

Association between Depression and Postural Balance in Older Adults with Knee Osteoarthritis in Saudi Arabia: A Cross-Sectional Study

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Abstract

Background: Several studies examined the reciprocal relationship between knee osteoarthritis (KOA), depression, and postural balance separately; however, few studies have investigated the relationship between them. Therefore, this study aimed to identify the relationship between postural balance and depression among patients with KOA in Saudi Arabia.

Methods and Results: A total of 71 patients with KOA were recruited (36 males, 35 females) with a mean age of 55.0±8.6 years, mean knee pain of 7.2±1.0, and mean Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) of 44.9±11.6. Depression was measured using the Hospital Anxiety and Depression Scale (HADS). The participants were asked to complete the HADS, rate their pain in both knees using the Visual Analogue Scale (VAS) and the WOMAC, and undergo the Berg Balance Scale (BBS) to assess the postural balance.

A significantly strong negative correlation was observed between postural balance and anxiety and depression in all the participants (BBS and HADS: $r=-0.920$, $P<0.001$), as well as a significant negative correlation between knee pain and postural balance (VAS and BBS: $r=-0.26$, $P=0.029$).

Conclusion: Decrease in postural balance was associated with a higher level of anxiety and depression in addition to knee pain among patients with KOA. (*International Journal of Biomedicine*. 2024;14(3):497-502.)

Keywords: knee pain • osteoarthritis • balance • depression • older adults

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Abbreviations

OA, osteoarthritis; BMI, body mass index; BBS, Berg Balance Scale, HADS, Hospital Anxiety and Depression Scale; KOA, knee osteoarthritis; QoL, quality of life; VAS, Visual Analogue Scale, WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index.

Introduction

With the rapid increase in population aging, the risk of chronic diseases among the elderly also increases. Osteoarthritis (OA), dementia, stroke, and coronary artery disease are the major disabling diseases among older adults.⁽¹⁾ OA is a chronic progressive disease that not only causes arthralgia in the lower

extremities in people over the age of 50 but also reduces their quality of life (QoL).⁽²⁾

From 2013 to 2025, the prevalence of knee osteoarthritis (KOA) is estimated to increase by 40% because of the increase in natural aging of the global population.⁽³⁾ In the Kingdom of Saudi Arabia, the prevalence of OA increases with age, from 30.8% in the 46- to 55-year-old age group to 60.6% in the

66- to 75-year-old age group. The risk factors for clinical KOA include (i) age, with an odds ratio (OR) of 1.0894 (95% confidence interval [CI], 1.08–1.09), adjusted for sex and body mass index (BMI), and (ii) female sex, with an OR of 1.261 (95% CI, 1.0456–1.5208), after adjusting for age and BMI. The association between clinical KOA and female sex was also significant (OR adjusted for age and BMI) at 1.261 (95% CI, 1.0456–1.5208).⁽⁴⁾

KOA is more common in women than men and in patients over the age of 50 as well. The greater tendency of women to overuse their knees may be related to the anatomical structure of the wide female pelvis as this width increases the physiological valgus of the knee, creating a risk of overloading on the medial side of the knee which is the area most likely to show signs of KOA.⁽⁵⁾ Moreover, multiple factors can affect older adults with KOA, leading to physical and psychological changes, including balance dysfunction and depression.⁽³⁾

Balance is defined as a person's ability to maintain their center of gravity within a specified range or range of support. This ability is important for maintaining maximum stability while standing with the base of support in the contact area of the feet on both sides.^(6,7) Therefore, the ability to sustain postural balance might be affected in patients with KOA as they suffer from increased overloading on the medial compartment of the knee joint in addition to joint stiffness.

Furthermore, recent studies have shown that long-term OA is one of the risk factors for developing depression in community-dwelling adults. In some communities, depression in older adults has been estimated at 8%–16%.⁽⁸⁾ Previous studies have reported that depression can exacerbate pain, impair functioning, increase disability, and adversely affect health-related QoL and treatment response in patients with OA.⁽⁹⁾ Additionally, depression can place a heavy burden on individuals with arthritis, their families, and society.⁽¹⁰⁾ Therefore, elderly patients with KOA and depression may require appropriate evaluation and treatment.

