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Degenerative Joint Scoring System - An Ortho-Rheumatological assessment tool

Manish Khanna [a], Preethi Selvaraj [b], Madhan Jeyaraman [a,c,*], Sathish Muthu [a,d], Venus Khanna [e]

[a] Indian Orthopaedic Rheumatology Association, Lucknow, Uttar Pradesh, India
[b] Department of Community Medicine, SRM Medical College Hospital and Research Centre, SRM Institute of Science and Technology, Chennai, Tamil Nadu, India
[c] Department of Orthopaedics, Faculty of Medicine – Sri Lalithambigai Medical College and Hospital, Dr MGR Educational and Research Institute, Chennai, Tamil Nadu, India
[d] Department of Orthopaedics, Government Medical College and Hospital, Dindigul, Tamil Nadu, India
[e] Deaprtment of Pathology, Prasad Institute of Medical Sciences, Lucknow, Uttar Pradesh, India

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ABSTRACT

Introduction: The most prevalent kind of arthritis in both developed and developing countries is osteoarthritis. Although many scales have been developed worldwide highlighting the importance of lifestyle interventions, very few scales have been constructed from developing countries and no scale has been developed in India. This study aims to develop a scale to assess osteoarthritis and describing the reliability, the validity of the instrument named Degenerative Joint Scoring System (DJSS).

Material and methods: The objective of this study was to develop and validate the scale to find out osteoarthritis. Epi info CDC sample size calculator was used to estimate the sample size. A total of 1120 study participants were present in our study to assess the sensitivity of the DJSS. Exploratory factor analysis was performed to assess the internal consistency of the scale. Content validity, construct validity, reliability, and yield were estimated.

Results: The scale-content validity index S-CVI/Average for the overall three constructs is 0.94. The reliability of the questionnaire was tested using Cronbach's alpha which was 0.9 and the intraclass correlation coefficient was 0.93; 95% CI (0.85, 0.96) ($P < 0.001$). The test-retest reliability was assessed showing $r = 0.92$. The Kaiser–Meyer–Olkin index was 0.805 for the adequacy of samples (Bartlett's test of sphericity was significant, $df = 105$, $P < 0.001$). As per the DJSS, 0–5 indicates possible osteoarthritis, 6–10 indicates probable osteoarthritis and 11–15 indicates definite osteoarthritis.

Conclusion: DJSS can help orthopaedicians, physiotherapists, and academics and researchers on the diagnosis of arthritis easily and recovery accessible. This instrument needs to be generalized by tracking the real outcomes of patient-reported outcome interventions from developed countries.

1. Introduction

The most prevalent kind of arthritis in both developed and developing countries is osteoarthritis (OA).[1] OA was ranked fourth among the world's diseases for the contributing disability factor. OA is the 11th largest contributor to global disability out of 291 conditions worldwide.[2] The most prevalent forms of OA are hip and knee OA, with the overall prevalence of knee osteoarthritis globally being 28.7%.[3] Around 22% to 39% of India's 1.25 billion population suffers from osteoarthritis. Osteoarthritis impacts the aging population mainly. In older people globally, it is a significant cause of injury. Around 9.6% of men and 18.0% of women aged over 60 years have symptomatic osteoarthritis globally, according to the World Health Organisation (WHO). One in two people over 85 years of age is commonly affected by the knee joint.[4] The disorder is associated with risk factors such as obesity, lack of exercise, genetic predisposition, bone mass, workplace accident, injuries, and gender that are modifiable and non-modifiable.[3] In women, OA is more popular than in men. Almost 45% of women over 65 years of age have signs, while 70% of those over 65 years of age show radiological evidence of OA.[5]

* Corresponding author. Department of Orthopaedics, Faculty of Medicine – Sri Lalithambigai Medical College and Hospital, Dr MGR Educational and Research Institute, Chennai, Tamil Nadu, India.
E-mail address: madhanjeyaraman@gmail.com (M. Jeyaraman).

