

Health-related quality of life in Egyptian patients with knee osteoarthritis: correlation with performance-related measures

Enas A. Abdelaleem^a, Yahia M. Rizk^b

^aDepartment of Rheumatology and Rehabilitation, Beni-Suef University Hospital, Faculty of Medicine, Beni-Suef University,

^bDepartment of Orthopedic Surgery, Beni-Suef University Hospital, Beni-Suef, Egypt

Correspondence to Enas A. Abdelaleem, MD, Department of Rheumatology and Rehabilitation, Beni-Suef University Hospital, Faculty of Medicine, Beni-Suef University, Beni-Suef, Egypt
e-mail: dr.enas2000@gmail.com

Received 20 November 2016

Accepted 30 January 2017

Egyptian Rheumatology & Rehabilitation
2018, 45:94–99

Objective

The aim of this work was to study the correlation between health-related quality of life and performance-related measures in Egyptian patients with primary knee osteoarthritis (OA).

Patients and methods

One hundred patients with primary knee OA who were attending the outpatient clinic of the hospital were included in the study. All patients had bilateral medial tibiofemoral knee OA. Radiological severity of the disease was evaluated with the Kellgren–Lawrence scale. All patients completed Knee Injury and Osteoarthritis Outcome Score (KOOS); that is a knee-related disorder-specific questionnaire for the assessment of quality of life. The Timed Up and Go test was used for the evaluation of performance-based functional status.

Results

Eighty-eight (88%) patients were female. The mean age was 57.30 ± 6.37 (50–75) years, and the mean BMI was 36.83 ± 5.37 kg/m². The mean symptom duration was 8.76 ± 4.71 years. The mean radiological stage was 2.88 ± 0.82 . There was a statistically significant negative correlation between all of the KOOS domains and Timed Up and Go ($P \leq 0.01$).

Conclusion

KOOS is not only a good indicator of physical performance in patients with knee OA but also provides information about the impact of knee-related disability on the quality of life and recreational activities.

Keywords:

knee osteoarthritis, Knee Injury and Osteoarthritis Outcome Score, physical performance, Timed Up and Go

Egypt Rheumatol Rehabil 45:94–99

© 2018 Egyptian Society for Rheumatology and Rehabilitation
1110-161X

Introduction

Osteoarthritis (OA) is an age-related disorder and the primary cause of pain, disability, and shortening of adult working life. The incidence of OA increases with age, with 25% of the population older than 50 years of age having OA of the knee [1].

OA is characterized by cartilage erosion, development of osteophytes, and changes in the subchondral bone and synovial fluid. The exact pathogenesis has yet to be clarified. OA is generally considered to have a complicated agenda that includes genetic, hormonal, metabolic, and biomechanical factors, and specific risk factors such as age, sex, obesity, and past injury have been identified [2].

Pain and physical dysfunction are main criteria for patients with knee OA. Both self-report questionnaires and performance-based tests are often used to assess knee-related pain and physical function. Self-assessment questionnaires provide information about the experience of a person during activities.

Self-report tests can easily be performed without investigator's intervention in a relatively short time [3].

Performance-based tests measure functional limitation, whereas self-report tests can show disability, which is the social side of the functional limitation [4]. Performance-based tests are considered to assess the functional loss earlier than the self-report tests [5].

Knee Injury and Osteoarthritis Outcome Score (KOOS) is an easy self-administered test based on Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) and Short Form-36 (SF-36) tests that contain activities of daily living (ADL), sport, and quality-of-life domains besides pain-related and symptom-related questions in knee OA. KOOS can be completed in ~10 min [6]. The Timed Up and Go

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

(TUG) test shows the lower extremity performance and measures the time that is required for standing up from the chair, walking 3 m, returning, and sitting back again in a clinical setting. The TUG test is also an easy test to perform and needs a physician for supervision. The TUG test can give information about the inadequate activity of a person; however, KOOS provides more comprehensive information about the indoor and outdoor activities of an individual [7].

