Remedy Open Access

Research Article
Published: 23 May, 2017

# Correlation of Western Ontario and Mcmaster Universities Osteoarthritis (WOMAC) and Short Form 36(SF36) Questionnaires in Patients with Knee Osteoarthritis

*Seyed Ahmad Raeissadat[1], Leyla Sedighipour[2]* and Elham Ghorbani[2]*

[1]PM&R Research Center of Shahid Beheshti University of Medical Sciences, Clinical and Research Development Center of Shahid Modarres Hospital, Iran

[2]Clinical and Research Development Center of Shahid Modarres Hospital, Iran

## Abstract

**Background:** The aim of the present study was evaluate the correlation between condition-specific and generic health status questionnaires for measuring health-related quality of life in patients with osteoarthritis (OA) of the knee.

**Methods:** This cross-sectional survey included a total of 424 patients aged 50 years and over, with symptomatic OA of the knees. All patients completed Correlation of Western Ontario and McMaster Universities Osteoarthritis (WOMAC) and Short Form (SF-36) questionnaires and were assessed for severity of OA. The correlation between radiographic findings, patients' symptoms also between the scores of two questionnaires were evaluated.

**Results:** A significant correlation was found between WOMAC pain, stiffness and function scores and all SF-36 domains and the strongest correlation were between WOMAC pain dimension and the SF physical function. There was correlation between patients BMI and SF-36, also VAS scores. Patients with knee OA in grade 2 and 3 had lower HRQL (according to both WOMAC and SF 36 measure) compared to patients with knee OA in grade 1.

**Conclusion:** There are agreements between dimensions of WOMAC and SF36 in measuring HRQL in patients with knee OA. Symptoms also correlate with radiographic findings and BMI. The use of both a generic measure of HRQOL such as the SF-36, and a disease specific such as WOMAC is useful in characterizing the global burden of this disease.

**Keywords: Knee osteoarthritis; Questionnaires; Quality of life**

OPEN ACCESS

***Correspondence:***
*Leyla Sedighipour, Clinical and Research Development Center of Shahid Modarres Hospital, Tehran, Iran, Tel: 98 21 22731112; Fax: 98 21 22731112;*
*E-mail: lsedighy@yahoo.com*

**Received Date**: *18 Nov 2016*
**Accepted Date:** *11 May 2017*
**Published Date:** *23 May 2017*

***Citation:***
*Raeissadat SA, Sedighipour L, Ghorbani E. Correlation of Western Ontario and Mcmaster Universities Osteoarthritis (WOMAC) and Short Form 36(SF36) Questionnaires in Patients with Knee Osteoarthritis. Remed Open Access. 2017; 2: 1058.*



## Introduction

Osteoarthritis (OA) of the knee is prevalent musculoskeletal problem worldwide [1,2]. Globally 3.6% of the population have osteoarthritis of the knee [3]. This condition impairs functional capacity and decreases quality of life (QOL) in patients by producing pain, stiffness and limitation in range of motion of the joint. Knee OA pose a significant economic burden on the community [4]. The goal of contemporary management of knee is control of pain and improvement in function and health-related quality of life [3,4]. In this context, it is necessary to develop valid outcome measures evaluating the effectiveness of the various treatment modalities in OA [5-7]. Quality of life has multiple dimensions [2]. Several generic and disease-specific questionnaires measure quality of life in patients with chronic conditions [8-10]. Short From-36 (SF-36) is among the generic measures that has been extensively used in different populations and shown to be a valid and reliable measure [8,11]. Disease or condition-specific instruments are useful for measuring clinically important changes in response to treatments [8,9,11]. The most widely used condition-specific instrument for the assessment of OA of the lower extremities which is valid and reliable is the Western Ontario and McMaster Universities (WOMAC) Osteoarthritis Index [11,12]. The literature supports the inclusion of both a generic and a disease-specific health related quality-of-life measure (HRQOL). There are advantages and disadvantages for both generic and disease specific measures [9,11]. The latter are designed to focus on the specific disorder and the patient's related problems related to it. So, disease specific tools may be more relevant to the patient and the physician than generic instruments, and may be better at detecting the effects of treatment other hand, generic measures may, because of their broader perspective, detect complications or side effects in areas of function

