Original Article

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Physiotherapy Section

Association between Leg Dominance and Symptom Onset in Knee Osteoarthritis: A Cross-sectional Study

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ABSTRACT

Introduction: Knee Osteoarthritis (KOA) plays a substantial role in the global burden of musculoskeletal disorders. Biomechanical factors such as leg dominance are hypothesised to contribute to the onset and progression of KOA; however, the relationship between dominant limb use and symptom development remains unclear.

Aim: To investigate the association between leg dominance and the onset and side of symptoms in KOA, utilising both a validated questionnaire and standardised functional task assessments.

Materials and Methods: A cross-sectional study was conducted at the Department of Sports Physiotherapy, KLE Institute of Physiotherapy, Belagavi, Karnataka, India, over 11 months, from May 2024 to March 2025. It involved 131 individuals aged between 45 and 70 years with radiologically confirmed Grade I or II KOA. Leg dominance was assessed through a standardised questionnaire and six motor tasks. The data collected were compiled in Microsoft Excel and analysed using IBM Statistical Package for the Social Sciences (SPSS) Statistics version 29.0. Chi-square tests and t-tests were used to analyse associations.

Results: A total of 131 participants (55 males and 76 females) were included in the final analysis. Right leg dominance was identified in 124 (94.7%) of the participants across all motor tasks, with a high concordance noted in the ball-kicking task between self-report and observation. Right knee pain was more common, reported by 111 (84.7%) participants, and the majority noted a gradual onset of symptoms, with 110 (84%) indicating this pattern. All left-leg dominant individuals were female and exhibited left-sided KOA (p-value <0.001). Sudden onset of symptoms was significantly associated with left-leg dominance, observed in 5 (71.4%) participants (p-value=0.001).

Conclusion: The study identified a significant association between leg dominance and both the side and onset of KOA symptoms. Dominant limb mechanics may play a role in asymmetric joint loading and early symptom manifestation. Assessing leg dominance through both self-report and task observation may aid in the early identification of at-risk individuals and support targeted rehabilitation planning.

Keywords: Symptom, Risk factors, Burden of disease, Prevalence, Surveys and questionnaires, Laterality, Motor skills

INTRODUCTION

The KOA is a prevalent and disabling musculoskeletal disorder characterised by the progressive degeneration of articular cartilage and subchondral bone, leading to pain, stiffness, and functional limitations [1,2]. Globally, KOA affects an estimated 365 million individuals, with prevalence increasing sharply with age and disproportionately impacting women [3,4]. The burden is expected to rise further due to population ageing, obesity, and lifestyle changes, with projections suggesting a near doubling of cases in certain regions by 2050 [5].

While established risk factors such as age, obesity, gender, malalignment, and prior joint injury have been extensively studied [6], less attention has been given to biomechanical contributors, particularly leg dominance. Leg dominance refers to the consistent preference for using one lower limb over the other in functional tasks such as kicking, stepping, and balancing [7]. This asymmetrical usage pattern can alter ground reaction forces and knee adduction moments during gait, increasing compressive and shear stresses on the dominant limb's articular cartilage [8-10]. Over time, such repetitive mechanical loading has been shown to contribute to focal cartilage wear, subchondral bone remodeling, and earlier degenerative changes, particularly in weight-bearing compartments of the knee.

Biomechanical factors are particularly relevant for the early detection and prevention of KOA because they directly influence the magnitude, distribution, and frequency of forces transmitted across the knee joint during daily activities. Asymmetric loading caused by leg dominance can lead to repetitive stress on articular cartilage, altered joint kinematics, and compensatory gait patterns, all of which may accelerate localised cartilage wear before radiographic changes become apparent [10]. Early identification of such loading asymmetries provides an opportunity to modify movement strategies, improve muscular balance, and optimise neuromuscular control interventions that may delay structural joint damage and symptom progression.