As the progression of the disease can sometimes be slow and gradual, many patients are not aware of the impact their OA has had upon important dimensions of their lives. Examining the impact of their OA on these dimensions will allow clinicians to personalize treatment and better outline the potential benefits [8]. A key reason for serial measurement of health-related quality of life is to reflect the changes that occur in an individual's health state in response to disease progression, various therapies, and recovery [9].

Aim of the work

The aim of this work was to study the correlation between KOOS (as a quality-of-life assessment questionnaire) and TUG (as a performance-related measure) in Egyptian patients with primary knee OA.

Patients and methods

Patients

One hundred patients with primary knee OA (12 male and 88 female) were included in this study. Their ages ranged from 50 to 75 years. They were recruited from the outpatient clinic of the Rheumatology and Rehabilitation Department, Beni-Suef University Hospital, Egypt. All knee OA patients fulfilled the criteria of American College of Rheumatology for the diagnosis of OA [10].

Inclusion criteria were as follows: age at least 50 years, knee pain, radiological stage of 2 or more; and medial tibiofemoral joint OA according to the Kellgren–Lawrence (KL) scale [11]. Exclusion criteria were as follows: presence of inflammatory joint disease or other secondary OA causes (e.g. acromegaly), a history of hip or knee surgery, severe back or hip pain, or presence of any neurological disease affecting their mobility.

The study was approved by the local ethical committee.

Consent was obtained from all patients involved in this study.

Methods

All patients were subjected to the following: full clinical history, thorough clinical examination, and evaluation of BMI. Plain radiograph of both knees anteroposterior and lateral views in standing position was obtained and scored using the KL radiological scale (for tibiofemoral joint only). Kellgren and Lawrence [11] classified the severity of OA as follows: grade 1, doubtful narrowing of joint space and possible osteophytic lipping; grade 2, definite osteophytes and definite narrowing of joint space; grade 3, moderate multiple osteophytes, definite narrowing of joints space, some sclerosis, and possible deformity of bone contour; and grade 4, large osteophytes, marked narrowing of joint space, severe sclerosis, and definite deformity of bone contour.

Specific tests:

Timed up and Go test

The TUG test measures the functional mobility. The time required for standing up from the chair, walking 3 m on the floor, turning around, returning, and sitting down again is recorded [12].

Knee Injury and Osteoarthritis Outcome Score

KOOS consisted of 42 items in total addressing five patient-related domains, including pain, ADL, sport and recreation function, and knee-related quality of life. All items were evaluated using a five-point Likert scale. Total score ranges between 0 and 100 [13].

Statistical analysis

Statistical package for scientific studies for Windows package program, version 19 was used for statistical analysis. Data were statistically described in terms of mean±SD, frequencies (number of cases), and relative frequencies (%) when appropriate. Correlations were made using the χ^2 -test whenever needed. Spearman's correlation coefficients were calculated to evaluate the relationship between performance-based tests and self-reported tests in patients with OA.

P values of less than 0.05 were considered significant. Correlations (*r*) were categorized as follows: 0 : 0.3 or -0.3, mild positive or negative correlation; 0.3 : 0.7 or -0.3 : -0.7, moderate positive or negative correlation; and 0.7 : 1 or -0.7: -1, strong positive or negative correlation.

Results

One hundred patients were included in this study with bilateral primary knee OA, 12 (12%) male and 88

(88%) female. Their ages ranged from 50 to 75 years with a mean of 57.30 ± 6.37 years. Their disease durations ranged from 1.00 to 20.00 years with a mean of 8.76 ± 4.71 years. Their BMIs ranged from 25.97 to 49.12% with a mean of $36.83 \pm 5.37\%$.

The KL score ranged from 2.00 to 4.00 with a mean of 2.88 ± 0.82 , and the TUG test ranged from 11.00 to 27.00 s with a mean of 17.64 ± 4.64 s.

Correlation between KL score and both BMI and age revealed a nonsignificant positive correlation ($P=0.196$ and 0.241 , respectively).

