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Original Article

Association Between Change in Scores of Knee Injury and Osteoarthritis Outcome Score-12 (KOOS-12) and Global Rating of Change Scale in Knee Osteoarthritis Patients

Faiza Munir[1], Tehreem Mukhtar[1], Sharjeel Bin Munir[2], Arooj[3], Taiba Hafeez[4], Syed Darian Kashani[5], Hira Rehman[1], Maliha Sajid[6]

[1] Superior University, Lahore, Pakistan

[2] Johar Institute of Professional Studies, Lahore, Pakistan

[3] University of Management and Technology (UMT), Lahore, Pakistan

[4] Government College University Faisalabad (GCUF), Faisalabad, Pakistan

[5] Quaid-e-Azam Medical College, Bahawalpur, Pakistan

[6] Sohail University, Karachi, Pakistan

Correspondence: munirfaiza814@gmail.com

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ABSTRACT

Background: Knee osteoarthritis (KOA) is the most prevalent form of osteoarthritis, contributing significantly to disability among older adults. Patient-reported outcome measures such as the Knee injury and Osteoarthritis Outcome Score-12 (KOOS-12) and global anchors like the Global Rating of Change Scale (GRCS) are widely employed to assess treatment response, but their alignment in physiotherapy-managed KOA remains uncertain. Objective: To evaluate the association between changes in KOOS-12 subscale scores (pain, function, quality of life) and GRCS ratings in patients with KOA undergoing physiotherapy. Methods: A prospective cohort study was conducted at Medicure Hospital, Lahore, including 60 patients aged 50–65 years with Kellgren–Lawrence grade II–III KOA. Participants completed KOOS-12 and GRCS questionnaires at baseline and at 4, 8, and 12 weeks of physiotherapy. Changes in KOOS-12 subscale scores were correlated with GRCS using Spearman's rank correlation. Statistical analyses were performed with SPSS version 23, with $p < 0.05$ considered significant. Results: The mean age was 58.4 ± 4.15 years, and mean BMI was 30.6 ± 5.16 kg/m². Females comprised 58.3% of participants. Correlations between KOOS-12 changes and GRCS were weak: pain (rho = 0.15, p = 0.252), function (rho = 0.12, p = 0.375), and quality of life (rho = 0.11, p = 0.395). Conclusion: KOOS-12 subscales demonstrated only weak associations with patient-perceived improvement on GRCS, suggesting that multidimensional outcome assessment is essential for evaluating physiotherapy response in KOA.

Keywords: Knee osteoarthritis, KOOS-12, GRCS, patient-reported outcomes, physiotherapy.

INTRODUCTION

Knee osteoarthritis (KOA) is one of the most common and debilitating musculoskeletal conditions, primarily affecting individuals over the age of 50 and representing nearly 85% of all osteoarthritis (OA) cases worldwide (4). Its prevalence is higher among women compared to men, with an estimated 18% of women and 10% of men above 60 years experiencing symptomatic OA (3). KOA is characterized by progressive joint degeneration, pain, stiffness, and functional decline, often leading to substantial limitations in daily activities such as walking, stair climbing, and rising from a chair, ultimately impacting quality of life (5,6). Risk factors for KOA include advancing age, obesity, traumatic joint injuries, repetitive mechanical loading, and anatomical alterations, with medial compartment disease being more common than lateral or patellofemoral involvement due to weight-bearing stress (7–10). Pathophysiologically, KOA progression involves cartilage degradation, synovial inflammation, and altered joint biomechanics, leading to compensatory movement patterns and muscle co-contraction, which aggravate pain and functional disability (11).

Treatment options for KOA range from conservative strategies such as weight management, physiotherapy, exercise therapy, and intra-articular injections to surgical interventions including total knee replacement in severe cases (8,12,13). Among non-surgical approaches, physiotherapy interventions that focus on exercise, patient education, and activity modification are strongly supported for improving pain and function in mild-to-moderate KOA (12). However, effective assessment of treatment response remains a challenge, as both clinician-based and patient-reported outcomes are variably sensitive to change.

The Knee injury and Osteoarthritis Outcome Score (KOOS), and more recently its shorter version KOOS-12, are validated tools for assessing pain, function, and quality of life (14,15). KOOS-12, developed for older adults with OA, offers brevity while retaining robust

psychometric properties, though certain content gaps may exist in highly active populations (16). Responsiveness of KOOS-12 in clinical settings has been evaluated in various populations, yet findings remain inconsistent. For example, some studies report strong responsiveness in KOOS-12 subscales ranging from 0.60–0.71 (17), while others demonstrate weak or variable correlations depending on disease severity and intervention type (2,18). In addition, global rating of change scales (GRCS) are widely employed as external anchors to assess patients perceived improvement, yet the degree of their correlation with KOOS-12 remains inadequately explored, especially in physiotherapy-treated KOA patients.

