



How does osteoporosis affect physical activity level, balance, kinesiophobia, sarcopenia risk and quality of life in the elderly?- A pilot study

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Abstract

Osteoporosis leads to a number of problems, such as falls and fractures. Therefore, it is very important to identify the problems and prevent these risks. With the aging of the world population, senile osteoporosis has gained importance. The aim of this study was to investigate sarcopenia risk, physical activity level, fall risk, kinesiophobia and quality of life in older people with and without osteoporosis. Demographic characteristics of individuals over 65 years of age with and without osteoporosis were noted. The Physical Activity Scale for the Elderly (PASE) questionnaire for the physical activity status of the participants, the Tampa Kinesiophobia Scale (TKS) for fear of movement, the Berg Balance Scale (BBS) for the postural control assessment, the Functional Reach Test (FRT) for the functional balance assessment, the Timed Up and Go Test (TUGT) for functional mobility assessment, the Strength, Assistance, Rise, Climb, Falls (SARC-F) questionnaire for sarcopenia risk, and the QUALEFFO-41 scale for quality of life assessment were used. A total of 71 participants were included in our study. While BBS and FRT results were significantly lower in the osteoporotic group ($p=0.02$, $p=0.01$, respectively), SARC-F scores were significantly higher than in the non-osteoporotic group ($p=0.03$). There was no significant difference in PASE, TKS, TUGT, and QUALEFFO-41 scores between the two groups ($p>0.05$). In the elderly population, the presence of osteoporosis was associated with the risk of balance impairment and sarcopenia but not with kinesiophobia.

Keywords: kinesiophobia, osteoporosis, physical activity level, quality of life, risk of sarcopenia

1. Introduction

Osteoporosis is the most common chronic bone disease, resulting in an increased risk of fracture as a result of low bone mass and deterioration of the micro-architecture of bone tissue (1). Osteoporosis and its complications, especially hip fractures, cause physical, psychological, social, and economic burdens (2). The most basic preventive and therapeutic approach in osteoporosis is physical activity because immobilization is an important risk factor for bone loss (2).

Kinesiophobia is the fear of movement caused by the belief of susceptibility to injury and limits physical activity (2). Sarcopenia, which is defined as a syndrome characterized by generalized and progressive loss of muscle mass and strength, which can lead to poor outcomes such as physical disability, poor quality of life, and death, is an important public health problem in the aging population (3).

In the literature, there are only a few studies evaluating the relationship between osteoporosis and kinesiophobia and examining the effect of Pilates exercise on kinesiophobia in osteoporosis, while there are several studies on osteoporosis and fall risk (2, 4-7). These studies were conducted on the adults, not the elderly population. With the aging of the world population, senile osteoporosis has gained importance. Senile

osteoporosis is associated with aging, so it affects both men and women. The increase in fracture risk and mortality due to balance and vision problems and sarcopenia is higher compared to postmenopausal osteoporosis (8).

The first aim of our study is to compare the sarcopenia risk, physical activity level, risk of falling, kinesiophobia, and quality of life between elderly individuals with and without osteoporosis. The second aim of this study is to analyze the relationship between sarcopenia risk, physical activity level, risk of falling, kinesiophobia, and quality of life in elderly individuals with osteoporosis.

2. Materials and Methods

Individuals aged 65 years and older who applied to our outpatient clinic between December 1, 2020, and February 1, 2021, and had a Bone Mineral Densitometry (BMD) result within the last year were included in our study. Those who volunteered to participate in the study were included, and detailed informed consent was obtained from the participants. Participants were divided into two groups: patients diagnosed with osteoporosis (Group 1, lumbar spine and femoral neck T score ≤ 2.5 SD) according to the definition of the World Health Organization, and those without osteoporosis (Group 2, lumbar

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spine and femoral neck T score > -1 SD) as controls (9).