Results of KOOS questionnaire and its subtypes are presented in Table 1.

Correlations between the TUG test of OA patients with some of the demographic and radiographic parameters of the disease showed different results (Table 2).

Table 1 Descriptive statistics of Knee Injury and Osteoarthritis Outcome Score questionnaire and all subtypes

	Range (%)	Mean \pm SD (%)
KOOS	7.10–60.70	35.90 ± 18.09
Symptoms	10.71–67.86	39.85 ± 20.75
Pain	5.56–63.89	35.99 ± 19.24
ADL	5.88–63.24	36.44 ± 17.27
Sport/rec	0.00–50.00	29.20 ± 17.88
QOL	6.25–68.75	34.88 ± 18.04

ADL, activities of daily livings; KOOS, Knee Injury and Osteoarthritis Outcome Score; QOL, quality of life; sports/rec, sports and recreational activities.

Table 2 Correlations between the Timed Up and Go test with some of the demographic and radiographic parameters

Parameters	TUG	
	<i>r</i>	<i>P</i>
Age	0.302	0.033*
Disease duration	0.571	0.001*
BMI	–0.011	0.938
KL	0.858	0.001*

KL, Kellgren–Lawrence Score; TUG, Timed Up and Go test.

* $P < 0.05$, significant.

Table 3 Correlations between Knee Injury and Osteoarthritis Outcome Score with some of the demographic and radiographic parameters

Parameters	KOOS	
	<i>r</i>	<i>P</i>
Age	–0.145	0.316
Disease duration	–0.609	0.001*
BMI	0.031	0.832
KL	–0.920	0.001*

KL, Kellgren–Lawrence scale; KOOS, Knee Injury and Osteoarthritis Outcome Score. * $P < 0.05$, significant.

Correlations between KOOS questionnaire of OA patients with some of the demographic and radiographic parameters of the disease are presented in Table 3.

Correlation between KOOS questionnaire and the TUG test of cases showed a significant negative correlation ($r = -0.884$, $P = 0.001$). Correlations between all subtypes of KOOS questionnaire and the TUG test showed a significant negative correlation ($P = 0.001$) (Table 4 and Fig. 1).

Discussion

In the present study we found a significant positive correlation between age and the TUG test, wherein the time needed for the test increases as the age

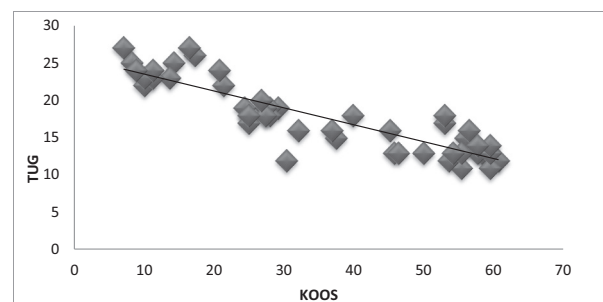
Table 4 Correlations between Knee Injury and Osteoarthritis Outcome Score questionnaire and all subtypes with the Timed Up and Go test of osteoarthritis patients

	TUG
KOOS	
<i>r</i>	–0.884
<i>P</i>	0.001*
Symptoms	
<i>r</i>	–0.871
<i>P</i>	0.001*
Pain	
<i>r</i>	–0.864
<i>P</i>	0.001*
ADL	
<i>r</i>	–0.883
<i>P</i>	0.001*
Sports	
<i>r</i>	–0.849
<i>P</i>	0.001*
Quality of life	
<i>r</i>	–0.848
<i>P</i>	0.001*

ADL, activities of daily livings; KOOS, Knee Injury and Osteoarthritis Outcome Score; TUG, Timed Up and Go test.

* $P < 0.05$, significant.

Figure 1



Correlation between KOOS and the TUG test. KOOS, Knee Injury and Osteoarthritis Outcome Score; TUG, Timed Up and Go.

of the patient increases, and there was a negative correlation between age and KOOS, which was not significant.