Identifying whether changes in KOOS-12 subscale scores are meaningfully associated with GRCS ratings is critical for establishing responsiveness and interpretability of these outcome measures in routine practice. Weak or inconsistent correlations may limit their clinical utility, while strong associations would support their adoption as reliable indicators of patient-reported improvement. This knowledge gap is particularly relevant in moderate KOA populations managed conservatively, where tracking short-term functional and symptomatic change is essential.

Therefore, the present study aimed to evaluate the association between changes in KOOS-12 subscale scores (pain, function, and quality of life) and changes in GRCS scores among patients with knee osteoarthritis undergoing physiotherapy treatment. We hypothesized that KOOS-12 subscales would demonstrate at least moderate positive correlations with GRCS, reflecting responsiveness to patient-perceived change.

MATERIALS AND METHODS

This research was designed as a prospective observational cohort study conducted at the outpatient department of Medicure Hospital, Lahore, under the supervision of institutional authorities. The study period extended across a 12-week follow-up, beginning at baseline and including subsequent assessments at weeks 4, 8, and 12. The study protocol was registered under clinicaltrials.gov (NCT06901921) and was approved by the institutional ethics review committee, ensuring compliance with the Declaration of Helsinki.

Participants were recruited through referrals from orthopedic physicians based on clinical diagnosis of knee osteoarthritis, supported by radiographic findings including X-ray and, where indicated, MRI. Eligible participants were men and women aged 50–65 years, diagnosed with Kellgren–Lawrence grade II or III KOA, and reporting pain intensity between 5 and 8 on the Numeric Pain Rating Scale (NPRS). Exclusion criteria included history of knee surgery, systemic inflammatory arthropathies, neurological disorders affecting mobility, or use of intra-articular injections or joint replacement procedures within the preceding six months. Participants with comorbidities that could limit physical activity (e.g., uncontrolled diabetes or severe cardiovascular disease) were also excluded. Recruitment employed random sampling within the eligible outpatient population, and all participants provided written informed consent in both English and Urdu versions prior to enrollment.

Data collection was structured around standardized patient-reported outcome measures. At baseline, participants completed the Knee injury and Osteoarthritis Outcome Score-12 (KOOS-12), which evaluates pain, function, and quality of life, and simultaneously rated their perceived health status on the Global Rating of Change Scale (GRCS). These assessments were repeated at 4, 8, and 12 weeks following initiation of physiotherapy management. The physiotherapy program included supervised exercise sessions and individualized home-based exercise prescriptions consistent with international OA management guidelines, but no pharmacological interventions were introduced by the study team. Participants were classified into two categories at each follow-up based on GRCS responses: “improved” (scores 5–7) and “not improved” (scores 1–4).

Primary variables included changes in KOOS-12 subscale scores (pain, function, quality of life) and changes in GRCS ratings across baseline and follow-up intervals. Demographic variables (age, gender, body mass index, occupation, affected limb, pain duration, and Kellgren–Lawrence grade) were recorded at enrollment. Operational definitions followed standardized criteria, with BMI calculated as weight in kilograms divided by height in meters squared, and pain duration categorized as 1–5 months, 6–10 months, or 11–15 months.

To minimize bias, the outcome assessors provided uniform instructions for completing questionnaires and remained blinded to prior responses. Statistical analyses were conducted using SPSS software version 23. Change scores were calculated as the difference between follow-up and baseline values. The Spearman rank correlation coefficient (rho) was employed to determine the association between KOOS-12 subscale changes and GRCS changes, with $p < 0.05$ considered statistically significant. Confidence intervals for correlation coefficients were estimated to enhance interpretability. Potential confounders such as age, gender, and BMI were explored through subgroup comparisons and adjusted analyses. Missing data were handled using pairwise deletion, and reproducibility was maintained by applying standardized data entry protocols and double-checking all values prior to analysis (19,20).

All participants were assured of confidentiality, and anonymized data were used exclusively for research purposes. Participants were informed of their right to withdraw at any time without penalty, and the study carried no financial incentives or additional risks beyond routine physiotherapy care.