Inclusion criteria included: 1) age ≥ 65 years, 2) those who have BMD measurement in the last year

Exclusion criteria included: 1) those with mental and auditory problems that prevent communication with researchers, 2) those with severe painful conditions that may cause kinesiophobia (advanced gonarthrosis, advanced intervertebral disc disease, advanced spinal stenosis), 3) people with a history of disease that may affect mobility and balance, such as any neurological or musculoskeletal disease, 4) those with severe systemic disease 5) those with metabolic bone disease other than osteoporosis

The study was performed in accordance with the Declaration of Helsinki, and approved by the Local Ethics Committee (Approval Date: 25.11.2020, Approval Number: E1-20-1319).

The demographic data of the participants (age, gender, body mass index, education, employment, and marital status) were recorded.

Age at menopause and physical activity status assessed by the Physical Activity Scale for the Elderly (PASE) questionnaire were noted (10). PASE is a self-reported scale consisting of 10 questions measuring patients' leisure, domestic, and work-related activities in the past seven days. It has sub-scales such as leisure time activities, housework activities, and work-related activities. Although the total PASE score ranges from 0 to 400, even higher scores indicate a good level of activity. A Turkish validity and reliability study of PASE was conducted (10).

In our study, fear of movement was evaluated with the Tampa Kinesiophobia Scale (TKS). TKS is a 17-item scale developed to measure fear of movement/re-injury. The scale includes parameters of injury/re-injury and fear avoidance in work-related activities. A 4-point Likert score (1= I strongly disagree, 4= I totally agree) is used in the scale. After reversing the 4th, 8th, 12th, and 16th items, the total score is calculated. The person gets a total score between 17-68. A high score on the scale indicates a high level of kinesiophobia. The Turkish version of TKS was shown as valid and reliable (11).

For the evaluation of balance, the Berg Balance Scale (BBS), which was developed for the evaluation of postural control and which has been validated and studied in Turkish, was used (12). Scoring is given as 0-4 on this scale, which evaluates daily activities, including static sitting and standing balance in 14 items, as well as transfers, turning, and picking up objects from the ground. It scores from 4 (normal performance) to 0 (not able to do the movement) according to the person's ability to do what is asked of him/her safely and independently. The total score is 56 points.

The functional balance of the individuals was evaluated with the Functional Reach Test (FRT). The person receiving

the treatment is first asked to extend his arm forward, and the distance he reaches is recorded. They are then asked to reach as far forward as possible without lifting their heels off the ground, and the maximum value they can reach without losing their balance is marked. This measurement is repeated three times and averaged (13).

Functional mobility assessment was done with the Timed Up and Go Test (TUGT). With this test, walking speed, balance, functional level, and ability to go out are measured. In this test, the person is asked to get up from the chair they are sitting in, walk 3 meters at a safe and normal speed, turn, walk back, sit on the chair again, and the time is recorded in seconds. The test starts with the patient's feet flat on the floor and their arms resting on the armrest of the chair. Three repetitions are performed, and the best result is recorded (14). If an elderly individual completes the test for 12 seconds or more; it is defined as a "high risk of falling" (15).

The Strength, Assistance, Rise, Climb, Falls (SARC-F) questionnaire was used for the assessment of sarcopenia risk (16). The SARC-F questionnaire is a questionnaire evaluating a total of 5 parameters: strength, walking, getting up from a chair, climbing stairs and falling. The total score ranges from 0-10, with ≥ 4 points indicating the risk of sarcopenia risk (16-18).

The quality of life of the participants was evaluated with the QUALEFFO-41 scale, which is one of the disease-specific assessment scales. This questionnaire consists of 5 subgroups pain (QUALLEFO-p), physical function (QUALLEFO-pf), social function (QUALLEFO-sf), general health assessment (QUALLEFO-gha) and mental function (QUALLEFO-mf) and includes 41 questions in total (QUALLEFO-t). QUALEFFO-41 is scored between 0-100, with a high score indicating a low quality of life. Turkish version of QUALEFFO-41 was reported to be valid and reliable (19).

Then, demographic and clinical characteristics between the group with and without osteoporosis, PASE, QUALEFFO-41, TKS, TUGT, FRT, SARC-F, and BBS scores, and the relationship between these assessment scales were examined in groups with osteoporosis.

