



## RESEARCH ARTICLE

## Reliability and validity of the Bangla version of the knee injury and osteoarthritis outcome score

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### ABSTRACT

**Background:** Patient self-assessed outcome scores for musculoskeletal conditions are limited in Bangladesh, especially for knee osteoarthritis. Therefore, a reliable outcome measure like the widely used knee injury and osteoarthritis outcome score (KOOS) for Bangladeshi population is necessary. The aim was to assess the validity and reliability of the Bangla version of KOOS.

**Methods:** Following Beaton *et al.* forward-backwards method, an expert committee translated and adapted the original English version of KOOS with slight modifications for the Bangladeshi Bangla-speaking population. The psychometric testing assessed the questionnaire's reliability using internal consistency (Cronbach's alpha) and test-retest reliability (Intraclass correlation coefficients). The questionnaire was compared to validated Bangla versions of the Short-Form 36 health survey (SF-36) and the Western Ontario and McMaster Universities Arthritis Index (WOMAC) to establish construct validity.

**Results:** This study involved 150 patients with knee osteoarthritis. Bangla KOOS was found to have good internal consistency (0.77-0.88) and high test-retest reliability (0.86-0.99). Construct validity was established by comparing Bangla KOOS with the WOMAC and SF-36. The Bangla KOOS sub-scores showed negative correlations with WOMAC domains ( $\rho = -0.41$  to  $-0.93$ ) and positive correlations with SF-36 domains ( $\rho = 0.26$  to  $0.68$ ).

**Conclusions:** Findings showed that the Bangla KOOS is a reliable and valid measure for evaluating outcomes in Bangladeshi patients with knee osteoarthritis. It is a dependable and valid outcome measure tailored to the local language.

**Keywords:** Bangla, KOOS, validity, reliability, osteoarthritis

### INTRODUCTION

Systemic Osteoarthritis of the knee is a major cause of chronic and long-term disability in adults and poses a significant global health challenge. It is most common after the age of 40, with its prevalence rising sharply as people get older.<sup>1</sup> In Bangladesh, knee osteoarthritis is the second most prevalent musculoskeletal condition,<sup>2</sup> leading to substantial work loss.<sup>3</sup> Bangladesh's economic progress has led to an expanding aging population, and estimates suggest a 160% rise in the global population aged 65 or above between 2008 and

2040.<sup>4</sup> As Bangladesh experiences economic growth and an aging population, the prevalence and associated healthcare costs of knee osteoarthritis are expected to rise, adding to the existing economic burden. Consequently, the increase in evidence-based practice necessitates the availability of user-friendly, validated, and dependable clinical tools to assess treatment response and make precise clinical decisions.<sup>5, 6</sup> Therefore, it is crucial for researchers and clinicians to measure the clinical conditions in patients with knee osteoarthritis.

## HIGHLIGHTS

1. This study assessed the reliability and validity of the Bangla version of the knee injury and osteoarthritis outcome score (KOOS) in individuals with knee osteoarthritis.
2. The KOOS is a widely used patient-reported outcome measure designed to assess symptoms and functional limitations in patients with knee injuries and osteoarthritis.
3. We found the Bangla version of the KOOS is suitable for use in both clinical and research settings, particularly in Bangladesh and other regions where Bangla is spoken.

The knee injury and osteoarthritis outcome score (KOOS) is a widely used instrument for assessing the functional status and symptoms of individuals with knee injuries.<sup>7-8</sup> The assessment tool consists of 42 items that examine pain, symptoms, activities of daily living (ADL), sports and recreational function, and knee-related quality of life (QOL). Initially created in English and Swedish, the KOOS scale is currently available in over 45 languages.<sup>9</sup>

Currently, there is no validated version of the KOOS outcome measurement tool available in Bangla. However, there is a Bangla version (done among Bengali speaking Indian population), which has not been validated.<sup>10</sup> This study aims to adapt and validate the Bangla version of KOOS for the Bangladeshi population to promote broader use of this questionnaire in patients with knee osteoarthritis and facilitate multinational studies. Specifically, the study will assess the test-retest reliability, internal consistency, and construct validity of the Bangla version of KOOS.

