.382	33.088±6.572	34.071±3.537	34.476±4.869
PHF	68.521±6.382	66.912±6.572	65.929±3.537	65.524±4.869
LF/HF	0.471±0.135	0.507±0.138	0.521±0.08	0.535±0.121
SD1_PP	0.187±0.083	0.179±0.081	0.203±0.056	0.212±0.048
SD2_PP	0.097±0.059	0.106±0.068	0.139±0.092	0.184±0.128
APP_ENT	0.767±0.225	0.814±0.252	0.841±0.242	0.819±0.197
SPEC_ENT	6.674±0.327	6.708±0.282	6.794±0.241	6.822±0.253
DFA_ALPHA	0.087±0.096	0.083±0.063	0.089±0.075	0.104±0.074
DFA_ ALPHA1	0.087±0.096	0.083±0.063	0.089±0.075	0.104±0.074
PETROSIAN _FD	0.999997±0.000004	0.999997±0.000003	0.999995±0.000004	0.999996±0.000002
KATZ_FD	6.581±4.145	6.665±4.865	5.899±4.029	5.116±2.316

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Abbreviations: PHF: Percent high frequency; PLF: Percent low frequency; PVLF: Percent very low frequency; LF/HF: Low frequency/high frequency; SD1 PP and SD2 PP: SD1 and SD2 of the Poincare plot; App_Ent: Approximate entropy; Spec_Ent: Spectral entropy; DFA: Detrended fluctuation analysis; FD: Fractal dimension.

differ significantly in age, ANCOVA was conducted to examine balance indices with age as a covariate because it was correlated with balance indices. General property, job status, monthly income, stressful events, type of disease, diet style, and internet use for entertainment were measured using the Pearson chi-square test. $P<0.05$ were considered to be significant.

Results

After the volunteers arrived, suitable individuals were selected, and tests and questionnaires were administered. Data from 15 people in each group (WP and WOP) were analyzed. Table 1 shows that no significant differences were observed in general demographic characteristics, such as age, BMI, employment status, diseases, eating style, recreational internet use, and stressful events, between the two groups. Only the income distribution differed significantly between them. Regarding the cognitive ability tests, measuring inhibitory control, flexibility, and attention, no significant difference was observed between the WP and WOP groups. Regarding psychological characteristics to assess the level of stress, anxiety, and depression based on the DASS and MH based on the SF-36 in the dimensions of emotional health, fatigue, SF, pain, and general health, no significant difference was observed between the two groups. On the physical health subscale of the SF-36, the WP group had a higher score than the WOP group. There was no significant difference in physical activity level between the IPAQ and IPAQ subscales.

Mean±SD of HRV features before and after the cognitive tests. According to the results, there was no significant difference between the groups before and after the cognitive tests (Table 2).