As evident in the literature published over the years, several studies have been conducted to examine the reciprocal relationship between KOA, depression, and postural balance separately. However, few studies have investigated the relationship between KOA, depression, and postural balance in patients with KOA in Saudi Arabia. Therefore, the main purpose of the present study was to investigate the association between depression and postural balance in older adults with KOA in Saudi Arabia.

Methods

Study design and recruitment

This study used a cross-sectional design. This study followed the Helsinki Declaration guidelines. Ethical approval of this study has been granted from the National Health Services Committee in Makkah Al-Mukarramah. Before data collection, approval was granted on November 1, 2022 (IRB Number H-02-K-076-1022-825). The participants were recruited from King Abdulaziz General Hospital, Makkah Al-Mukarramah, Saudi Arabia, using convenience sampling. Participants were recruited between November 2, 2022, and

February 1, 2023. Based on recent research investigating the prevalence of OA in Saudi Arabia and according to the Raosoft sample size calculator, the target sample was 377 participants based on a 50% response rate, a 5% margin of error, and a 95% confidence level.⁽¹¹⁾ The inclusion criteria were as follows: (a) age 40 years or older; (b) diagnosed with KOA (unilateral or bilateral); (c) able to do daily tasks independently; and (d) able to walk at least 30 feet with or without the use of an assistive device. The exclusion criteria were as follows: (a) has a history of any neurological problem (e.g., Parkinson's disease, multiple sclerosis, peripheral neuropathy, stroke, or vestibular dysfunction) or any other known musculoskeletal disorder that affects physical function (e.g., joint replacement, amputation, or physically limiting arthritis); (b) subjects who have undergone joint replacement surgeries for lower limb joints; (c) subjects who are suffering from physical disability and/or visual impairment; and (d) subjects with cardiovascular or psychological conditions that restrict physical activity daily.

Patient and public involvement

Patients or the public were not involved in the design, or conduct, or reporting, or dissemination plans of our research.

Study measurement tools

All participants were voluntarily asked to consent to participate in this study before data collection. During the data collection process, participants passed through four stages, which included completing the demographic information questionnaire, the Hospital Anxiety and Depression Scale (HADS), the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), and finally, performing the Berg Balance Scale (BBS) at Physical therapy department in King Abdulaziz General Hospital, Makkah Al-Mukarramah, Saudi Arabia.

a) Demographic information: This study developed a demographic sheet to collect the participants' personal information (i.e., age, sex, BMI, marital status, residence, educational level, knee affected with KOA (right, left, or both), duration of the disease, comorbidities, use of walking aids, and knee pain on reach using the Visual Analogue Scale (VAS), as this scale is presented in a 10 cm line, where 0 means no pain, and 10 means extreme pain, and has a reliability of 0.79.⁽¹²⁾

b) Hospital Anxiety and Depression Scale (HADS): Depression among the participants was measured using the Arabic version of the HADS. It has 14 items assessing anxiety (seven items) and depression (seven items), which are rated on a four-point Likert-type scale ranging from 0 to 3. The scores in each subscale were computed by summing the corresponding items, with a maximum score of 21 for each subscale. A score of 0–7 is considered normal, 8–10 means a borderline case, and 11–21 indicates a case (anxiety or depression). Applied to community-dwelling older adults, the Saudi version of the HADS had a Cronbach's alpha score of 0.91 in the current study. The reliability of the current Arabic HADS version is comparable to that of other Arabic HADS versions. For instance, our Cronbach's α for the HADS anxiety subscale is 0.83 (95% confidence interval: 0.79–0.88), and for the HADS depression subscale, it is 0.77 (0.7–0.83).⁽¹³⁾

c) *Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC)*: Disease extent was assessed using the WOMAC index, which comprises a self-assessment questionnaire with 24 items on three subscales: pain (five items, score range: 0–20), stiffness (two items, score range: 0–8), and physical function (17 items, score range: 0–68). Higher scores indicated increased pain and stiffness and limited physical function. The Arabic version of WOMAC has strong internal consistency (Cronbach's alpha = 0.74–0.82) and acceptable test-retest reliability.⁽¹²⁾

d) *The Berg Balance Scale (BBS)*: It is a task performance scale comprising 14 different balance activities. Higher overall scores imply less impaired balance and vice versa, and the range of possible points for each activity is between 0 and 4, with the total BBS scores ranging from 0 to 56. The BBS has high relative reliability, with the inter-rater reliability estimated at 0.97 (95% CI 0.96 to 0.98) and the intra-rater reliability estimated at 0.98 (95% CI 0.97 to 0.99). The absolute reliability of the BBS varies across the scale, with minimal detectable change with 95% CI varying between 2.8/56 and 6.6/56.⁽¹⁴⁾