2.1. Statistical Analysis

Data analyses were conducted using Statistical Package for the Social Sciences (SPSS 28.0 for Windows) software. The variables were investigated using visuals (histograms and probability plots) and the Kolmogorov-Smirnov test to determine whether they were normally distributed. In reporting descriptive statistics, the data were expressed as mean \pm standard deviation (SD) for normally distributed continuous variables median (minimum-maximum) for non-normally distributed continuous variables, and frequency and percentage (%) for nominal and categorical variables. The Pearson chi-square test, or Likelihood ratio tests, were used to compare nominal variables and categorical variables between the groups. In addition, the independent samples T-test and Mann-

Whitney U tests were used to compare the continuous values between the groups. The correlation between physical activity, kinesiophobia level, risk of sarcopenia risk, and quality of life in the osteoporosis group was examined by the Spearman correlation test. A p-value less than 0.05 ($p < 0.05$) was accepted as statistically significant.

3. Results

A total of 71 elderly individuals, 33 in the osteoporotic group and 38 in the non-osteoporotic group, with a mean age of 70.01 ± 4.45 years, were included in our study. The comparison of demographic data between the groups is presented in Table 1.

Table 1. Comparison of demographic data between elderly individuals with osteoporosis and without osteoporosis

		Group 1n=33	Group 2n=38	p
Age (years) mean (SD)		70.06 (3.41)	70.01(4.45)	0.48*
BMI mean (SD)		28.73 (4.84)	30.94 (3.31)	0.02*
Gender n(%)	Female	28 (84.8)	32 (84.2)	0.95**
	Male	5 (15.2)	6 (15.8)	
Educational Status n(%)	Illiterate	7 (21.2)	6 (15.8)	0.37**
	Literate	7 (21.2)	8 (21.1)	
	≤ 5 years	14 (42.4)	19 (50.0)	
	5-8 years	2 (6.1)	2 (5.3)	
	8-12 years	2 (6.1)	2 (5.3)	
Marital Status n(%)	≥12 years	1 (3.0)	1 (2.6)	0.37**
	Married	21 (63.6)	28 (73.7)	
	Others	12 (36.4)	10 (26.3)	
Physical Activity n(%)	Insufficient	28 (84.8)	28 (73.7)	0.26**
	Sufficient	5 (15.2)	10 (26.3)	
Age of menopause for women mean (SD)		44.38 (6.41)	44.28 (5.75)	0.19***

SD: Standart Deviation, BMI: Body Mass Index. *:Independent Sample t Test, **:Pearson ki-kare testi, ***:Mann-Withney U test. Bold values indicate statistically significant results ($p < 0.05$).

The comparison of physical activity, kinesiophobia level, sarcopenia risk, and quality of life between the groups are presented in Table 2 and Fig. 1. While BBS and FRT results were significantly lower in the osteoporotic group ($p=0.02$, $p=0.01$, respectively), SARC-F scores were significantly higher than the non-osteoporotic group ($p=0.03$). There was no significant difference in PASE, TKS, TUGT, QUALLEFO-t, and QUALLEFO-subscores between the two groups ($p > 0.05$).

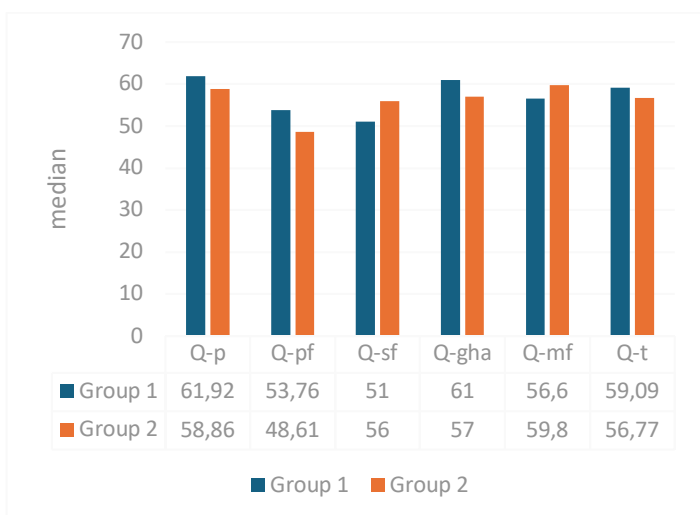


Fig. 1. Comparison of quality of life between elderly individuals with osteoporosis and without osteoporosis Q: QUALLEFO, p: pain, pf: physical function, sf: social function, gha: general health assesment, mf: mental health, t: total Mann-Whitney U test, ($p > 0.05$)