Similar to the results of our study, Sivachidambaram *et al.* [14] correlated self-reported questionnaire (KOOS) with some objective measures in primary OA knee patients and found that KOOS has almost no correlation with age.

Penserga and Tanque [15] reported lack of correlation between age and WOMAC disability subscales ($r=-0.077$). Moreover, Nebel *et al.* [16] reported lack of correlation between age and objectively measured gait parameters. Similar results were reported by Cubukcu *et al.* [17] using WOMAC. Correlations between age and WOMAC pain, stiffness, and function were 0.081, -0.49, and 0.114, respectively; all were statistically nonsignificant [17].

Paradowski *et al.* [18] found that women in the age group 55–74 years had poorer physical function and knee-related quality of life. Moreover, Zakaria *et al.* [19] used SF-36 to assess health-related quality of life in patients with knee OA and found that there were correlations between mental health components and physical functioning with age.

Maly *et al.* [20] found a nonsignificant correlation between age and pain intensity ($r=-0.03$) and physical performance ($r=0.09$).

There have been inconsistent results about the correlation of BMI with health status in patients with knee OA. In our study there was no significant correlation between BMI and the score of KOOS and the TUG test. This could be attributed to the fact that all of our patients were overweight with no great variations in their BMI.

Smith *et al.* [21] studied the associations between physical disability measures [WOMAC and general health status (SF-36) questionnaires] and BMI in knee OA patients and found that increasing BMI was associated with high objective and self-reported measures of physical disability [22].

Elbaz *et al.* [22] reported that BMI significantly correlated with all subscales of WOMAC ($P<0.001$) and SF-36 but their correlation was less than 0.30. Moreover, Sanghi *et al.* [23] reported a similar correlation between BMI and WOMAC ($r=0.592$, 0.634, and 0.749 for pain, stiffness, and ADL subscales).

The relation between BMI and OA is mediated by another local factor such as changed mechanical loading of the joint – for example, malalignment [24]. Moreover, Maly *et al.* [20] reported mild positive correlation between BMI and sit-to-stand performance ($r=0.47$, $P<0.01$).

The association between the radiographic severity of OA and disability was conflicting. In the present study, the radiological finding assessed using KL score was found to be significantly correlated with KOOS and the TUG test. Akune *et al.* [25] found that women with OA and KL score (grade 4) were strongly associated with the magnitude of quality of life loss in a study investigating the impact of knee OA on the quality of life in Japanese women.

In a study by Sabirli *et al.* [26], there was a statistically significant positive relationship between KL radiological stages and the TUG test ($r=0.628$; $P<0.01$).

Moreover, Muraki *et al.* [27] found that patients with OA and KL grade 3 or 4 had a significantly lower physical quality of life as measured using the physical component summary score of the SF-8 and pain domains of the WOMAC, whereas mental quality of life, as measured using the mental component summary score of the SF-8, was higher in patients with KL grade 3 or 4 than in those with KL grade 0 or 1.

In contrast, Creamer *et al.* [28] found that self-reported disability in patients with knee OA has a nonsignificant correlation with radiological severity. This could be due to socioeconomic differences. Barker *et al.* [29] also found that radiographic score was not found to be closely associated with function, and among patients with the same radiographic score there was a significant variation in function, pain, and power.

Külcü *et al.* [30] reported that radiological examination of the knee is used for the evaluation of OA, but its use for assessing the severity of the disease is questionable.

In this study, all subgroups of KOOS showed a moderate inverse correlation with the TUG test. This relationship between two measures indicates that KOOS can give useful information about the functional performance of the patient with knee OA. The correlation between the performance-based tests and self-reported questionnaires is important, as they together or alone are frequently used for evaluation and to follow-up the knee OA patients in clinical practice. These tests give information about knee-related pain, symptoms, and functions.