## METHODS

This study included 150 individuals diagnosed with knee osteoarthritis who were receiving outpatient treatment at four medical institutions in Bangladesh: The Department of Physical Medicine and Rehabilitation at Bangabandhu Sheikh Mujib Medical University (BSMMU), Kurmitola General Hospital in Dhaka, Sher-E-Bangla Medical College Hospital in Barishal, and the Department of Orthopedic Surgery at Cumilla Medical College Hospital in Cumilla. Among the participants, 85 were female. The diagnosis was confirmed by an orthopedic surgeon and two

physiatrists based on clinical and radiographic findings. Individuals with language difficulties or other conditions affecting knee symptoms, such as rheumatoid arthritis, were excluded.

### ***Adaptation of the Bangla version of KOOS to Bangladeshi Bangla***

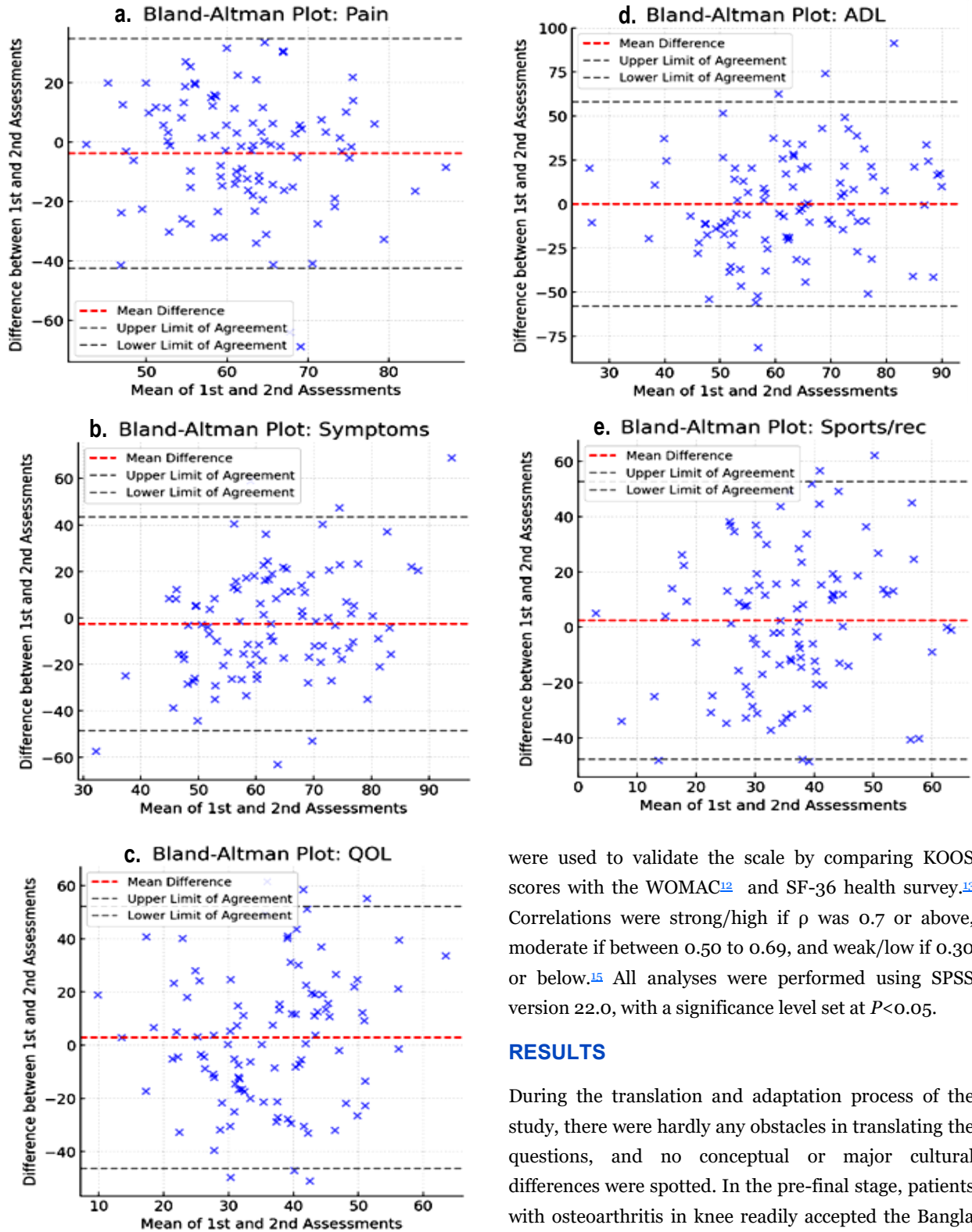
Cross-cultural adaptation is essential when introducing a self-reported outcome measure to a new country. In this study, we followed Beaton *et al.*'s forward-backward method.<sup>11</sup> After synthesising two forward translations, we compared our Bangla version with the Indian-translated version to minimize cultural differences between Bangladeshi and Indian Bangla. We then produced a final Bangla version, which was back translated into English, followed by subsequent stages. The pre-final Bangla version was tested on 20 volunteer patients to confirm comprehension, and the final version was evaluated for reliability and validity among 30 participants.