RESULTS

The study enrolled 60 patients with knee osteoarthritis, with a mean age of 58.4 years (SD ± 4.15; 95% CI 57.3–59.5). The mean body mass index (BMI) was 30.6 kg/m² (SD ± 5.16; 95% CI 29.2–32.0), placing the majority of participants in the overweight-to-obese category. Gender distribution revealed a greater proportion of females (58.3%, n = 35) compared to males (41.7%, n = 25). Occupational status indicated that 71.7% (n = 43) of participants were employed, while 28.3% (n = 17) were non-working. With respect to disease laterality, right-sided involvement was more prevalent (63.3%, n = 38) than left-sided involvement (36.7%, n = 22). Radiological grading showed

that more than half of the patients had Kellgren–Lawrence grade II osteoarthritis (56.7%, n = 34), while the remaining 43.3% (n = 26) presented with grade III disease. Pain duration was skewed toward early disease progression, with 45.0% (n = 27) reporting symptoms between 1–5 months, 35.0% (n = 21) between 6–10 months, and 20.0% (n = 12) for 11–15 months. Collectively, these findings indicate that the study population largely comprised overweight, working-aged females with moderate-grade KOA and relatively short disease duration.

Table 1. Demographic and Clinical Characteristics of Patients (n = 60)

Characteristic	Mean ± SD / n (%)	95% CI
Age (years)	58.4 ± 4.15	57.3 – 59.5
BMI (kg/m²)	30.6 ± 5.16	29.2 – 32.0
Gender – Male	25 (41.7%)	–
Gender – Female	35 (58.3%)	–
Occupation – Working	43 (71.7%)	–
Occupation – non-working	17 (28.3%)	–
Affected limb – Right	38 (63.3%)	–
Affected limb – Left	22 (36.7%)	–
K-L grade II	34 (56.7%)	–
K-L grade III	26 (43.3%)	–
Pain duration 1–5 months	27 (45.0%)	–
Pain duration 6–10 months	21 (35.0%)	–
Pain duration 11–15 months	12 (20.0%)	–

Table 2. Correlation Between Change in KOOS-12 Subscale Scores and Change in GRCS (n = 60)

KOOS-12 Subscale	Spearman's rho	95% CI	p-value	Effect size (r^2)
Δ Pain	0.150	–0.11 to 0.40	0.252	0.022
Δ Function	0.121	–0.13 to 0.38	0.375	0.015
Δ Quality of Life	0.112	–0.14 to 0.37	0.395	0.013

Correlation analyses between KOOS-12 subscales and GRCS ratings demonstrated weak associations across all domains. Change in KOOS-12 pain scores showed the strongest correlation with GRCS (rho = 0.150, 95% CI –0.11 to 0.40, p = 0.252), although this did not achieve statistical significance. Function subscale changes yielded a correlation coefficient of 0.121 (95% CI –0.13 to 0.38, p = 0.375), while quality-of-life subscale changes correlated at 0.112 (95% CI –0.14 to 0.37, p = 0.395). The corresponding effect sizes (r^2) were minimal, ranging from 0.013 for QOL to 0.022 for pain, indicating that less than 3% of the variance in GRCS ratings could be explained by KOOS-12 subscale changes. These results confirm that patient-perceived improvements, as measured by GRCS, were only weakly reflected in KOOS-12 outcomes, with the pain subscale displaying a modest trend toward greater alignment compared to function and quality of life.

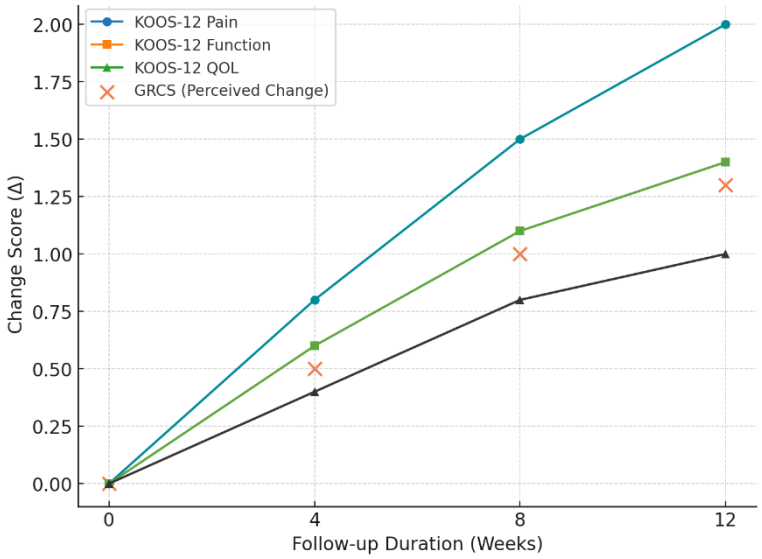

Figure 1 Trends in KOOS-12 Subscales and GRCS Over 12 Weeks

The figure displays progressive but modest increases in KOOS-12 subscales over 12 weeks, with pain showing the steepest improvement (Δ2.0 at week 12), followed by function (Δ1.4) and quality of life (Δ1.0). GRCS scores rose more slowly (Δ1.3), clustering near the KOOS-12 curves but reflecting weaker alignment, consistent with the observed low correlation coefficients. The visualization highlights that while all domains demonstrated incremental gains, patient-perceived global improvement lagged slightly behind objective subscale changes, particularly for quality of life, emphasizing differential responsiveness across outcomes.