In the study by Terwee *et al.* [31], there was a modest correlation between WOMAC and various performance-based tests in knee OA. Lin *et al.* [32] also found a mild correlation between WOMAC and physical performance tests in OA knee patients ($r=0.33-0.54$). Juhakoski *et al.* [5] showed a similar correlation between self-report and performance-based measures in patients with knee or hip OA.

Moreover, Stratford *et al.* [33] reported a moderate correlation between self-reported lower extremity function scale and TUG time ($r=0.42$) on patients waiting for knee arthroplasty. Maly *et al.* [34] also reported a mild but significant correlation between the 6-min walk test (6-MWT), WOMAC pain, and stiffness subscales ($r=-0.39$ for pain and $r=-0.48$ for stiffness). Liikavainio *et al.* [35] found a strong correlation between WOMAC and the 5-MWT ($r=-0.485$, -0.525 , and -0.577 for pain, stiffness, and function subscales, respectively; $P<0.001$ for all). Sutbeyaz *et al.* [36] reported a negative correlation between WOMAC pain, function subscales, and 6-MWT ($r=-0.205$ for pain, $P<0.001$; $r=-0.646$ for function, $P<0.05$). Similar to the results of our study, Steultjens *et al.* [3] observed a mild but significant correlation between observed and self-reported physical performance ($r=0.20-0.26$; $P<0.01$). Kennedy *et al.* [37] found a mild-to-moderate correlation ($r=0.21-0.50$) between self-reported and actual physical performance on 1044 knee arthroplasty patients. Moreover, Adegoke *et al.* [38] reported a positive correlation ($r=0.56$) between self-reported function and actual physical performance (stair climbing and TUG test), which is similar to our result ($r=0.461$).

Sabirli *et al.* [26] reported that all subgroups of KOOS showed a moderate inverse correlation with the TUG test, which is similar to our result.

Moreover, Sivachidambaram *et al.* [14] correlated self-reported questionnaire (KOOS) with some objective measures in primary OA knee patients and found that all KOOS subtypes have a significant correlation with 6-MWT. 6-MWT had a weak correlation with KOOS-ADL ($\rho=0.461$) and a strong correlation with KOOS symptom, KOOS-pain, and KOOS-sports ($\rho=0.578$, 0.619 , and 0.536 , respectively) and a very strong correlation with KOOS-quality of life ($\rho=0.733$) [14].

Conclusion

The significant correlation between KOOS questionnaire and the TUG test in patients with primary knee OA

indicates that KOOS is not only a good indicator of physical performance in patients with primary knee OA but also provides information about the impact of knee-related disability on the quality of life and recreational activities.

Thus, it will be of great benefit for patients with primary knee OA to include KOOS questionnaire and the TUG test as a part of the routine care of OA patients. Further longitudinal studies including larger OA population are needed to assess the efficacy of different lines of treatment in these patients using KOOS questionnaire and the TUG test.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflict of interest.