### ***Test procedure***

Each participant completed three questionnaires: (1) the adapted Bangla version of KOOS, (2) the validated Bangla version of the Western Ontario and McMaster Universities Arthritis Index (WOMAC),<sup>12</sup> and (3) the validated Bangla version of the Short Form 36 (SF-36) health survey.<sup>13</sup> The participants were randomly selected and invited for a second data collection at two points in time at least seven days apart.

### ***Statistical analyses***

The instrument's test-retest reliability was assessed using the intraclass correlation coefficient (ICC), and internal consistency was evaluated with Cronbach's alpha, where a coefficient of 0.70 or higher is considered acceptable.<sup>14</sup> To assess agreement between repeated KOOS measurements, the Bland-Altman method was applied across its five domains: pain, symptoms, activities of daily living (ADL), sports/recreation, and quality of life (QOL). The plots demonstrated good test-retest repeatability, with most differences falling within the established agreement limits, confirming the KOOS's reliability in a clinical setting. Spearman's rank correlation coefficients ( $\rho$ )



**FIGURE 1** Bland-Altman plot for test-retest reliability of Bangla version of knee injury and osteoarthritis outcome score (KOOS) of (a) pain, (b) symptoms, (c) quality of life (QOL), (d) activities of daily living (ADL), and (e) sports/ recreation.

were used to validate the scale by comparing KOOS scores with the WOMAC<sup>12</sup> and SF-36 health survey.<sup>13</sup> Correlations were strong/high if  $\rho$  was 0.7 or above, moderate if between 0.50 to 0.69, and weak/low if 0.30 or below.<sup>15</sup> All analyses were performed using SPSS version 22.0, with a significance level set at  $P < 0.05$ .

**RESULTS**

During the translation and adaptation process of the study, there were hardly any obstacles in translating the questions, and no conceptual or major cultural differences were spotted. In the pre-final stage, patients with osteoarthritis in knee readily accepted the Bangla KOOS. Therefore, the questionnaire was used in the subsequent validation study without further adaptation or modification.

The individual Cronbach's alpha values for the five KOOS sub-scores, pain, symptoms, activities of daily living (ADL), sports/recreational function, and quality of life (QOL) were 0.88, 0.73, 0.86, 0.85, and 0.77, respectively (TABLE 1). The ICC for these sub-scores, ranged from 0.86 to 0.99.

The Bland-Altman plot shows the mean of the first and second assessments on the x-axis and the difference between the first and second assessments on the y-axis. The red dashed line represents the mean difference, and the grey dashed lines represent their 95% confidence intervals.