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1.1. Existing scales

Knee osteoarthritis scales can be broadly classified into three types: radiological, arthroscopic, and functional. Radiological scales includes Kellgren and Lawrence scale (K & L),[6] International knee documentation committee scale (IKDC),[7] osteoarthritis Research Society International Joint Space Narrowing scale (OARSIJSN),[8] Whole-Organ Magnetic Resonance Imaging Score (WORMS),[9] and Ultrasonographic Grading Scale for Severity of Primary Knee Osteoarthritis (UGSSPKOA).[10] Arthroscopic knee OA scales includes French Society of Arthroscopy (SFA),[11] Collins, Moidified Collins and outer bridge scale.[12] Functional Knee OA scales includes Short Form 36 Arthritis Specific (SF 36 ASHI),[13] Western Ontario and McMaster University (WOMAC),[14] Knee Osteoarthritis Outcome Score (KOOS),[15] Functional Status Index; KSSS: Knee Society Scoring System (FSI),[16] Osteoarthritis Severity Indices of Lequesne (LEQUESNE), Comprehensive osteoarthritis test (COAT),[17] Ibadan Knee Osteoarthritis Outcome Measure (IKHOAM),[18] Community Balance and Mobility Scale (CBM), Arthritis Impact Measurement Scales (AIMS),[19] Knee Osteoarthritis Fears and Beliefs Questionnaire (KOF-BeQ),[20] and Medical Outcomes Study Questionnaire Short Form 36 Health Survey (MOS SF-36).[12]

1.2. Need for study

In India, many health care professionals treat patients with different stages of osteoarthritis. Surprisingly, however many of them do not use the appropriate scale or outcome measure to document their gained advantages.[8,9] Health care practitioners should be made mindful of the value of using appropriate scales to record the improvement of patients. An age-long tradition has become the assessment of patient success in healthcare settings. In clinical practice, the outcome indicator is the process by which the health care provider, the patient, the public can determine the final effects of care and its impact on the patient's and society's health.[10,21] In clinical decision making, the assessment of clinical findings in the health care delivery system is mandatory.[7,22] Physical disability due to pain and lack of functional capacity lowers the quality of life and raises the risk of further morbidity. Since highly efficient therapeutic management is not available, the preventive component of lifestyle interventions in the form of a balanced diet and exercise should be stressed. Although many scales have been developed worldwide highlighting the importance of lifestyle interventions, very few scales have been constructed from developing countries and no scale has been developed in India. This study aims to develop a scale to assess osteoarthritis and describing the reliability, the validity of the instrument named Degenerative Joint Scoring System (DJSS).

2. Methodology

The objective of this study was to develop and validate the scale to find out osteoarthritis. A semi-structured questionnaire was prepared to assess the personal history, family history, and other demographic variables, etc. The study started in the year of June 2021 for a period of six months. Ethical committee approval was taken for the conduction of the study and after taking informed consent to participate and publish the results of the study, the participants were exposed to the questionnaire to assess the demographic variables and one to one interview for pre-designed pretested validated modified questionnaire to assess the 15 determinants of osteoarthritis. Epi info CDC sample size calculator was used to estimate the sample size for descriptive study using random sampling at 5% confidence limit and 99% confidence level. The total sample size estimated was about 1019 for 37.9% prevalence of osteoarthritis according to Pal et al.[2] Adding 10% non-response rate, the total sample size was estimated around 1120. TRIPOD checklist of prediction model development and validation was used in our study.

The following steps were adopted before the development of the tool.

- ➢ A review of the literature provided adequate content for tool preparation.
- ➢ Analysis of the pros and cons with the existing instrument from these search engines including PubMed, PubMed Central, Medline, Scopus, and Google Scholar.
- ➢ Consultation with experts like knee replacement surgeon, arthroplasty surgeons

Initially, items like age, body mass index, sex, smoking, alcohol, menopausal status, difficulties of activities of daily living, major joint involvement, history of significant trauma, history of fractures, steroid use, developmental bone disease, metabolic bone disease, night pain, high risk of occupation, crepitus, ROM reduction, serum calcium, serum phosphorus, serum vitamin D3, x-ray joint space reduction, presence of osteophytes and deformities were included. After validation 22 items entered the final phase of 15 items.