Table 3 shows the relationship between physical activity, kinesiophobia level, sarcopenia risk, and quality of life of patients in the osteoporosis group. A negative moderately significant correlation was found between PASE scores and QUALLEFO-p scores in elderly osteoporotic patients ($r = -0.530$, $p = 0.02$). Moderate negative correlation between TKS scores and BBS scores, a moderate positive correlation with TUGT results, a positive strong correlation with SARC-F scores, a moderate positive correlation with QUALLEFO-pf scores, a positive moderate correlation with QUALLEFO-sf scores, and QUALLEFO-t scores positive moderate correlation was detected (respectively $r = -0.498$, $p = 0.013$; $r = 0.454$, $p = 0.018$; $r = 0.661$, $p < 0.001$; $r = 0.540$, $p = 0.001$; $r = 0.437$, $p = 0.011$; $r = 0.537$, $p = 0.001$). BBS scores were moderately positive correlate with FRT, moderately negative by TUGT, moderately negative by SARC-F scores, poorly negatively by QUALLEFO-p scores, moderately negative by QUALLEFO-sf and QUALLEFO-t scores (respectively $r = 0.593$, $p < 0.001$; $r = -0.565$, $p = 0.001$; $r = -0.433$, $p = 0.017$; $r = -0.368$, $p = 0.035$; $r = -0.467$, $p = 0.006$; $r = -0.544$, $p = 0.001$). There was a weak negative correlation between FRT results and QUALLEFO-sf scores ($r = -0.360$, $p = 0.040$). There was a weak positive correlation between TUGT results and SARC-F, a moderate positive correlation with QUALLEFO-p and a moderate positive correlation with QUALLEFO-t ($r = 0.397$, $p = 0.030$, $r = 0.447$, $p = 0.013$, $r = 0.547$, $p = 0.002$, respectively). A moderate positive correlation was found between SARC-F scores and QUALLEFO-total scores ($r = 0.437$, $p = 0.016$).

Table 2. Comparison of physical activity, kinesiophobia level, and sarcopenia risk between elderly individuals with osteoporosis and without osteoporosis

	Group 1 n=33 median (min/max)	Group 2 n=38 median (min/max)	p*
PASE	125.41 (78.81/208.60)	128.0 (52.0/212.0)	0.88
TKS	44.51 (19.0/60.0)	42.0 (18.0 /59.0)	0.51
BBS	50.0 (31.0/55.0)	52.0 (31.0/56.0)	0.02
FRT	7.0 (4.0/14.0)	10.0 (3.0/15.0)	0.01
TUGT	12.0 (7.0/20.0)	13.0 (8.0/19.0)	0.87
SARC-F	3.0 (0.0/6.0)	2.0 (0.0/6.0)	0.03

PASE: Physical Activity Scale for the Elderly, TKS: Tampa Kinesiophobia Scale, BBS: Berg Balance Scale, FRT: Functional Reach Test, TUGT: Timed Up and Go Test, *: Mann-Whitney U test. Bold values indicate statistically significant results (p<0.05).