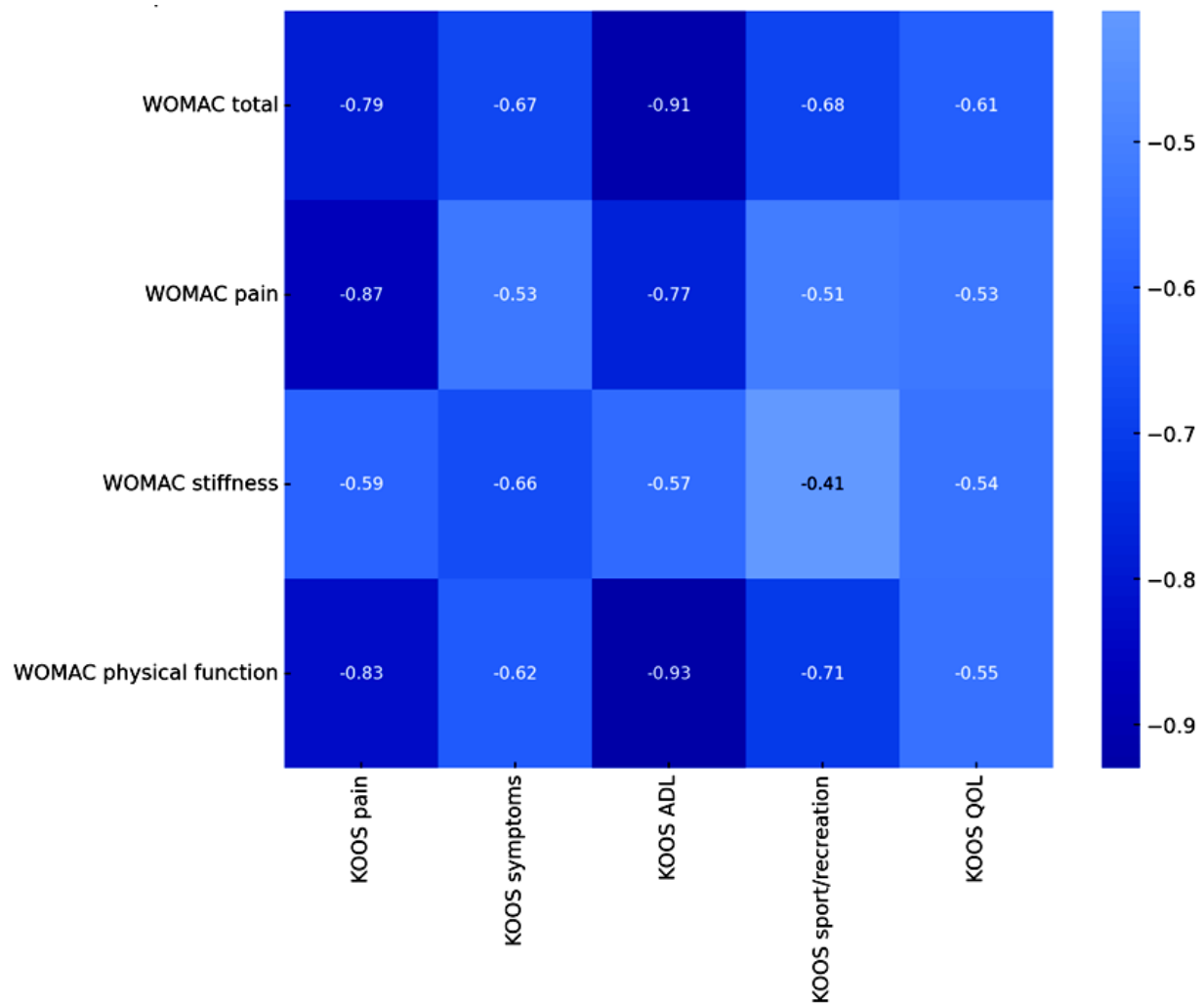
For the pain, the plot shows good agreement between the two assessments (1st mean: 61.5, sd: 13.5 and 2nd