The first category is socio-demographic variables with seven parameters including anthropometric characteristics. It comprised of age, body mass index (BMI), sex, smoking history, Alcohol history, menopausal history, difficulties in activities of daily living.

The second category was a total of five symptom determinants including developmental bone disease, metabolic bone disease, night pain, crepitus and range of movement reduction.

The third category is the laboratory determinant of osteoarthritis which has been identified for this study, which includes serum calcium, serum phosphorus, and serum vitamin D3.

2.1. Development of the criteria checklist

A criteria checklist for validation of all the tools was developed by the investigator. It comprises of areas relating to relevancy, appropriateness, and accuracy. The experts were requested to make either 'agree' or 'disagree' for each 'item against its relevancy', for tools on baseline variables, spiritual health behavior scale, and spiritual health practices. All experts were required to give their valuable suggestions or remarks.

2.2. Validation of instrument

The prepared tools along with the objectives, blueprints, and criteria rating scale were given to six experts. All the tools were returned after the validation of the content. There was 100% agreement in most of the items in the baseline proforma. To assess the DJSS tool, it was prepared which consisted initially of 24 items. The items were divided as per the areas as follows: Socio-demographic, symptom determinant, and laboratory determinant. For each domain, two constructs have been identified, and against each construct, there are determinants, which qualify for the construct. The three constructs within the domains were taken to formulate the DJSS consisting of 15 items.

2.3. Study participants

The study participants were chosen from the field practice area of private medical college and hospital. The participants above 30 years of age of both genders took part in the study. Data were collected by personal interview method from the residents of Chengalpattu district in their native language. The residential address of the participants was taken from rural health training center of private medical college and hospital. A total of 13,493 population were present in rural filed practice area of private medical college and hospital. A total of 2699 houses were identified. Sampling unit was stratified randomly selected individuals from that area, and from each house only one eligible person was interviewed. The participants were selected from every 2nd house in rural area in individual wards. If the selected house was locked, not willing to participate or no adult fulfilling the inclusion criteria, immediately the next house was visited. The study helps in developing a validated tool among family and community physicians to identify

degenerative joint diseases and to improve the quality of life. This study will help the community physicians to identify osteoarthritis at the earliest and helps in preventing future degenaration.

2.4. Statistical analysis

Descriptive statistics was reported as mean (SD) for continuous variables, frequencies (percentage) for categorical variables. In case of any missing data in excel, the data was retrieved retrospectively from data collection form. Cronbach's alpha and the intraclass correlation coefficient were used to find the reliability of the instrument. Factor analysis was done to scrutinize the construct validity of the questionnaire using Kaiser–Meyer–Olkin (KMO) index and Bartlett's test of sphericity. Scree plot was used to explain the proportion variance and ROC curve were used to illustrate the classification model at all classification thresholds.Data were statistically evaluated with IBM SPSS statistics for Windows, Version 26.0., IBM Corp., Chicago, IL.

3. Results

3.1. Content validity

To examine the content validity rate (CVR), the questionnaire was given to 6 experts in the specialties related to the field of the study; the answers were designed based on a three-point Likert scale consisting of necessary, helpful but not necessary, and not necessary. Then the questionnaire's CVR was assessed; according to the Lawsche table, if the item score was over 0.95, the item was considered as an appropriate and necessary one.[23] Regarding the obtained scores at this stage, those comments, and views of the respondents and the rethought on the items with lower scores, those that seemed unable to measure the desired concept or those that had a little connection with the issue were excluded.

The indexes of "relevance", "clarity", "simplicity" and "ambiguity" were examined. The experts were asked to respond to two questions: (1) the viewpoints they believed should be imposed and (2) suggestions for the items that should be entered into the questionnaire. A separate content validity index (CVI) was calculated for each item and scale. Thus, we calculated scale-content validity index S-CVI/Average for the overall three constructs (1.00 + 1.00+0.83 + 1.00+1.00 + 0.83)/6 = 0.94.