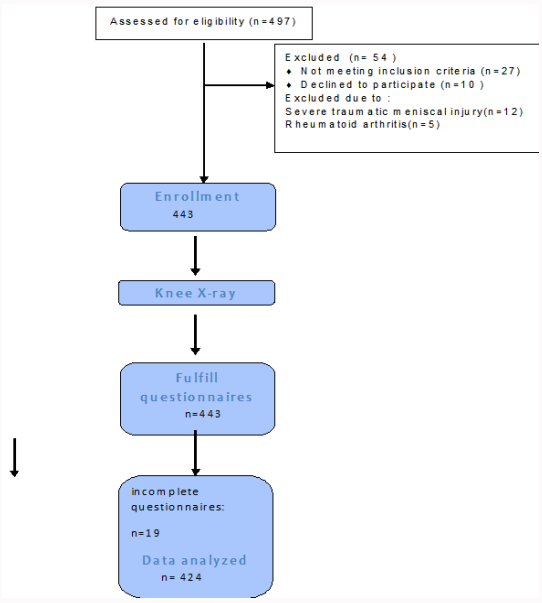


**Figure 1:** Flowchart of patients with knee osteoarthritis.

or organ systems not specifically related to the disease under consideration. (HRQL) [9,11-13]. Furthermore, the severity of the disease should be determined by objective and subjective measures including questionnaires on order to select the appropriate therapy [9,14].

WOMAC and SF-36 are widely used in clinical and research settings. Although he correlation of these two questionnaires were previously investigated [8,11], the association between the severity of osteoarthritis and quality of life has not been evaluated before; also there is disagreement between different studies about the effect of Body Mass Index (BMI) on quality of life in patients with knee OA [2,6,14].

The purpose of the present study was to compare the correlation between the generic HRQOL tool, the SF-36, with a disease-specific HRQOL measure, the WOMAC, in a large population of patients with knee OA, also to determine whether there is association between disease severity determined by radiographic indices and quality of life, also between BMI and quality of life measured by the above questionnaires.

## Methods

### Recruitment of patients

In this cross-sectional survey, conducted at physical medicine clinic at educational hospital, all patients with knee pain referred to the outpatient clinic during 2014 were evaluated to enter the study.

Study approval was obtained from the Research Ethics Committee of Shahid Beheshti University of Medical Sciences.

### Inclusion criteria

Patients were recruited according to ACR criteria for clinical diagnosis of idiopathic knee OA. ACR criteria were based on knee pain in either knee on most days for at least1 month in the previous year and at least two of the following signs/symptoms: stiffness, crepitus, bony tenderness, and bony enlargement [15].

Exclusion criteria were: 1) inflammatory arthritis; 2) self-reports of having current knee conditions such as meniscus tears and knee ligament ruptures; 3) those with neurological conditions or medical comorbidity (e.g., terminal conditions such as end-stage renal disease, heart failure or malignancy), drug abuse, or a psychiatric disorder.

Patients with above criteria were recruited in this study and provided informed consent.

Radiography of the affected knee was requested for each patient. Radiographs of the knees were weight-bearing anteroposterior (AP) and lateral film. Knee films were scored by a radiologist, unaware of the clinical status of the subject, according to the Kellgren and Lawrence (K/L) grading system [16].

Demographic and socioeconomic information were assessed via interviewing with each patient.

Persian version of the short form-36 (SF-36) questionnaire of health survey [17] and Western Ontario and McMaster Universities Arthritis Index (WOMAC) questionnaire [18,19] were fulfilled by all patients. These questionnaire have been shown to be valid and reliable instruments to evaluate HRQO in patients with lower limbs osteoarthritis [17-19]. Interview was performed by a resident of physical and rehabilitation medicine.

### Measures

Western and Ontario and McMaster Universities Osteoarthritis (WOMAC).

The WOMAC is a multidimensional, self-administered health status instrument for evaluative research in knee OA clinical trials. The WOMAC consists of 24 items divided into 3 subscales. The pain scale includes five items asking about pain at activity or rest. The stiffness scale includes two questions. The function dimension explores the degree of difficulty in daily activities [13,18].

The WOMAC is present in both 5-point Likert-type and 100 mm Visual Analog formats. In this study, the Persian WOMAC was used [18], and all 24 WOMAC items are rated on a likert rating scale. The Likert Scale version uses the following descriptors for all items: none, mild moderate, severe, and extreme.

### SF-36

The SF-36 is a multi-purpose, short-form health questionnaire. It takes approximately 7 to10 minutes to be completed. It yields an 8-scale profile of functional health and well-being scores. These scales include: physical function, role limitations due to physical problems, bodily pain, vitality or energy level, role limitations due to personal or emotional problems, mental health, social function, and general health perception ranging from 0 (“maximal symptoms/maximal limitations/poor health”) to 100 (“no symptoms/no limitations/ excellent health”) [11,13].