**TABLE 1** Background internal consistency of knee injury and osteoarthritis outcome score (KOOS) domains (n=30)

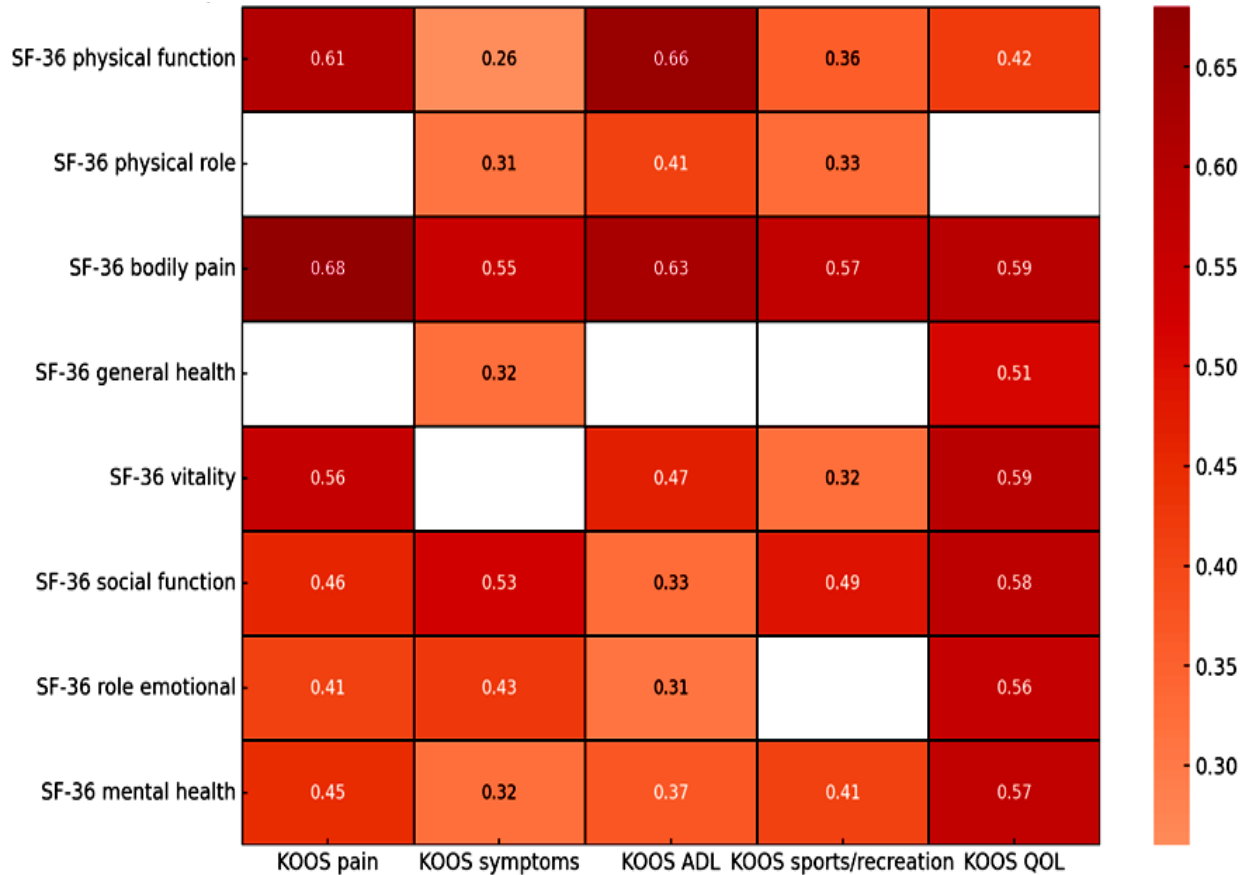
KOOS domains	Cronbach's alpha
Pain	0.88
Symptoms	0.73
Activities of daily living	0.86
Sport or recreation	0.85
Quality of life	0.77

mean: 63.5, sd: 14.7) with most differences centered around the mean difference line.

For symptoms, similar to the pain domain, the differences are well distributed around the mean difference (1st mean: 60.6, sd: 17.6 and 2nd mean: 62.6, sd: 15.6), indicating consistency between the two assessments. The plot for ADL also demonstrated good



**FIGURE 2** Spearman's rank correlation coefficients between Bangla version of knee injury and osteoarthritis outcome score (KOOS) and Western Ontario and McMaster Universities Arthritis Index (WOMAC)



**FIGURE 3** Spearman's rank correlation coefficients between Bangla version of knee injury and osteoarthritis outcome score (KOOS) and Short Form 36 (SF-36) scores

agreement, with the differences mostly lying within the limits of agreement (1st mean: 63.6, sd: 20.6 and 2nd mean: 64.6, sd: 19.6). Also, there is a noticeable clustering around the mean difference line for sports/recreation (1st mean: 36.5, sd: 17.4 and 2nd mean: 34.6, sd: 16.4), indicating strong agreement between the assessments. The differences for QOL (1st mean: 33.5, sd: 18.5 and 2nd mean: 34.5, sd: 15.5) are mainly within the limits of agreement, showing consistency between the first and second assessments (**FIGURE 1**).

The Spearman's rank correlation coefficients ( $\rho$ ) between KOOS and WOMAC scores, where  $\rho$  from -0.79 to -0.93 denotes strong negative correlations, and the  $\rho$  from -0.41 to -0.68 denotes moderate to strong negative correlations. KOOS sub-scores generally demonstrated moderate to very strong negative correlations with the WOMAC scores ( $\rho = -0.41$  to  $-0.93$ ) (**FIGURE 2**).