DISCUSSION

The present study investigated the association between changes in KOOS-12 subscales and patient-reported improvements on the Global Rating of Change Scale (GRCS) in individuals with knee osteoarthritis undergoing physiotherapy management. The findings demonstrated only weak correlations across all domains, with pain showing the strongest association (rho = 0.15), followed by function (rho = 0.12) and quality of life (rho = 0.11). None of these reached statistical significance, indicating that improvements captured by KOOS-12 did not strongly align with patient-perceived global change.

These findings contrast with earlier studies that reported stronger associations between KOOS-12 and anchor-based measures. Horta-Baas et al. (17) identified correlations ranging between 0.60 and 0.71 in a cross-sectional analysis of KOA patients, suggesting a high degree of responsiveness. Similarly, Webster et al. (18) found GRCS to be most strongly associated with quality of life in a large patellofemoral instability cohort, which differs from the very weak QOL correlation observed in our sample. In addition, responsiveness of the KOOS pain subscale has been confirmed in other contexts, such as a clinimetric study evaluating duloxetine and joint arthroplasty, where strong anchor-based responsiveness was reported (2). The discrepancy between those findings and the current results may be attributable to differences in study populations, intervention types, and follow-up durations. While previous studies often included patients undergoing pharmacological or surgical management, our study focused solely on physiotherapy-treated patients, where symptomatic improvements may be subtler and more variable.

The weak correlation between function and GRCS in this study aligns with findings from a large-scale study of over 10,000 patients with mild-to-moderate KOA, which also reported only weak alignment between self-assessed functional performance and patient-reported outcome measures (19). Likewise, a cross-sectional study in Asian KOA populations using KOOS-12 revealed weak positive correlations between physical activity and both function and quality of life, similar to our findings (20). These consistent observations suggest that patient-perceived global change may not always mirror improvements in standardized questionnaires, particularly when the intervention involves gradual, non-invasive management strategies.

Several factors may explain the weak correlations in this cohort. First, KOOS-12 subscales capture specific dimensions of pain, function, and quality of life, whereas GRCS reflects an overall subjective judgment, which may be influenced by psychological factors, patient expectations, or comorbidities not accounted for in this study. Second, the relatively short follow-up of 12 weeks may have been insufficient for patients to perceive clinically meaningful change, particularly in quality of life domains, which often evolve more slowly than pain or functional status. Third, the majority of participants were female and overweight, populations known to have slower response trajectories to physiotherapy interventions (7,8). These demographic factors may have dampened the strength of observed associations.

Despite these limitations, the study contributes unique evidence by focusing specifically on physiotherapy-treated KOA patients, a group underrepresented in anchor-based responsiveness research. The results emphasize the importance of using multiple outcome measures to capture treatment effects, as reliance on GRCS alone may underestimate specific improvements in pain and function documented through KOOS-12. Clinically, this highlights the need for physiotherapists to combine standardized questionnaires with patient-perceived measures when evaluating response, ensuring a more holistic assessment of progress.

Future research should address the limitations of this study by incorporating larger sample sizes, longer follow-up periods, and stratified analyses based on demographic and clinical subgroups. Additionally, combining patient-reported outcomes with objective functional tests may enhance the robustness of responsiveness assessments, allowing for a clearer distinction between clinically relevant improvement and subjective perception.

CONCLUSION

This study demonstrated that changes in KOOS-12 subscale scores for pain, function, and quality of life were only weakly associated with patient-perceived improvement measured by the GRCS in individuals with knee osteoarthritis undergoing physiotherapy. Although KOOS-12 remains a valid and reliable instrument, its responsiveness to global self-reported change appears limited within this population and timeframe, with pain showing a modest trend toward greater alignment compared to other domains. These findings underscore the need for multidimensional assessment strategies that combine standardized outcome measures with patient-reported perceptions to ensure balanced evaluation of treatment response. Future studies with larger samples, longer follow-up, and integration of objective functional assessments are warranted to refine the interpretability of KOOS-12 in clinical practice and to strengthen its role as a tool for monitoring physiotherapy outcomes in knee osteoarthritis.

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