Assessing leg dominance through both self-report and functional testing offers a practical, low-cost screening approach to detect individuals at higher mechanical risk for KOA in its preclinical or early stages. However, few studies have examined the relationship between leg dominance and the side or onset of KOA symptoms, and the findings have been inconsistent [11-14]. This gap is further pronounced in Indian populations, where activity patterns, footwear habits, and cultural practices may influence limb use and loading patterns.

Therefore, this cross-sectional study aimed to investigate the association between leg dominance and KOA symptom onset and side, using a combination of validated questionnaires and standardised functional tasks. The primary objective was to determine whether leg dominance is associated with the side (right vs. left knee) and type of onset (gradual vs. sudden) of KOA symptoms. The secondary objectives were:

1. To compare self-reported dominance from the Waterloo Footedness Questionnaire-Revised (WFQ-R) with task-based functional dominance assessments.

2. To analyse demographic and anthropometric factors {age, gender, height, weight, Body Mass Index (BMI)} in relation to KOA presentation and dominance.
3. To examine whether leg dominance influences the distribution of unilateral versus bilateral KOA.

Understanding this relationship could support the early identification of at-risk individuals and inform targeted prevention and rehabilitation strategies.

MATERIALS AND METHODS

This research employed a cross-sectional observational design and was undertaken from May 2024 to March 2025 in the Department of Sports Physiotherapy at the KLE Institute of Physiotherapy in Belagavi City, Karnataka, India. The study was ethically approved by the Institutional Ethical Board (Ref. No. 657 dated 03/04/2024), and all subjects provided informed written consent.

Sample size calculation: The minimal sample size was estimated to be 73 using a formula designed for estimating population proportions in observational research [15].

$$n = \frac{Z^2 \times p(1-p)}{d^2}$$

where Z=1.96 for a 95% confidence level, p = anticipated prevalence of right-leg dominance, and d = 0.05 margin of error. Based on prior large-scale studies in healthy adult populations, the prevalence of right-leg dominance has been consistently reported at 90-96% [16]. Given the absence of KOA-specific prevalence data, a conservative midpoint estimate of 95% was chosen to maximise sample precision while avoiding underestimation. This yielded a minimum sample size of 73 participants. To account for possible dropouts or incomplete data, an additional 10% was added (adjusted n = 81). Ultimately, 131 participants were enrolled to improve statistical power for subgroup analyses.

Inclusion criteria: Individuals aged 45 to 70 years who had been radiographically diagnosed with Grade I or II unilateral or bilateral knee osteoarthritis [17] were included in the study.

Exclusion criteria: The presence of neurological disorders, a history of bilateral knee arthroplasty, any soft-tissue injuries affecting the lower limbs, or the use of assistive ambulatory devices were excluded from the study.

Study Procedure

Participants were selected through convenience sampling. A radiological assessment was performed prior to functional testing. All participants underwent standardised weight-bearing anteroposterior (AP) knee radiographs using the same digital radiography system, with the X-ray beam centered at the joint line and the knee flexed to approximately 15° to optimise visualisation of the joint space. Radiographic severity was graded according to the Kellgren-Lawrence (K-L) classification, and only Grade I and Grade II cases were included. Two musculoskeletal radiologists, each with over 10 years of clinical experience, independently evaluated the images while blinded to participants' clinical and dominance data. Any discrepancies were resolved through consensus discussion.

Leg dominance was then assessed using the WFQ-R, a validated instrument comprising 12 items evaluating foot preference in functional activities such as kicking, stair-climbing, and balance [16]. The WFQ-R has demonstrated excellent test-retest reliability and was selected for its widespread use and psychometric robustness [18,19]. Responses were scored on a 5-point Likert scale, classifying individuals as right-, left-, or mixed-dominant. Before the main data collection, the WFQ-R was pilot-tested in a subset of 10 individuals with clinically diagnosed KOA who were not included in the final sample. All 12 items were easily understood, with an average completion time of 4.2±1.1 minutes, and no participant reported difficulty interpreting task descriptions. No modifications were required, so the same version of the WFQ-R was used in this study.