3.2. Reliability of the instruments

In total 15 items entered the final phase of DJSS. The reliability of the questionnaire was tested using Cronbach's alpha which was 0.91 (calculated by using SPSS V 20) and the intraclass correlation coefficient (ICC) was 0.93; 95% CI (0.85, 0.96) ($P < 0.001$). The test-retest reliability was assessed showing $r = 0.92$ (Pearson correlation coefficient). The scale was validated and reliability was established for the urban and rural literate adults. The content validity was evaluated with the help of a team of expert specialists. In general, the assessment of reliability and validity showed that the whole questionnaire had acceptable validity and reliability.

Factor analysis was done to scrutinize the construct validity of the questionnaire. This was assessed for the items encompassing of modified spiritual health scale. The range of factors for each item having Eigenvalue >1 was extracted for principal component analysis and its variance is shown in Table 1. The Kaiser–Meyer–Olkin (KMO) index was 0.805 for the adequacy of samples (Bartlett's test of sphericity was significant, $df = 105$, $P < 0.001$). Bartlett's Test of Sphericity is the test for the null hypothesis that the correlation matrix has an identity matrix.

3.3. Scoring on the scale

As per DJSS, in our present study, a total score of 15 was computed denoting one score of each determinant. The complete scheme of DJSS is given by Table 2 in which a cumulative score of 0–5 indicates probable osteoarthritis, 6–10 possible osteoarthritis and 11–15 indicates definite osteoarthritis.

3.4. Predictive factors of osteoarthritis

Scoring will be done for each of the items in the scale. Out of 15 items, age above 40, female gender, BMI more than 25, history of smoking, history of alcohol, menopausal history, difficulties in activities of daily living, presence of developmental bone disease, presence of metabolic bone disease, presence of night pain, presence of crepitus, reduction of range of movements, decreased serum calcium, decreased serum phosphorus, decreased serum vitamin D3 were given a score of one each respectively (see Fig. 1).

Table 2
Degenerative joint scoring system 2020.

DJSS Predictive Variables	Score
Demographic variables	
Age > 40	1
Female gender	1
Lifestyle variables	
BMI > 25	1
History of Smoking	1
History of Alcohol	1
Event variables	
Menopause	1
Developmental of bone disease	1
Metabolic bone disease	1
Symptom variables	
Difficulties in activities of daily living	1
Night pain	1
Crepitus	1
Reduction in range of movements	1
Biochemical variables	
Low Serum Calcium	1
Low Serum Phosphorus	1
Low Serum Vitamin D3	1
Cumulative Score Interpretation	
0–5	Possible Osteoarthritis
6–10	Probable Osteoarthritis
11–15	Definite Osteoarthritis

Table 1
Total variance explained for items in the modified spiritual health scale.

Component	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.81	18.77	18.77	2.816	18.77	18.77
2	1.76	11.73	30.51	1.76	11.73	30.51
3	1.45	9.71	40.22	1.45	9.71	40.22
4	1.27	8.47	48.69	1.27	8.47	48.69
5	1.06	7.08	55.77	1.06	7.08	55.77
6	1.05	4.41	59.92	1.05	4.41	59.92

Extraction method: Principal component analysis.

3.5. Trial of the scale in the field

A total of 1120 study participants were present in our study to assess the sensitivity of the DJSS. Demographic details of the trial participants are represented in Table 3. A total of 844 participants (75.4%) were already having osteoarthritis. Our DJSS was carried over on these study participants. We had about 273 (20.3%) participants having mild osteoarthritis, 345 (30.8%) participants having moderate osteoarthritis, and the remaining 502 (44.8%) participants were having severe osteoarthritis. The current instrument has got 83% sensitivity and 75% specificity in finding new cases of OA among the study population (Table 4, Fig. 2).