The Spearman's rank correlation coefficients ( $\rho$ ) between KOOS and SF-36 scores, where 0.61 to 0.68 indicate strong positive correlations, 0.26 to 0.59 weak to strong positive correlations. Non-significant correlations indicated by white or very light colours. A strong positive correlation were found between KOOS pain domain with SF-36 physical function (0.61) and bodily pain (0.68); KOOS ADL domain with SF-36 physical function (0.66) and bodily pain (0.63) (**FIGURE 3**).

## DISCUSSION

The study showed that the Bangla KOOS is a dependable and effective tool for measuring outcomes among Bangla-speaking patients with knee osteoarthritis. Excellent test-retest reliability of the Bangla KOOS was demonstrated in the participants with knee osteoarthritis. Such high ICC values could be explained by the duration of the symptoms in this

sample, which are almost similar to the original English,<sup>7</sup> Persian,<sup>16</sup> Arabic,<sup>17</sup> and Italian<sup>18</sup> version. The Cronbach's alpha values in the Bangla KOOS were above the 0.70 and similar to Chinese,<sup>6</sup> Arabic,<sup>17</sup> Italian,<sup>18</sup> Greek,<sup>19</sup> French,<sup>20</sup> and Spanish<sup>21</sup> versions of KOOS.

WOMAC was selected to evaluate the construct validity in this study because of its good validity and reliability among this patient.<sup>22</sup> In addition, its Bangla translation was available. The fairly strong correlations between KOOS and the WOMAC suggested agreement between the two scales and indicated good construct validity of the Bangla KOOS. The agreements were strong if the corresponding KOOS and WOMAC subcategories were compared. For instance, KOOS ADL ( $\rho = -0.93$ ) and pain ( $\rho = -0.87$ ) scores were highly associated with WOMAC physical function and pain scores. However, some unmatched domains, like KOOS sports and recreation function scores, demonstrated relatively weaker correlation with the WOMAC.

We selected SF-36 to evaluate its validity, as SF-36 is considered a generic quality of life measure. As we expected, only a fair to moderate significant association between KOOS and most of the domains of SF-36 was found in patients with knee osteoarthritis. Out of the eight subscales, physical function, bodily pain, social function and mental health were significantly associated with all subscores of KOOS ( $\rho = 0.32-0.66$ ,  $P < 0.05$ ). Moreover, the better self-perception of physical function and lower symptoms were associated with higher levels of knee function in the current study and previous reports.<sup>23</sup> According to other previous studies, the general health of SF-36 was not associated with most of the KOOS subscores due to its generic nature.<sup>24</sup> <sup>25</sup> SF-36 only assessed the self-perceived level of overall health and is comparatively less responsive, when compared with KOOS, to detect the changes in knee-related symptoms, function, and quality of life.<sup>26</sup> In particular, the insignificant association between sport and recreation function of KOOS and most of the mental health-related domains of SF-36, similar to other KOOS validation studies,<sup>27</sup> suggest the divergent construct validity.

The major limitation of the present study was the sample homogeneity. Although KOOS is a disease-specific instrument for patients with knee osteoarthritis, we did not include patients after total knee replacement. Therefore, the instrument's generalizability towards this particular sample is limited. In addition, the present study did not use direct outcome measurements as validation measures. Instead, we only focused on assessing the association of other relevant instruments with the Bangla Osteoarthritis Index. Further investigation addressing both direct and indirect measurements is warranted.

### Conclusion

Our data support that the Bangla KOOS is reliable, and valid instrument for self-assessment of symptoms and functional status in Bengali people with knee osteoarthritis. The current study can facilitate local research and multinational studies.

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### Author contributions

*Conception and design:* MIH, TM, and KH. *Acquisition, analysis and interpretation of data:* SMA, TM, and MIH. *Manuscript drafting and critical revision:* MIH, TM, SMA, KH, and RDC. *Approval of the final version of the manuscript:* MIH, TM, SMA, KH, and RDC. *Guarantor of accuracy and integrity of the work:* MIH and TM.

### Funding

This study did not receive any fund.

### Conflict of interest

We do not have any conflict of interest.

### Ethical approval

The study was approved by the Institutional Review Board of Sher-E-Bangla Medical College (memo no.: SBMC/IRB/2023/03). Although the KOOS instrument is in the public domain and does not require permission, we informed Prof. EM Roos about adapting the original version. The study followed the guidelines of the Declaration of Helsinki and written informed consent was obtained from all participants before the start of the study.

### Data availability statement

We confirm that the data supporting the findings of this study would be shared upon reasonable request.

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