Table 3. Correlation analysis results of physical activity, kinesiophobia level, risk of sarcopenia and quality of life in the osteoporosis group

	PASer/p	TKSr/p	BBSr/p	FRTTr/p	TUGTr/p	SARC-Fr/p
PASE	-	-	-	-	-	-
TKS	-0.037 0.843	-	-	-	-	-
BBS	0.119 0.523	-0.408 0.013	-	-	-	-
FRT	-0.075 0.687	-0.271 0.128	0.593 <0.001	-	-	-
TUGT	-0.145 0.456	0.454 0.018	-0.565 0.001	-0.320 0.084	-	-
SARC-F	-0.187 0.331	0.661 <0.001	-0.433 0.017	-0.212 0.260	0.397 0.030	-
QUALLEFO-p	-0.530 0.023	0.295 0.096	-0.368 0.035	-0.167 0.354	0.447 0.013	0.241 0.199
QUALLEFO-pf	-0.052 0.789	0.540 0.001	-0.283 0.111	-0.311 0.075	0.219 0.245	0.325 0.079
QUALLEFO-sf	0.041 0.832	0.437 0.011	-0.467 0.006	-0.360 0.040	0.199 0.291	0.306 0.101
QUALLEFO-gha	-0.168 0.367	0.178 0.322	0.098 0.586	0.218 0.224	0.345 0.062	0.225 0.231
QUALLEFO-mf	0.075 0.689	0.295 0.276	-0.226 0.206	-0.265 0.137	0.330 0.075	0.266 0.155
QUALLEFO-t	-0.242 0.181	0.537 0.001	-0.544 0.001	-0.287 0.106	0.547 0.002	0.437 0.016

PASE: Physical Activity Scale for the Elderly, TKS: Tampa Kinesiophobia Scale, BBS: Berg Balance Scale, FRT: Functional Reach Test, TUGT: Timed Up and Go Test, p: pain, pf: physical function, sf: social function, gha: general health assessment, mf: mental health, t: total p value was calculated by Spearman correlation test. Bold values indicate statistically significant results (p<0.05).

4. Discussion

In this study, the effects of the presence of osteoporosis on kinesiophobia, sarcopenia risk, balance, physical activity level, and quality of life in elderly individuals were examined. It was found that the osteoporotic group had a lower BMI and worse balance, and the risk of sarcopenia risk was higher than the non-osteoporotic group. Physical activity level, quality of life, and kinesiophobia assessments were similar in both groups.

In the study by Günendi et al., which examined the effect of osteoporosis on kinesiophobia, they found that TKS and QUALLEFO-41 scores were worse in the osteoporotic group than in the control group (2). In another study examining the effect of kinesiophobia on the quality of life in postmenopausal women with osteoporosis over 50 years of age, the level of kinesiophobia was found to be higher and the quality of life worse in the osteoporotic group (20). In our study, on the contrary, kinesiophobia, and quality of life were found to be similar in both groups. The differences in the number of participants in the studies and the inclusion of only individuals

aged 65 and over in our study, as well as the examination of both male and female individuals, may be effective in the different results obtained.

Starting from the 6th decade, BMD decreases by 1-1.5%, and muscle mass decreases by 1% each year, thus increasing the risk of diseases such as osteoporosis and sarcopenia approximately two times (21). With aging, the balance of bone formation and destruction in the musculoskeletal deteriorates, and this deterioration increases in cases such as inactivity and trauma. Muscle and bone are tissues that interact with each other. As the muscle mass increases, the tension applied by the muscle to the periosteum during the movement will increase, and this will stimulate bone formation. The decrease in the mechanical interaction between muscle and bone with the decrease in physical activity in old age triggers the development of osteosarcopenia (22, 23). In our study, although physical activity levels were similar in both groups, the SARC-F score was higher in the osteoporotic group.

Osteoporosis is painless as long as there is no fracture. The most important cause of fracture in the elderly is falling, and the most important cause of falling is balance disorder (24). Therefore, it is very important to evaluate the balance when evaluating the fear of movement in patients with osteoporosis. BBS, TUGT, and FRT are tests that can be used to assess balance in patients with osteoporosis. In our study, BBS and FRT were lower in the osteoporotic group compared to the control group, while TUGT was found to be similar in both groups (12 seconds in the first group, 13 seconds in the second group). In the intragroup comparison of the scales in the osteoporotic group, a negative correlation was found between BBS and TUGT and a positive correlation between BBS and FRT. TKS correlated positively with TUGT and negatively with BBS. In addition, the negative correlation between FRT and BBS and some subscores of QUALEFO-41 and the positive correlation between TKS and TUGT and some subscores of QUALEFO-41 was remarkable. These results suggest that if there is a deterioration in balance, there may be fear of movement, slowing of movements due to fear of movement, and deterioration in functional mobility and quality of life. In a study investigating the validity of the Korebalance system, which is a computer-assisted balance system, in patients with postmenopausal osteoporosis, the Korebalance test system, BBS, and TUGT were used, and the Korebalance Static and dynamic test results were correlated with TUGT and BBS (25). In that study, the mean TUGT was found to be 9.71 seconds, and it can be thought that the age difference of the participants between the studies was effective in the fact that it was less than the time in our study.