4. Discussion

Available data on the scales used in OA diagnosis, prognosis, and recovery indicates that outstanding reliability and validity are available for both the Oxford knee score and WOMAC. Oxford knee score has excellent test-retest reliability (ICC >0.9) and good concurrent validity with Intermittent and constant OA pain of $\rho = -0.88$ and with KOOS-physical function short form of $\rho = -0.85$.[7] WOMAC has excellent reliability with pain subscale (ICC = 0.90) and high concurrent validity with Lequesne OA algofunctional index, SF-36, and NHP. OA Severity Indices of Lequesne has good internal reliability but has fair to strong concurrent validity with SF-36. IKHOAM, KOOS (pain and ADL function), and CB and M have excellent test-retest reliability but a non-acceptable level of concurrent validity with criterion measures.[22] Comparison of our study reliability with other studies is presented in Table 5.

At face value, the domains covered by the DJSS appear to represent elements that are likely to be important to patients. It shows adequate internal consistency and has no floor or ceiling effects across mixed groups of patients with knee conditions. The DJSS has been shown to be responsive to change following surgical interventions, highlighting its usefulness in this patient population. All the measurements available are from developing nations, with the exception of IKHOAM.[22] We hope that this set of outcome indicators used in OA diagnosis, prognosis, and recovery will promote the usage of our new scale. We do use the scales validated and accessible from developed countries in developing countries such as India. Due to cross-cultural variance, this may not reflect the actual treatment impact among OAs. None of the scales from India are available. The outcome factors to be used in OA diagnosis, prognosis, and recovery really need to be assessed. This current screening tool has got a yield of 68% in detecting new cases in the community. The DJSS involves minimal administrative and respondent burden and can be easily scored in the dispensary using the online application. However,

Table 3
Baseline characteristics of study participants (n = 1120).

Variable	Frequency	Percentage
Age		
30–40	86	7.7
41–50	292	26.1
51–60	337	30.1
61–70	253	22.6
71–80	152	13.6
Gender		
Male	507	45.3
Female	613	54.7
BMI		
<18.5	24	2.1
18.6–24.9	368	32.9
25.0–29.9	637	56.9
30.0–34.9	91	8.1
Substance use		
Smoking	342	30.5
Alcohol	378	33.8
Difficulties of activities of daily living	646	57.7
Developmental bone disease	64	5.7
Metabolic bone disease	95	8.5
Night pain	288	25.7
Crepitus	655	58.5
Range of movement reduction	668	59.6

Table 4
Degenerative Joint Scoring System as a predictor of osteoarthritis (n = 1120).

DJSS	Osteoarthritis Present	Osteoarthritis Absent
Present	700	70
Absent	144	206
Statistic Component	**Value**	**95% CI**
Sensitivity	82.94%	80.23%–85.42%
Specificity	74.64%	69.08%–79.66%
Positive predictive value	90.91%	89.07%–92.47%
Negative predictive value	58.86%	54.84%–62.76%
Accuracy	80.89%	78.47%–83.16%

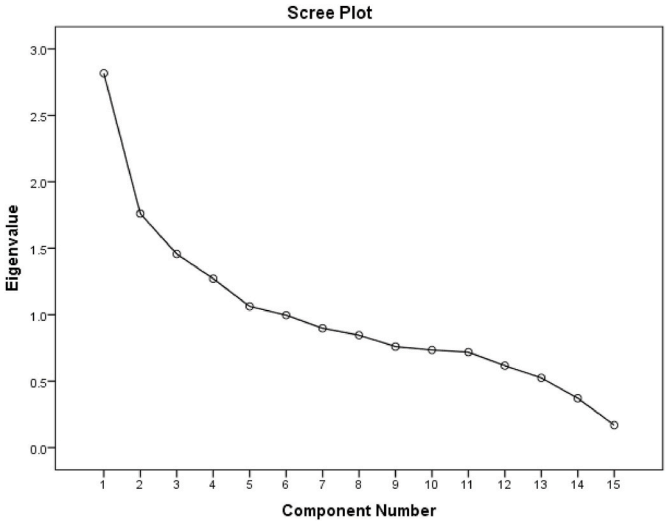

Fig. 1. Scree plot for the 15 determinants of DJSS.