In addition to the WFQ-R, participants performed six standardised motor tasks to objectively assess leg dominance. These tasks were adapted from the standardised protocol described by van Melick et al., which has been previously validated for assessing lower limb dominance in healthy adults and shown to have high test-retest reliability [16]. The tasks were grouped into:

1. **Mobilising tasks:** Kicking a ball, tracing shapes on the floor, picking up marbles.
2. **Stabilising tasks:** Standing on one leg, jumping on one leg, stomping on a designated target.

Standardisation of procedure and examiner training: All tasks were demonstrated by an examiner prior to performance. Participants completed two trials of each task, performed in a fixed sequence: kicking a ball → tracing shapes → picking marbles → stomping on target → standing on one leg → jumping on one leg. The first foot used to initiate each task was recorded as dominant. All tasks were performed barefoot on a non slip mat to eliminate footwear-related variability. Rest intervals of 30 seconds were provided between tasks to reduce fatigue effects. Target distances and object placements were identical for all participants (e.g., ball positioned 1.5 m from the participant, marble container placed 0.5 m laterally). Examiners underwent structured training sessions and practiced scoring using standardised video recordings before data collection. A prestudy calibration exercise was conducted on 10 pilot participants to ensure uniform scoring, resulting in >95% interobserver agreement. During the study, two trained observers monitored performance; disagreements were resolved by consensus immediately after the trial.

Demographic information (age, gender, occupation), anthropometric measures (height, weight, BMI), physical activity levels, and the presence of co-morbidities were recorded to allow for a more comprehensive understanding of potential influencing factors. All collected data were anonymised using unique coded identifiers and stored in a password-protected digital database, accessible only to the core research team. This process ensured participant confidentiality and adhered to ethical guidelines for data management.

STATISTICAL ANALYSIS

The data were compiled in Microsoft Excel and analysed using IBM SPSS Statistics version 29.0. Continuous variables were summarised as means and Standard Deviations (SD), while categorical variables were expressed as frequencies and percentages. The Shapiro-Wilk test was used to assess normality. Independent sample t-tests were applied to compare means between two groups. Associations between categorical variables were evaluated using the Chi-square test or Fisher's exact test when expected cell counts were less than five, and statistical significance was set at p-value <0.05.

RESULTS

A total of 131 participants (55 males, 76 females) aged between 45 and 70 years were included in the final analysis. All participants met the inclusion criteria of radiographically confirmed Grade I or II KOA and completed both subjective and task-based leg dominance assessments. The mean age was 61.51±9.37 years, with a mean height of 5.38±0.39 feet, a weight of 67.48±11.46 kg, and a BMI of 25.42±5.06 kg/m² [Table/Fig-1].

Right knee pain was reported by the vast majority of participants (111/131; 84.7%), while only 15.3% reported left knee pain. Additionally, 84% experienced a gradual onset of symptoms, whereas 16% reported a sudden onset. With respect to the type of KOA, unilateral cases were more frequent (71.0%) than bilateral cases (29.0%). This background pattern highlights a clear tendency

Parameter	Range	Mean± SD
Age (years)	45-70	61.51±9.37
Height (feet)	4.1-6.4	5.38±0.39
Weight (kg)	43-92	67.48±11.46
BMI (kg/m²)	16.2-39.8	25.42±5.06

[Table /Fig-1]: Descriptive statistics of participants (n = 131).

for KOA symptoms in this population to first appear on one side, usually the right, and to develop slowly over time [Table/Fig-2].