The SF-36 is the most widely used general health status instrument and has been translated into many languages. The instrument is for persons aged 14 years and older. Studies show excellent psychometric properties and there seems to be good responsiveness to change in patients with rheumatic conditions, compared with some longer instruments [13].

### Statistical analysis

To investigate a possible influence of patient characteristics such as age, sex, BMI, and radiographic OA severity on the WOMAC and SF-36, the associations between the WOMAC and SF-36 subscales

**Table 1:** Demographic characteristics of the patients with knee OA.

| | |
|---|---|
| Age(mean±sd) | 58±8 |
| Sex(male/female) | 59(14%)/362(86%) |
| Duration of symptoms | 11±3(months) |
| BMI(weight(kg) /height(m)$^2$<br>20-25<br>25-30<br>30-35<br>>35 | 4.2±28(19-40)<br>96(22%)<br>191(45%)<br>100(24%)<br>37(9%) |
| Kellgren-lawrence rating score<br>Grade I<br>Grade II<br>Grade III<br>Grade IV | <br>29(6%)<br>187(44%)<br>146(34%)<br>62(14%) |
| Educational level<br>Primary school<br>Secondary school<br>High school / university | <br>193(46%)<br>97(22%)<br>134(32%) |

**Table 2:** VAS, WOMAC and SF-36 scores in patients with knee osteoarthritis.

| | Mean Score ±sd | median | Interquartile ($25^{th}$-$75^{th}$) |
|---|---|---|---|
| VAS | 3.5±2.21 | 5-Feb | 3.5 |
| WOMAC subscale | | | |
| Pain | 7.04±4.43 | 0-3 | 7 |
| Stiffness | 2.08±1.88 | | 2 |
| Physical function | 22.1±13.2 | | |
| SF-36 subscales | | | |
| Physical function | 25-65 | 45 | 43.51±26.8 |
| Physical role limitation | 0-75 | 34 | 30.9±40.4 |
| Bodily pain | 43.3-70 | 55 | 53.2±26.6 |
| Energy/Vitality | 40-75 | 60 | 56.9±24.4 |
| Emotional role limitation | 0-100 | 33.3 | 48.8±42.9 |
| Mental health | 44-78 | 60 | 60.9±23.6 |
| Social function | | 70 | 65.4±28.5 |
| General health | 45-80 | 60 | 60.6±21.6 |
| PCS-36 | 0-100 | 52 | 47.3±23 |
| MCS36 | 40-100 | 61 | 58.7±23 |

and these characteristics were quantified by Wilcoxon's rank sum test and by Kruskal-Wallis one-way analysis of variance. Data were analyzed using Statistical Package for Social Sciences (SPSS) for Windows version 6.0 program. Both questionnaires were scored according to guidelines of their authors [17,18].

Median and interquartile ranges were presented as well as means and standard deviations.

To assess the correlation between WOMAC and the SF-36 measures we used Spearman's rank correlation coefficient, The Spearman correlation coefficient was interpreted as follows: <0.3: none; 0.31–0.5: weak; 0.51–0.7: strong; 0.71–0.9: very strong; and >0.9: excellent [9].

## Results

At the beginning, 497 patients were first evaluated for eligibility to enter the study. At the end 424 patients were included in the study (flow chart, Figure 1). The study population characteristics of age, BMI and the percentage of patients with K/L rating score are listed in Table 1. As it can be read from this table, most of the patients were overweight and obese (69%).

**Table 3:** Mean scores of WOMAC, SF 36 and VAS in 4 subgroups of patients (stratified according To BMI).

| Measure | Score(Mean ±sd) | P value |
|---|---|---|
| ***WOMAC*** | | |
| BMI (20-25)<br>BMI(25-30)<br>BMI(30-35)<br>BMI(>35) | 29±17.5<br>32.±17.4<br>29.1.±20.3<br>37±18.3 | 0.1 |
| ***SF36*** | | |
| BMI (20-25)<br>BMI(25-30)<br>BMI(30-35)<br>BMI(>35) | 59.2±21.6<br>51.8±18.9<br>52.5±22.7<br>43.7±18.3 | 0.003 |
| ***VAS*** | | |
| BMI (20-25)<br>BMI(25-30)<br>BMI(30-35)<br>BMI(>35) | 2.9±1.8<br>3.7±2<br>3.3±2.3<br>3.9±2.4 | 0.02 |