Statistical analysis

IBM Statistical Package for the Social Sciences software (SPSS, version 29) was used for all data analyses. The BMI was calculated for each participant using weight in kilograms (kg) and height in meters (m). Age, BMI, VAS, BBS, and WOMAC were analyzed using descriptive statistics and presented as means and standard deviations (SDs). The associations between BBS, HADS, knee pain (VAS), and WOMAC were calculated using the Pearson correlation test. The level of statistical significance was determined to be 0.05.

Results

Participants' characteristics

Initially, 76 participants were enrolled in this study; however, five were excluded because of missing data, leaving 71 participants with KOA to be included in the final analysis. Of these 71 individuals, 35 female (49.3%) and 36 male (50.7%) participants completed the study. The mean age and SD for all participants were 54.972±8.552 years, the mean BMI and SD were 30.772± 3.552 kg/m², the mean VAS and SD of knee pain were 7.239± 0.918, and the mean WOMAC and SD were 44.958±10.873.

Interestingly, when the data were separated according to sex, differences were identified, and these were measured using an independent t-test between the male and female groups. The mean age, VAS of knee pain, balance (BBS), and disease extent (WOMAC) of the male participants were significantly higher than those of the female participants ($P<0.001$). In contrast, the female participants reported statistically significant higher BMIs and greater levels of anxiety and depression than the male participants ($P<0.001$). The data are shown in Table 1.

Association between postural balance, anxiety and depression, knee pain, and disease extent

The associations between postural balance using BBS, anxiety and depression using HADS, knee pain using

VAS, and disease extent using WOMAC were investigated and measured using Pearson's correlation statistical test. In general, there was a significantly strong negative correlation between postural balance and anxiety and depression in all the participants (BBS and HADS: $r=-0.92$, $P<0.001$), which means that a decrease in postural balance is associated with a higher level of anxiety and depression among the participants and vice versa. Another significant negative correlation was observed between knee pain and postural balance in all the participants (VAS and BBS: $r=-0.26$, $P=0.029$), which means that an increasing level of knee pain is associated with worse postural balance among the participants and vice versa. The data are presented in Table 2.

Table 1.

Participants' characteristics based on gender and for the general group.

| Variable | Male (n=36) | Female (n=35) | P-value | All participants (n=71) |
|------------------------|-------------|---------------|---------|-------------------------|
| | Mean ± SD | Mean ± SD | | Mean ± SD |
| Age, years | 59.3±7 | 51.0 ±8.7 | <0.001 | 55.0±8.6 |
| BMI, kg/m ² | 30.2 ±3 | 31.4 ±4.0 | <0.001 | 30.8±3.6 |
| VAS, cm | 7.4 ±1.0 | 7.1 ±1.0 | <0.001 | 7.2±1.0 |
| WOMAC | 46.4 ±11.8 | 43.1±11.8 | <0.001 | 44.9±11.6 |
| BBS | 43.3±7.3 | 41.1 ±6.4 | <0.001 | 2.2±7.0 |
| HADS | 15.6 ±5.3 | 17.9 ±5.2 | <0.001 | 16.7±5.4 |

Table 2.

Association between different study variables for all study participants (Pearson's Correlations).

| Variables | All participants (n=71) | |
|---------------------|-------------------------|---------|
| | r | P-value |
| BBS and HADS | -0.916 | <0.001 |
| Pain (VAS) and HADS | 0.210 | 0.079 |
| Pain (VAS) and BBS | -0.259 | 0.029 |
| WOMAC and HADS | 0.215 | 0.072 |
| WOMAC and BBS | -0.196 | 0.101 |

Moreover, when each subgroup of male and female participants was tested separately, the male subgroup, unlike the female one, showed a significant positive correlation between pain and anxiety and depression (male subgroup VAS and HADS: $r=0.44$, $P=0.004$) and a significant negative correlation between pain and postural balance (male subgroup VAS and BBS: $r=-0.478$, $P=0.004$). This means that a higher level of knee pain is associated with greater anxiety and depression and worse postural balance among the male participants in this study and vice versa. On the other hand, the female subgroup showed a significant negative correlation between disease extent and postural balance (female subgroup WOMAC and BBS; $r=-0.36$, $P=0.034$), which means that an

increase in disease extent is associated with worse postural balance among the female participants and vice versa. The data are presented in Table 3.