Variable	Category	n (%)	95% CI for %
Gender	Male	55 (42.0)	33.9%-50.5%
	Female	76 (58.0)	49.5%-66.1%
Site of pain	Right knee	111 (84.7)	77.6%-89.9%
	Left knee	20 (15.3)	10.1%-22.4%
Onset	Gradual	110 (84.0)	76.7%-89.3%
	Sudden	21 (16.0)	10.7%-23.3%
KOA type	Unilateral	93 (71.0)	62.7%-78.1%
	Bilateral	38 (29.0)	21.9%-37.3%
Dominance	Right leg	124 (94.7)	89.4%-97.4%
	Left leg	7 (5.3)	2.6%-10.6%

[Table/Fig-2]: Distribution of gender, site of pain, and onset of pain.
*n: Number of participants; CI: Confidence interval

Demographic comparisons: Independent t-test analysis revealed no statistically significant differences between males and females in age, height, weight, or BMI. Males were slightly taller on average (5.42±0.45 feet) than females (5.36±0.34 feet), but the difference was not significant (p-value=0.380) [Table/Fig-3]. Participants with left knee pain were significantly taller than those with right knee pain (p-value=0.006) [Table/Fig-4]. No significant demographic differences were found based on the onset of pain [Table/Fig-5].

Variable	Gender	Mean±SD	t	p-value
Age (years)	Male	61.45±9.87	-0.06	0.953
	Female	61.55±9.05		
Height (feet)	Male	5.42±0.45	0.88	0.380
	Female	5.36±0.34		
Weight (kg)	Male	68.64±10.63	0.98	0.328
	Female	66.64±12.03		
BMI (kg/m²)	Male	24.90±4.62	-1.00	0.320
	Female	25.80±5.35		

[Table/Fig-3]: Comparison of demographics by gender.
*Independent samples t-test applied; p<0.05 considered statistically significant

Variable	Site of pain	Mean±SD	t	p-value
Height (feet)	Right knee	5.34±0.38	-2.78	0.006*
	Left knee	5.60±0.36		

[Table/Fig-4]: Comparison by site of pain.
*Independent samples t-test applied; p<0.05 considered statistically significant

Variable	Onset of pain	Mean±SD	t	p-value
Age (years)	Gradual	61.88±9.31	1.04	0.302
	Sudden	59.57±9.66		

[Table/Fig-5]: Comparison by onset of pain.
*Independent samples t-test applied; p<0.05 considered statistically significant

Self-reported and task-based leg dominance: Self-reported assessments using the WFQ-R revealed that 124 participants (94.7%) were right-leg dominant, while 7 participants (5.3%) were left-leg dominant. Functional assessments across six standardised motor tasks yielded identical results, confirming the dominance classification. Notably, there was perfect agreement (100%) between self-reported dominance and the leg used for the ball-kicking task in all participants [Table/Fig-6]. A heatmap showing normalised proportions of right versus left leg use across all six tasks indicated a strong preference for the right leg, consistent across all functional observations.

Task	Right Leg n (%)	Left Leg n (%)
Kicking a ball	124 (94.7)	7 (5.3)
Tracing shapes	124 (94.7)	7 (5.3)
Picking marbles	124 (94.7)	7 (5.3)
Stomping on marbles	124 (94.7)	7 (5.3)
Standing on one leg	124 (94.7)	7 (5.3)
Jumping on one leg	124 (94.7)	7 (5.3)

[Table/Fig-6]: Task-based leg dominance.

Associations between leg dominance and KOA characteristics: Significant associations were observed between leg dominance and KOA presentation variables. All left-leg dominant participants were female (p-value=0.021, Cramer's V=0.18, weak effect). Similarly, all left-leg dominant individuals reported left-sided KOA (p-value <0.001, Cramer's V=0.55, large effect). For symptom onset, left-leg dominant participants were 16.9 times more likely (95% CI: 3.0-94.4) to report a sudden onset compared to right-leg dominant individuals (p-value=0.001, Cramer's V=0.35, moderate effect). These effect sizes indicate that, although left-leg dominance was relatively uncommon, it showed a clinically meaningful association with both the side and onset of KOA symptoms [Table/Fig-7].