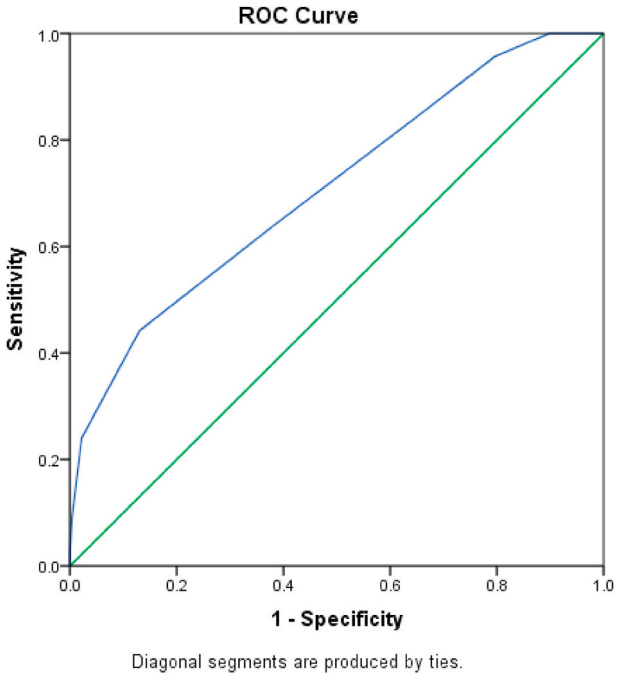

Fig. 2. ROC curve predicting the DJSS.

Table 5
Comparison of reliability among different type of functional knee osteoarthritis scales.

Scale	Type of scale	Reliability (ICC)
WOMAC [10]	Self-administered	0.83
KOOS [18]	Self- administered	0.89
KOFBeQ [25]	Self- administered	0.81
LEQUESNE [33]	Self- administered, sometimes interview	0.84
TLKSS [34]	Self- administered	0.88
COAT [20]	Physician required	0.79
IKHOM [21]	Self- administered and interview	0.94
CB & M [22]	Physician required	0.96
SF-36 [15]	Self- administered and interview	0.90
OKS [35]	Self- administered	0.93
KSSS [36]	Self- administered and interview	0.80
ASHI [15]	Self- administered and interview	0.82
AIMS [23]	Self- administered	0.78
DJSS (Present study)	Self- administered and interview	0.93

physicians using the online application need to know that the data provided are from a particular population, and cannot be representative of their individual patient's population. This scale is not self-administered, a physician is required. The use of a single aggregate score to represent overall socio-demographic variables, symptoms, laboratory determinants may mask deficits in one domain.

5. Conclusion

DJSS can help orthopaedicians, physiotherapists, and academics and researchers on the diagnosis of osteoarthritis easily, and recovery accessible. This instrument needs to be generalized by tracking the real outcomes of patient-reported outcome interventions from developed countries. DJSS can be a useful screening tool for people at risk for Osteoarthritis and will help in identifying and grading the disease early.

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Data

Data involved in the study may be submitted upon request.

Informed consent

All the included participants in the study consented for participation and publication of the results derived out of the study.

Author contributions

Manish Khanna – Conceptualisation, supervision, validation, and reviewing drafts.

Preethi Selvaraj – Data curation, formal analysis, investigations, methodology, validation, writing original drafts and reviewing drafts.

Madhan Jeyaraman – Conceptualisation, supervision, validation, visualisation, and reviewing drafts.

Sathish Muthu – Data curation, formal analysis, investigations, methodology, administration, resources, writing original drafts and reviewing drafts.

Venus Khanna – Methodology, administration, resources, supervision, and reviewing drafts.

Declaration of competing interest

Authors declare no competing interests.

Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.cegh.2022.101093.

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