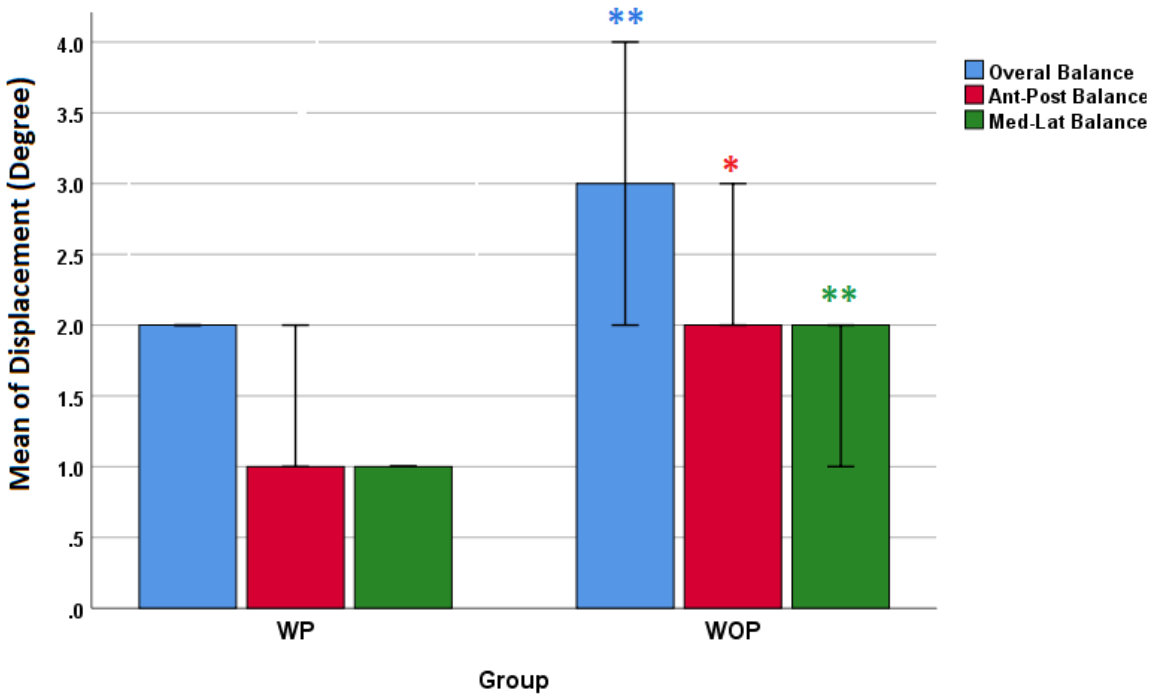

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Figure 3. The Mean and 95% CI of three balance indexes, overall, ant-post, and med-lat balance index, in the WP and WOP groups

*P<0.05, **P<0.01.

Note: According to ANCOVA, the WP group had significantly superior balance indices than the WOP group. The stars display significant color changes depending on the variables.

Analysis of balance indicators showed that the WOP group had significantly weaker control in maintaining balance, which means they have more displacement in the overall (P=0.006, partial Eta squared (η_p^2)=0.245), Ant-Post (P=0.05, η_p^2=0.13), and Med-Lat (P=0.009, η_p^2=l0.227) balance index after the plate was titled (Figure 3).

In the double task (balance control with cognitive load), the WOP group had significantly greater deviations in three overall (P=0.002, η_p^2=0.316), Ant-Post (P=0.003, η_p^2=0.277), and Med-Lat (P=0.049, η_p^2=0.136) indices of the Biodex test (Figure 4). However, no significant difference was observed between the two groups in the percentage of time spent on the right or left side, or in front or back.

Discussion

In this study, confounding factors in balance control in elderly men were controlled to examine the impact of prayer on postural balance. The results showed that demographic factors, such as age, BMI, occupation, diet type, time spent on the Internet, common diseases, severe stress, and income level, did not differ significantly between the two groups of WP and WOP. On the other hand, no significant differences were observed in physical activity levels, pain, MH measures (stress, anxiety, and depression), and cognitive abilities (inhibition control, flexibility, and attention). Even the autonomic response, examined using HRV, did not differ significantly before and after slightly stressful cognitive tests. However, in terms of balance indices under both simple and dual-task conditions, the WP group had a significantly better ability to maintain balance than the WOP group, with age as a covariate. Thus, there is a relationship between prayer and the control of balance. Previous studies also showed that subjects who regularly pray had better scores on the Berg balance test than those WOP. However, they did not control for several confounding factors that affect balance control [6, 7]. Prayer has many elements, such as physical, physiological, and mental elements, that make it a good balancing exercise to repeat many times throughout the day [4, 11]. When praying, the body's center of mass moves forward and backward over a certain distance from the base of support. This