Variable	Right-leg dominant n (%)	Left-leg dominant n (%)	p-value¹	Effect Size
Gender	Male 55 (44.4), Female 69 (55.6)	Male 0 (0.0), Female 7 (100.0)	0.021*	Cramer's V=0.18 (weak) OR not computable (all left-dominant were female)
Site of pain	Right knee 111 (89.5), Left knee 13 (10.5)	Right knee 0 (0.0), Left knee 7 (100.0)	<0.001*	Cramer's V=0.55 (large) OR not computable (all left-dominant had left KOA)
Onset of pain	Gradual 108 (87.1), Sudden 16 (12.9)	Gradual 2 (28.6), Sudden 5 (71.4)	0.001*	Cramer's V=0.35 (moderate) OR=16.9 (95% CI: 3.0-94.4)

[Table/Fig-7]: Association between leg dominance and KOA characteristics
*¹Fisher's exact test; p<0.05 considered statistically significant, OR-Odds ratio.

Demographic comparison by dominant leg: Mean ages were slightly lower in the left-leg dominant group (56.57±10.98 years) compared to the right-leg dominant group (61.79±9.24 years), but this difference was not statistically significant (p-value=0.152). Height and BMI also did not differ significantly between groups. These findings suggest that the observed differences in symptom side and onset type are unlikely to be explained by demographic composition or body size [Table/Fig-8].

Variable	Right Leg (n=124)	Left Leg (n=7)	t	p-value
Age (years)	61.79±9.24	56.57±10.98	1.44	0.152
Height (feet)	5.37±0.39	5.61±0.28	-1.63	0.107
BMI (kg/m²)	25.50±5.09	24.67±3.69	0.74	0.458

[Table/Fig-8]: Demographic comparison by dominant leg.
*Independent samples t-test applied; p<0.05 considered statistically significant

Leg dominance in unilateral vs. bilateral KOA: In unilateral KOA cases (n=93), 93.5% were right-leg dominant and 6.5% left-leg dominant. In bilateral KOA cases (n=38), 97.4% were right-leg dominant and 2.6% left-leg dominant. The difference in dominance distribution between unilateral and bilateral groups was not statistically significant (p-value=0.673). This suggests that while leg dominance is strongly related to which side experiences symptoms, it may not be a major determinant of whether both knees eventually become affected [Table/Fig-9].

KOA type	Right-leg dominant n (%)	Left-leg dominant n (%)	p-value¹	Cramer's V
Unilateral (n=93)	87 (93.5)	6 (6.5)	0.673	0.04 (negligible)
Bilateral (n=38)	37 (97.4)	1 (2.6)		

[Table/Fig-9]: Leg dominance distribution in unilateral vs. bilateral KOA.
*¹Fisher's exact test; p<0.05 considered statistically significant

DISCUSSION

This study examined the relationship between leg dominance and the symptomatic presentation of KOA using both self-reported and task-based assessments. The results revealed a strong association between leg dominance and the symptomatic presentation of KOA, with 94.7% of participants (n=124) demonstrating right-leg dominance across all functional tasks. The complete concordance between self-reported dominance and observed performance in mobilising tasks, such as kicking, supports the validity of using both subjective and objective methods to assess limb dominance, consistent with previous studies emphasising their concordance in healthy adults.

Notably, participants with left-leg dominance were more likely to report left-sided KOA and a sudden onset of symptoms. This could reflect compensatory motor adaptations developed to reduce mechanical load on the symptomatic side, a phenomenon previously observed in neuromuscular assessments of KOA patients. Importantly, in present study effect size analyses revealed that left-leg dominant participants were nearly 17 times more likely to report sudden onset compared to right-leg dominant individuals (OR = 16.9, 95% CI: 3.0-94.4).