**Table 4:** The Correlation between WOMAC and SF-36 dimensions.

| | | **WOMAC** | |
|---|---|---|---|
| | Pain | Stiffness | Function |
| **SF-36 subscales** | | | |
| Physical function | -0.647* | -0.476 | -0.737 |
| Physical role limitation | -0.576 | -0.392 | -0.644 |
| Bodily pain | -0.622 | -0.471 | -0.657 |
| Energy/Vitality | -0.258 | -0.257 | -0.321 |
| Emotional role limitation | -0.224 | -0.181 | -0.245 |
| Mental health | -0.173 | -0.137 | -0.206 |
| Social function | -0.326 | -0.306 | -0.428 |
| General health | -0.319 | 0.249 | -0.321 |
| PCS-36 | -0.731 | -0.498 | -0.775 |
| MCS-36 | -.329 | -0.262 | -0.379 |

Table 2 summarizes the mean, standard deviation, median values, and interquartile for each of the aspects of the WOMAC and SF-36.

There was correlation between patients BMI and VAS also between BMI and SF-36 scores. (BMI grading: group 1: BMI: 20-25 kg/m$^2$; group 2: BMI: 26–29 kg/m$^2$, group 3: BMI: 30-35 kg/m$^2$ and group 4: BMI >35 kg/m$^2$). In patients with higher BMI, quality of life increased according to VAS and WOMAC scores (Table 3).

Younger patients (<50 year old) gained significantly better scores of Emotional role and general health subscales of SF-36 compared to older patients.

A significant correlation was revealed between WOMAC pain, stiffness and function scores and all SF-36 domains ($p<0.0001$). The strongest correlation was between WOMAC pain dimension and the SF physical function compared with other SF-36 scales (rho=0.647) (Table 4).

The WOMAC function dimension had the strongest Spearman's correlation coefficient with the SF-36 physical functioning scale (rho=0.737) (Table 4).

The WOMAC stiffness dimension had rho coefficients of 0.476 with the physical functioning scale of the SF-36. The coefficients are negative, as higher scores in WOMAC are correlated with lower SF-36 the scores and improvements in the HRQL (Figure 2).

We also investigated the relationship of WOMAC scores with

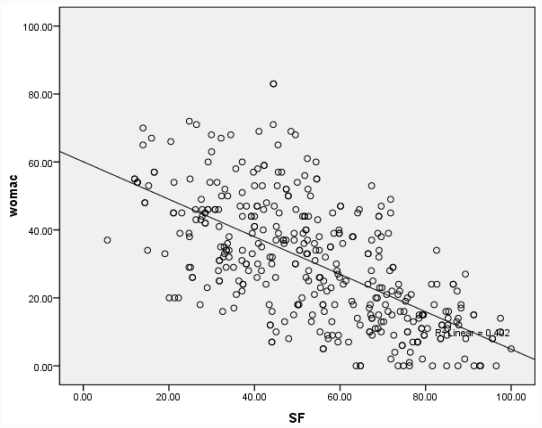


**Figure 2:** The Correlation between WOMAC (total score) with SF36 (total score).

**Table 5:** Mean scores of WOMAC, SF 36 and VAS according to OA severity (four grades of Kellgren Lawrence).

| Measure | Score(Mean ±sd) | P value |
|---|---|---|
| WOMAC | | |
| Grade I<br>Grade II<br>Grade III<br>Grade IV | 17.3±15.6<br>28.2±16.9<br>31.±17.5<br>44.4±18 | <0.001 |
| SF36 | | |
| Grade I<br>Grade II<br>Grade III<br>Grade IV | 72.9±22.9<br>54±19.1<br>50.8±19.94<br>44.7±19.6 | <0.001 |
| VAS | | |
| Grade I<br>Grade II<br>Grade III<br>Grade IV | 2.7±3<br>3.1±2<br>3.5±2.1<br>4.9±1.8 | <0.001 |

SF-36 PCS and MCS scale scores. As shown in Table 4, WOMAC dimensions were better correlated with PCS than MCS. The WOMAC function correlated best with PCS (rho=0.775).

Patients with knee OA in grade 2 and 3 had lower HRQL (according to both WOMAC and SF 36 measure) compared to patients with knee OA in grade 1 (P<0.05) (Table 5).

## Discussion

In this study, significant correlation was found between WOMAC pain, stiffness and function scores and all SF-36 domains, the strongest correlation was between WOMAC pain dimension and the SF physical function compared withotherSF-36 scales. Also, impairment of HRQL was associated with increasing radiographic change. The association between HRQL measured by WOMAC and SF36 and radiographic scales was not evaluated in previous studies.