References

- 1 Tonge DP, Pearson MJ, Jones SW. The hallmarks of osteoarthritis and the potential to develop personalised disease-modifying pharmacological therapeutics. *Osteoarthritis Cartilage* 2014; 22:609–621.
- 2 Fahlman L, Sangeorzan E, Chheda N. Older subjects without radiographic knee osteoarthritis: weight, height, and body mass index. *Aging Dis* 2013; 4:201–209.
- 3 Steultjens MPM, Roorda LD, Dekker J, Bijlsma JWJ. Responsiveness of observational and self-report methods for assessing disability in mobility in patients with osteoarthritis. *Arthritis Rheum* 2001; 45:56–61.
- 4 Hoeymans N, Wouters ER, Feskens EJ, van den Bos GA, Kromhout D. Measuring functional status: cross-sectional and longitudinal associations between performance and self report (Zutphen Elderly Study 1990–1993). *J Clin Epidemiol* 1996; 49:1103–1110.
- 5 Juhakoski R, Tenhonen S, Anttonen T, Kauppinen T, Arokoski JP. Factors affecting self-reported pain and physical function in patients with hip osteoarthritis. *Arch Phys Med Rehabil* 2008; 89:1066–1073.
- 6 Roos EM, Lohmander LS. The Knee Injury and Osteoarthritis Outcome Score (KOOS): from joint injury to osteoarthritis. *Health Qual Life Outcomes* 2003; 1:64.
- 7 Shimada H, Kim H, Yoshida H, Yoshida Y, Saito K, Suzukawa M, *et al.* Factors associated with the Timed Up & Go test score in elderly women. *J Phys Ther Sci* 2010; 22:273–278.
- 8 Woolf AD, Pfleger B. Burden of major musculoskeletal conditions. *Bull World Health Organ* 2003; 81:646–646.
- 9 Hickey A, Barker M, McGee H, O'Boyle C. Measuring health-related quality of life in older patient populations: a review of current approaches. *Pharmacoeconomics* 2005; 23:971–993.
- 10 Altman R, Asch E, Bloch D. Development of criteria for the classification and reporting of osteoarthritis. Classification of osteoarthritis of the knee. Diagnostic and Therapeutic Criteria Committee of the American Rheumatism Association. *Arthritis Rheum* 1986; 29: 1039–1049.
- 11 Kellgren JH, Lawrence JS. Radiological assessment of osteoarthritis. *Ann Rheum Dis* 1957; 16:494–502.
- 12 Podsiadlo D, Richardson S. The Timed 'Up & Go': a test of basic functional mobility for frail elderly persons. *J Am Geriatr Soc* 1991; 39:142–148.
- 13 Paker N, Bugdayci D, Sabirli F, Ersoy S, Özel S. Knee Injury and Osteoarthritis Outcome Score: reliability and validation of the Turkish version. *J Med Sci* 2007; 27:350–356.
- 14 Sivachidambaram K, Ateef M, Tahseen S. Correlation of Self-Reported Questionnaire (KOOS) with some objective measures in primary OA knee patients. *ISRN Rheumatol* 2014; 2014:301485.
- 15 Penserga EG, Tanque AAG. Predictors of disability among Filipinos with knee osteoarthritis. *Int J Rheum Dis* 2008; 11:251–256.