This underscores that the observed association is not only statistically significant but also clinically meaningful. Similar compensatory strategies have been documented during unilateral tasks, particularly when joint pain or instability influences task execution [12]. The findings align with prior research suggesting that leg dominance and limb asymmetries may lead to unequal joint loading. Golightly YM et al., found that limb length inequality was associated with an increased risk and severity of KOA, especially in the longer or mechanically overloaded limb [9]. Likewise, a study on patients with unilateral hip OA demonstrated higher loading on the contralateral knee, supporting the role of chronic mechanical stress in joint degeneration [8].

Biomechanical studies have shown that KOA patients often exhibit altered joint kinematics and reduced muscle activation in key stabilisers, such as the quadriceps and gluteus medius, which may exacerbate joint instability. Present study observation of task-dependent variability in limb use, especially in stabilising tasks, aligns with this evidence and highlights the impact of neuromuscular adaptation on functional performance [14]. Quadriceps weakness, a well-established risk factor for KOA, has also been linked to disease progression and functional limitations. The preferential use of the non affected limb in unilateral tasks may represent a protective strategy but could further contribute to asymmetrical loading and degeneration progression in the contralateral joint [12]. Additionally, Karataş L and Utkan Karasu A, emphasised the influence of foot posture and medial longitudinal arch height on symptom severity in KOA, suggesting a broader interplay of biomechanical factors that were not addressed in the current study. Future research incorporating gait analysis, foot posture assessment, and limb alignment evaluations would provide a more comprehensive understanding of these interactions [8].

While biomechanical mechanisms, such as asymmetric loading and differences in neuromuscular control, offer plausible explanations for the observed associations, other factors may also have influenced these findings. Occupational demands, sports participation, previous lower limb injuries, and cultural or habitual movement patterns could impact both limb dominance and the side or onset of KOA symptoms [12, 13]. From a clinical perspective, early identification of functional asymmetries through subjective questionnaires and task-based observations may assist in tailoring rehabilitation strategies. Interventions that address strength imbalances, correct abnormal gait patterns, and improve neuromuscular control could potentially delay symptom progression and enhance function in individuals at risk for asymmetric KOA. Future longitudinal studies with larger, more balanced samples and comprehensive biomechanical assessments are recommended to better understand the role of leg dominance in KOA pathophysiology.

Limitation(s)

This study has certain drawbacks. A critical limitation is the very small subgroup of left-leg-dominant participants (n=7). The extremely limited number of left-dominant cases restricts statistical power, increases the risk of Type I errors, and prevents reliable generalisation to the wider KOA population. Another limitation was that the analyses relied on bivariate comparisons without adjusting for potential confounders such as age, BMI, and gender. The absence of multivariate regression modeling means that the observed associations may be partly explained by these unaccounted variables. Moreover, important biomechanical parameters, including foot posture, gait patterns, and limb alignment, were not evaluated.

CONCLUSION(S)

This study highlights a strong association between leg dominance and symptomatic KOA, suggesting that dominant limb mechanics may contribute to asymmetrical joint loading and symptom development. Assessing leg dominance through both self-report and task observation may support the early identification of at-risk individuals and inform targeted rehabilitation strategies. However, the very small subgroup of left-leg-dominant participants represents a critical limitation, and the findings related to left dominance cannot be generalised without replication in larger and more balanced samples.