Table 3.

Association between different study variables for male and female groups (Pearson's Correlations).

| Variables | Male (n=36) | | Female (n=35) | |
|---------------------|-------------|---------|---------------|---------|
| | r | P-value | r | P-value |
| BBS and HADS | -0.892 | <0.001 | -0.937 | <0.001 |
| Pain (VAS) and HADS | 0.435 | 0.009 | 0.041 | 0.817 |
| Pain (VAS) and BBS | -0.478 | 0.004 | -0.060 | 0.730 |
| WOMAC and HADS | 0.289 | 0.093 | 0.301 | 0.079 |
| WOMAC and BBS | -0.186 | 0.286 | -0.360 | 0.034 |

Association between postural balance, anxiety and depression, knee pain, and disease extent while controlling for age, BMI, and gender

The results of the regression analysis when controlling for age, BMI, and gender showed that the only significant predictor was gender, as found between balance (BBS) and anxiety and depression (HADS) ($\beta=0.22$, $P=0.001$); pain (VAS) and anxiety and depression (HADS) ($\beta=-0.76$, $P=0.001$); pain (VAS) and balance (BBS) ($\beta=-0.03$, $P=0.001$); and disease extent (WOMAC) and balance (BBS) ($\beta=-0.86$, $P=0.001$). The data are presented in Table 4.

Table 4.

Association among variables while controlling demographics.

| Variables | | Unstandardized Coefficients (B) | Std. Error | Standardized Coefficients (β) | t | P-value |
|---------------------|--------|---------------------------------|------------|---------------------------------------|-------|---------|
| BBS and HADS | Age | -0.45 | 0.12 | -0.19 | -1.01 | 0.32 |
| | BMI | -0.21 | 0.05 | -0.56 | -1.11 | 0.76 |
| | Gender | 0.44 | 0.02 | 0.22 | 0.30 | 0.001 |
| Pain (VAS) and HADS | Age | 0.12 | 0.004 | 0.65 | 0.32 | 0.13 |
| | BMI | -0.22 | 0.01 | -0.32 | -0.65 | 0.33 |
| | Gender | -0.45 | 0.11 | -0.76 | -1.32 | 0.001 |
| Pain (VAS) and BBS | Age | 0.12 | 0.008 | 0.43 | 0.44 | 0.54 |
| | BMI | -0.24 | 0.07 | -0.15 | -0.67 | 0.41 |
| | Gender | 0.11 | 0.02 | 0.03 | 0.78 | 0.001 |
| WOMAC and HADS | Age | -0.3 | 0.002 | -0.07 | -1.03 | 0.22 |
| | BMI | -0.56 | 0.14 | -0.81 | -1.01 | 0.23 |
| | Gender | 0.40 | 0.06 | 0.07 | 0.90 | 0.64 |
| WOMAC and BBS | Age | 0.08 | 0.007 | 0.02 | 0.87 | 0.70 |
| | BMI | 0.77 | 0.05 | 0.90 | 0.67 | 0.66 |
| | Gender | 0.42 | 0.13 | 0.86 | 0.32 | 0.001 |

Discussion

This study investigated the prevalence of depression and its effects on balance among older adults with KOA in Saudi Arabia. Similar to our findings, those of a cross-sectional study conducted in Europe showed that there was a significant association between depression, pain, and QoL, leading to balance disturbance. As a result, there is a strong and significant relationship between depression and balance.⁽¹⁵⁾ Additionally, it was shown that balance was a predictor of depression,⁽¹⁶⁾ as this study demonstrated a strong negative association between balance and depression.