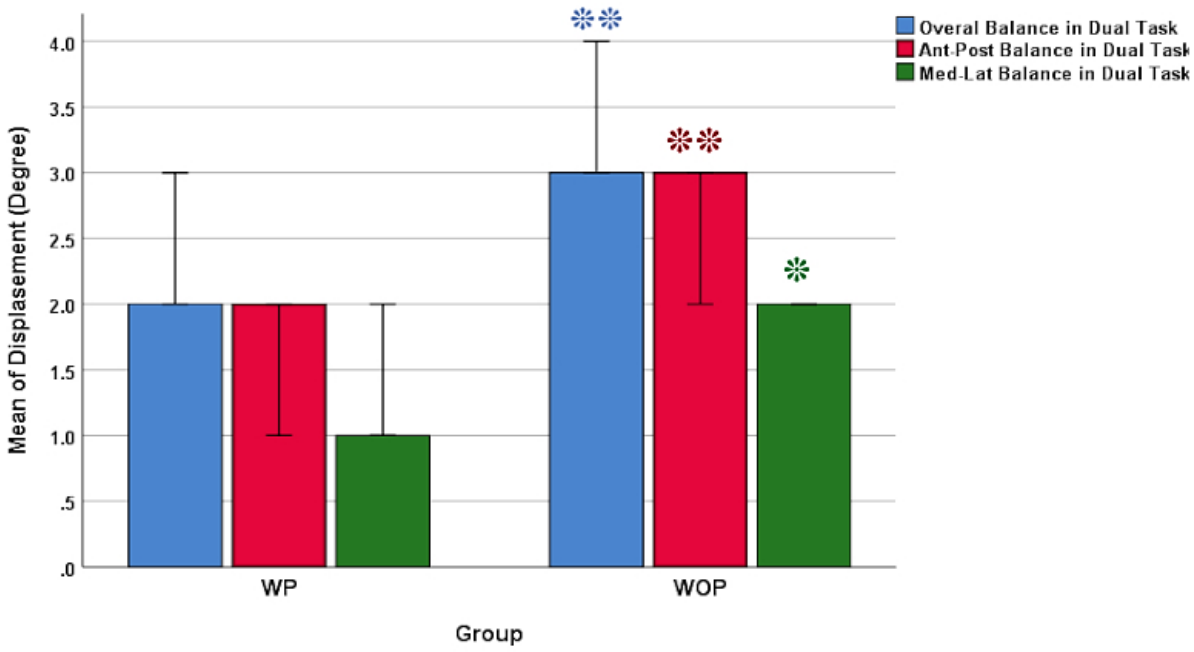

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Figure 4. The mean and 95% CI of three balance indexes, overall, ant-post, and med-lat balance index, in dual tasks in the WP and WOP groups

Note: According to ANCOVA, the WP group had balance indices that were significantly superior to those of the WOP group. The stars exhibited significant color changes based on the variables.

*P<0.05, **P<0.01.

change, especially during the transition from bowing to standing and vice versa, and from sitting to standing, increases the need for worshipers to maintain balance. Furthermore, when a person bows and prostrates, the head being in line with and lower than the heart makes it easier for blood to flow to the brain. As a result, parasympathetic tone rises, which enhances brain and heart function and benefits overall health [9, 10, 21, 22].

Compared to Tai Chi, which is considered a gentle but effective exercise for training balance control and requires at least 45 minutes of practice twice a week [23]. Prayer is repeated 3 to 5 times a day, each time taking about a few minutes. The length of all daily prayers must not exceed 30 minutes. The most significant aspect of prayer is its repetition throughout the day. The study's limitation was that women and young people were not assessed.

Conclusion

The elderly men who regularly prayed had better balance control in simple and dual task conditions more than matched men in terms of age, BMI, occupation, type of diet, spending time on the Internet, common diseases, severe stress, physical activity levels, pain, MH state, stress, anxiety and depression levels, and finally, the cognitive abilities, inhibition control, flexibility and attention and even the response of their autonomic system, which HRV examined. Age was also considered as a covariate. The act of praying takes only a few minutes but has several effects on health. It is suggested that future studies on balance control in elderly and young people compare people who perform prayer with those who perform Tai Chi.

Ethical Considerations

Compliance with ethical guidelines

The study was approved by the Ethics Committee of Baqiyatallah University of Medical Sciences, Tehran, Iran (Code:2024-11-09/ IR.BMSU.BAQ.REC.1403.180).

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Authors' contributions

Material preparation, data collection, and data analysis: Seyed Shahab Mirhajian, Gila Pirzad Jahromi, Abolfazl Mirani, Sousan Salari, and Hossein Mozaffari; Writing the original draft: by Boshra Hatef; Conceptualization, study design, review, editing and final approval: All authors.

Conflict of interest

The authors declared no conflict of interest.

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