- 16 Nebel MB, Sims EL, Keefe FJ, Kraus VB, Guilak F, Caldwell DS, *et al.* The relationship of self-reported pain and functional impairment to gait mechanics in overweight and obese persons with knee osteoarthritis. *Arch Phys Med Rehabil* 2009; 90:1874–1879.
- 17 Cubukcu D, Sarsan A, Alkan H. Relationships between pain, function and radiographic findings in osteoarthritis of the knee: a cross-sectional study. *Arthritis* 2012; 2012:984060.
- 18 Paradowski PT, Bergman S, Sundén-Lundius A, Lohmander LS, Roos EM. Knee complaints vary with age and gender in the adult population. Population based reference data for the Knee injury and Osteoarthritis Outcome Score (KOOS). *BMC Musculoskelet Disord* 2006; 2:38.
- 19 Zakaria ZF, Bakar AA, Hasmoni HM, Rani FA, Kadir SA. Health-related quality of life in patients with knee osteoarthritis attending two primary care clinics in Malaysia: a cross-sectional study. *Asia Pac Fam Med* 2009; 8:10.
- 20 Maly MR, Calder KM, Macintyre NJ, Beattie KA. Relationship of inter-muscular fat volume in the thigh with knee extensor strength and physical performance in women at risk of or with knee osteoarthritis. *Arthritis Care Res* 2013; 65:44–52.
- 21 Smith G, Leibman S, Caterson I, Giuffrè B, Fransen M, Sambrook P, *et al.* Cartilage defects are associated with physical disability in obese adults are physically disable. *Rheumatology* 2009; 48:1290–1293.
- 22 Elbaz A, Debbi EM, Segal G. Sex and body mass index correlate with Western Ontario and McMaster Universities Osteoarthritis Index and quality of life scores in knee osteoarthritis. *Arch Phys Med Rehabil* 2011; 92:1618–1623.
- 23 Sanghi D, Srivastava RN, Singh A, Kumari R, Mishra R, Mishra A. The association of anthropometric measures and osteoarthritis knee in non-obese subjects: a cross sectional study. *Clinics* 2011; 66:275–279.
- 24 Reijman M, Pols HAP, Bergink AP, Hazes JM, Belo JN, Lievense AM, *et al.* Body mass index associated with onset and progression of osteoarthritis of the knee but not of the hip: the Rotterdam Study. *Ann Rheum Dis* 2007; 66:158–162.
- 25 Akune T, Oka H, En-Yo Y, Yoshida M, Saika A, Suzuki T, *et al.* Impact of knee and low back pain on health-related quality of life in Japanese women: the Research on Osteoarthritis Against Disability (ROAD). *Mod Rheumatol* 2010; 20:444–451.
- 26 Sabirli F, Paker N, Bugdayci D. The relationship between Knee Injury and Osteoarthritis Outcome Score (KOOS) and Timed Up and Go test in patients with symptomatic knee osteoarthritis. *Rheumatol Int* 2013; 33:2691–2694.
- 27 Muraki S, Akune T, Oka H, En-Yo Y, Yoshida M, Saika A, *et al.* Association of radiographic and symptomatic knee osteoarthritis with health-related quality of life in a population-based cohort study in Japan: the ROAD study. *Osteoarthritis Cartilage* 2010; 18:1227–1234.
- 28 Creamer P, Lethbridge-Cejku M, Hoshberg MC. Factors associated with functional impairment in symptomatic knee osteoarthritis. *Rheumatology* 2000; 39:490–496.
- 29 Barker K, Lamb SE, Toye F, Jackson S, Barrington S. Association between radiographic joint space narrowing, function, pain and muscle power in severe osteoarthritis of the knee. *Clin Rehabil* 2004; 18:793–800.
- 30 Külcü D, Yanik B, Atalar H. Associated factors with pain and disability in patients with knee osteoarthritis. *Turk J Rheumatol* 2010; 25:77–81.
- 31 Terwee CB, van der Slikke RM, van Lummel RC, Benink RJ, Meijers WG, de Vet HC. Self-reported physical functioning was more influenced by pain than performance-based physical functioning in knee-osteoarthritis patients. *J Clin Epidemiol* 2006; 59:724–731.
- 32 Lin YC, Davey RC, Cochrane T. Tests for physical function of elderly with knee and hip osteoarthritis. *Scand J Med Sci Sports* 2001; 11:280–286.
- 33 Stratford PW, Kennedy D, Pagura SMC, Gollish JD. The relationship between self-report and performance-related measures: questioning the content validity of timed tests. *Arthritis Rheum* 2003; 49:535–540.
- 34 Maly MR, Costigan PA, Olney SJ. Determinants of self-report outcome measures in people with knee osteoarthritis. *Arch Phys Med Rehabil* 2006; 87:96–104.
- 35 Liikavainio T, Lyytinen T, Tyrväinen E, Sipilä S, Arokoski JP. Physical function and properties of quadriceps femoris muscle in men with knee osteoarthritis. *Arch Phys Med Rehabil* 2008; 89:2185–2194.
- 36 Sutbeyaz ST, Sezer N, Koseoglu BF, Ibrahimoglu F, Tekin D. Influence of knee osteoarthritis on exercise capacity and quality of life in obese adults. *Obesity* 2007; 15:2071–2076.
- 37 Kennedy D, Stratford PW, Pagura SMC, Walsh M, Woodhouse LJ. Comparison of gender and group differences in self-report and physical performance measures in total hip and knee arthroplasty candidates. *J Arthroplasty* 2002; 17:70–77.
- 38 Adegoke BOA, Babatunde FO, Oyeyemi AL. Pain, balance, self-reported function and physical function in individuals with knee osteoarthritis. *Physiother Theory Pract* 2012; 28:32–40.