REFERENCES

[1] World Health Organization. Osteoarthritis. 2023. Available from: https://www.who.int/news-room/fact-sheets/detail/osteoarthritis.
[2] Li E, Tan J, Xu K, Pan Y, Xu P. Global burden and socioeconomic impact of knee osteoarthritis. Front Med (Lausanne). 2024;11:1323091.
[3] StatPearls. Knee Osteoarthritis [Internet]. NCBI Bookshelf; 2023. Available from: https://www.ncbi.nlm.nih.gov/books/NBK507884/.
[4] GBD 2021 Osteoarthritis Collaborators. Global, regional, and national burden of osteoarthritis, 1990-2020 and projections to 2050: A systematic analysis for the Global Burden of Disease Study 2021. Lancet Rheumatol. 2023;5(8):e508-20.
[5] Hunter DJ, Bierma-Zeinstra S. Osteoarthritis. Lancet. 2019;393(10182):1745-59.
[6] Sharma L. Osteoarthritis year in review 2015: Clinical. Osteoarthritis Cartilage. 2016;24(1):36-48.
[7] Case R, Thomas E, Clarke E, Peat G. Prodromal symptoms in knee osteoarthritis: A nested case-control study using data from the osteoarthritis initiative. Osteoarthritis Cartilage. 2015;23(7):1083-89. Doi: 10.1016/j.joca.2014.12.026.
[8] Karataş L, Utkan Karasu A. Association of medial longitudinal arch height and stiffness with lower extremity alignment, pain, and disease severity in knee osteoarthritis: A cross-sectional study. Arch Rheumatol. 2024;39(4):641-51. Doi:10.46497/ArchRheumatol.2024.10858.
[9] Golightly YM, Allen KD, Renner JB, Helmick CG, Salazar A, Jordan JM. Relationship of limb length inequality with radiographic knee and hip osteoarthritis. Osteoarthritis Cartilage. 2007;15(7):824-29.
[10] Harvey WF, Yang M, Cooke TD, Segal NA, Lane N, Lewis CE, Felson DT. Associations of leg length inequality with prevalent, incident, and progressive knee osteoarthritis: A cohort study. Ann Intern Med. 2010;152(5):287-95. Doi: 10.1059/0003-4819-152-5-201003020-00006.
[11] Pan J, Huang W, Huang Z, Luan J, Zhang X, Liao B. Biomechanical analysis of lower limbs during stand-to-sit tasks in patients with early-stage knee osteoarthritis. Front Bioeng Biotechnol. 2023;11:1330082.
[12] Shakoor N, Dua A, Thorp LE, Mikolaitis RA, Wimmer MA, Foucher KC, et al. Asymmetric loading and bone mineral density at the asymptomatic knees of patients with unilateral hip osteoarthritis. Arthritis Rheum. 2011;63(12):3853-58.

[13] Alnahdi AH, Zeni JA, Snyder-Mackler L. Muscle impairments in patients with knee osteoarthritis. Sports Health. 2012;4(4):284-92.
[14] Norte GE, Hertel J, Saliba SA, Diduch DR, Hart JM. Quadriceps neuromuscular function in patients with anterior cruciate ligament reconstruction and knee osteoarthritis. J Athl Train. 2018;53(5):475-85.
[15] Lwanga SK, Lemeshow S. Sample size determination in health studies: A practical manual. Geneva: World Health Organization; 1991.
[16] van Melick N, Meddeler BM, Hoogeboom TJ, Nijhuis-van der Sanden MWG, van Cingel REH. How to determine leg dominance: The agreement between self-reported and observed performance in healthy adults. PLoS One. 2017;12(12):e0189876. Doi: 10.1371/journal.pone.0189876.
[17] Kellgren JH, Lawrence JS. Radiological assessment of osteo-arthrosis. Ann Rheum Dis. 1957;16(4):494-502. Doi: 10.1136/ard.16.4.494.
[18] Ipek F, Doğan M, Yildiz Kabak V, Atasavun Uysal S, Düger T. Cross-cultural adaptation, validity and reliability of Turkish version of the Waterloo Handedness and Footedness Questionnaire-Revised. Laterality. 2021;26(4):465-80. Doi: 10.1080/1357650X.2021.1882479. PMID: 33545018.
[19] Aloraini SM. Waterloo Handedness Questionnaire: Cross-cultural adaptation and psychometric properties of the Arabic version. Occup Ther Int. 2022;2022:3026415. Doi: 10.1155/2022/3026415. PMID: 36304079; PMCID: PMC9581684.

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