The incidence of depression varies considerably across the literature. However, the extant literature clearly indicates that patients with KOA are more likely to have depressive symptoms than the general population. In addition, a large amount of the literature shows that patients with KOA who suffer from depression tend to have worse clinical outcomes.⁽¹⁷⁾ A recent systematic review included 121 studies involving a total of 38,085 participants. The mean age of the participants was 64.3 years, and they were predominantly female (63%). The results showed a significant correlation between pain and depression/anxiety severity in patients with OA,⁽¹⁸⁾ which is consistent with the findings of our study. Moreover, according to a study published in 2020, patients with KOA are more prone to experience depression because of their urge to quit numerous hobbies and interests and because of memory issues, such that they prefer staying home rather than venturing out and trying new experiences.⁽¹⁷⁾ Our results showed that the mean BMI of all the participants was 30.77 kg/m², which falls under the obese category of BMI. Although this study has not investigated such a relationship, previous studies have shown that there is a positive relationship between obesity (BMI > 29.9 kg/m²) and depression in patients with KOA. Therefore, it is important for clinicians to consider BMI when managing depression, especially in female patients.⁽¹⁷⁾

When each group of male and female participants was tested separately, the male participants showed a significant positive correlation between pain and anxiety and depression and a significant negative correlation between pain and postural balance compared to the female participants. Another study was consistent with ours, showing that male patients were predisposed more to psychiatric features compared to female patients.⁽¹⁹⁾

Depression may be associated with reduced function in KOA patients. According to the National Institute of Mental Health, depression is a mood disorder that can be characterized by persistent sadness, feelings of helplessness, hopelessness, or worthlessness, pessimism, and irritability. A person with depression may also lose interest in daily activities, hobbies, and recreation. Therefore, it is understandable that depression could be associated with poor physical function, which is also consistent with the findings of the current study, as there is a positive correlation between the participants' WOMAC scores and depression, although this correlation was not significant.⁽²⁰⁾

Older adults with radiographic evidence of KOA have an increased likelihood of experiencing recurrent falls compared to those without KOA based on established risk factors.

Therefore, it has been suggested that fall prevention training should include older adults in all stages of KOA.⁽²¹⁾ As the risk of falls is also increased in those with depressive symptoms, the coincidence of depression and KOA may further increase this risk; therefore, this specific population with KOA may need additional physiotherapy beyond the standard modalities to address KOA and to include fall prevention strategies in the treatment protocol.⁽²²⁾

This study has also shown a significant negative correlation between BBS and HADS, which is consistent with a previous study that reported similar results of a significant negative relationship between BBS and the depression scale.⁽²³⁾ Moreover, another study found that KOA radiographic changes were significantly associated with postural sway and balance, as patients with moderate to severe KOA had more deficits in balance control.⁽²⁴⁾ Some studies attributed changes in balance among patients with KOA to the asymmetrical loading of the limbs.⁽⁵⁾ Additionally, the female participants suffered more than the male participants in terms of balance, as the negative relationship between WOMAC scores and BBS in this study was significant only among the female participants ($P=0.034$) and not among the male ones ($P=0.286$).⁽²⁵⁾

Finally, several studies in the literature showed that the risk of falls increases with symptomatic OA in lower limb joints. It was confirmed that symptomatic hip OA and KOA are essential risk factors for falls because an increased postural sway contributed to a high risk of falls in more than one-third of patients with KOA.^(26,27) In conclusion, there is a significant strong negative association between postural balance and anxiety and depression and a significant negative association between knee pain and postural balance among patients with KOA in Saudi Arabia. Future studies are advised to investigate the cause-and-effect relationship between postural balance and depression among patients with KOA in Saudi Arabia.

Strengths and Limitations

Although recruiting participants from both genders and finding significant results can be considered a strong point in this study, some limitations were noted. First, this study recruited a relatively small number of participants from Makkah Al-Mukarramah province, so the findings cannot be generalized to represent all Saudis, although previous studies showed similar results. Second, although a significant negative association was found between postural balance and anxiety and depression, the impact of postural balance training on anxiety and depression in patients with KOA remains unclear. In this study, we used the BBS to assess and adjust the capabilities of the clinic in which the study was conducted. However, we recommend future studies to adopt more advanced and accurate strategies to evaluate balance whenever it is accessible such as force platforms and Biodex Balance System,⁽²⁸⁾ to increase the reliability of findings on postural balance.

Competing Interests

The authors declare that they have no competing interests.

Disclaimers

The authors state that the views expressed in the submitted article are their own and not an official position of the institution or funder.

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