In a study involving 196 female patients aged 62-85 years, it was shown that sarcopenia has an effect on falling, fear of falling, and risk of falling, and this effect increases as the degree of sarcopenia increases (26). Although different assessment scales were used in our study similar results were obtained. It was found that sarcopenia risk was strongly positively correlated with kinesiophobia, weakly positively correlated with functional mobility, and moderately negatively correlated with postural control.

In a study conducted on the male population, sarcopenia, BMD, and quality of life were compared, and it was found that a decrease in BMD and deterioration in the quality of life were higher in the presence of sarcopenia (27). In our study, both male and female individuals were examined, and a positive correlation was found between sarcopenia risk and quality of life. In other words, as sarcopenia risk increases, the quality of life deteriorates.

Quality of life in osteoporosis has been studied in various studies (28, 29). In a study, it was shown that the quality of life of the elderly who exercised increased, and there was a positive relationship between physical activity level and quality of life (30). In the study of Sezer N et al., it was concluded that physical activity level is the strongest determinant of quality of

life (29). Quality of life in osteoporosis has generally been studied in the postmenopausal patient population, but according to our knowledge, there is no study in which it was examined only in the geriatric group. It has been shown that postmenopausal osteoporosis negatively affects the quality of life compared to people of similar age without osteoporosis (28-30). In our study, quality of life scores were found to be similar in geriatric individuals with and without osteoporosis. This may have been due to the similar physical activity and kinesiophobia levels of the patients with and without osteoporosis in our study. In our study, the relationship between PASE and QUALEFO-41 was also examined, and a moderately negative correlation was found between PASE and QUALEFO-p. This finding is valuable in that it reveals the effect of physical activity on quality of life in the elderly population as well.

Our study has some limitations. First, this is a pilot study, and the small number of participants is one of these limitations. The cross-sectional design of our study may be insufficient to show the change in balance and sarcopenia risk parameters before and after the diagnosis of osteoporosis. Prospective studies will provide more reliable results to confirm these conclusions. Trying to optimally investigate parameters such as balance and kinesiophobia by excluding diseases that may cause pain, balance, and movement disorders limits the number of participants because it is a study involving the elderly population. On the other hand, to the best of our knowledge, this is the first study in which the risk of osteoporosis, physical activity level, balance, kinesiophobia, and sarcopenia risk were evaluated together in individuals aged 65 years and older and is therefore important.

In conclusion, while the presence of osteoporosis was found to be associated with balance disorder and sarcopenia risk in the elderly population, no significant effect of osteoporosis on kinesiophobia was detected. Studies involving a larger patient population and long-term follow-up results are needed.

Conflict of interest

The authors have no conflicts of interest to declare.

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Authors' contributions

Concept: Z.K.Ü. and D.C., Design: Z.K.Ü. and D.C., Data Collection or Processing: Z.K.Ü., Analysis or Interpretation: Z.K.Ü. and D.C., Literature Search: Z.K.Ü. and D.C., Writing: Z.K.Ü. and D.C.

Ethical Statement

The study was performed in accordance with the Declaration of Helsinki, and approved by the Ankara City Hospital Ethics Committee (Approval Date: 25.11.2020, Approval Number:

E1-20-1319) and conducted in Ankara Hulusi Alataş Elmadağ State Hospital. The research was conducted ethically in accordance with the World Medical Association Declaration of Helsinki. Informed consent was obtained from all patients before the study.

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