Knee OA are among the most common musculoskeletal problems and the cause of chronic pain in elderly persons and have important public health implications [20]. Older adults with knee OA undergo a significant impact on multiple dimensions of HRQOL, compared with healthy controls [19-21].

There may be discordance between objective findings such as radiographs and patients symptoms including joint pain and impairment in physical function [22]. However, in our study, HRQL decreased as the severity of knee OA increased in radiographic imaging. This finding is in agreement with the result of other similar trials in OA patients which higher radiographic score were statistically associated with higher pain scores [2]. On the other side, in some studies, 10% of those with normal radiographs complain knee pain, while only 40%–79% of those with advanced radiographic abnormalities report pain and stiffness [7,9]. A number of other studies have been aimed at investigating the impact BMI on knee symptoms. In a study by Panj J, There were no correlations between BMI, duration of disease, KL score and the vast majority of SF-36 subscale scores in patients [20,23]. However, in a study by Pereira D, higher BMI were associated with higher radiographic score, also higher pain scores [24]. These findings are in line with the result of the present study that patients with higher BMI had higher pain, also lower quality of life according to SF 36 scale.

The WOMAC questionnaire is a valid and tested disease specific HRQOL questionnaire to assess symptoms and physical functional disability in patients with OA of the knee [25]. It was demonstrated that most of its dimensions are in good accordance with SF 36 as a generic HRQOL questionnaire [26,27].

In the present study also significant correlation was found between WOMAC scores and all SF-36 domains, the strongest correlation were between WOMAC pain dimension and the SF physical function. The WOMAC function dimension achieved the highest Spearman's correlation coefficient with the SF-36 physical functioning scale. This association between WOMAC and SF 36 dimensions is in agreement with the results of previous studies in this field [9]. The authors assessed the health status impact of hip and knee OA in 244 population aged 50 years and over and compared the metric properties of the WOMAC disease-specific questionnaire (Western Ontario and McMaster Universities) with generic measures [i.e., the Short Form 36 (SF-36) in patients with OA of the lower extremities of patients with OA of the lower extremities [9]. This investigation has confirmed that WOMAC is the instrument of choice for evaluating patients with lower limb OA. For a more general insight into patient's health and in particular cross-sectional studies of the elderly, where comorbidity is common, theSF-36 should also be used [28,29].

A number of studies demonstrate that the condition-specific measure is more sensitive to knee problems than the generic measure [27]. These findings corroborate that these instruments are measuring different aspects of patients' health. A generic measure (SF-36) was not as sensitive to knee impairment as condition specific measures [28,29].

These results highlight the various uses for these measures. The disease-specific instrument detects improvements in the knee postsurgery, whereas the generic measure points out that these elderly subjects continue to have major disabilities. Disease-specific measures are essential to detect improvements due to specific interventions and to confirm the usefulness of the intervention on a patient's pain and function due to the specific disease [30]. Generic measures are important to document patient's overall pain and function due to any condition [29,30].

## Conclusion

In the present study, there was an association between OA severity based on radiographic findings and HRQL (according to both WOMAC and SF 36 instruments), also between BMI and pain score, also between BMI and quality of life according to SF 36 scale. There was agreement between dimensions of WOMAC and SF36 in

measuring HRQL in patients with knee OA. Symptoms also correlate with radiographic findings.

The strong point of the present study was large sample size compared to similar studies. A limitation of our study is its cross-sectional nature, also the sample of our study could not be representative of the general knee OA population as female predominance was very high Future studies should address the comparative sensitivity of generic and disease-specific measures in the same subject over time. This information is important to the design of intervention studies when these instruments are used as outcome measures. A clinically important change in these instruments after surgical or rehabilitation interventions needs to be assigned.

## References

1. Murray CJL, Lopez AD. The global burden of disease. World Health Organisation. 1996.
2. Pereira D, Severo M, Ramos E, Branco J, Santos RA, Costa L, et al. Potential role of age, sex, body mass index and pain to identify patients with knee osteoarthritis. Int J Rheum Dis. 2015.
3. Marks. Impact of age, gender, and disease and health status on physical and psychological correlates of knee osteoarthritis disability. Open Longevity Science. 2008;2:49-57.
4. Garratt AM, Brealey S, Gillespie WJ, DAMASK Trial Team. Patient-assessed health instruments for the knee: a structured review. Rheumatology (Oxford). 2004;43:1414-1423.
5. Steultjens MP, Roorda LD, Dekker J, Bijlsma JW. Responsiveness of observational and self-report methods for assessing disability in mobility in patients with osteoarthritis. Arthritis Rheum. 2001;45:56-61.
6. 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.
7. Salaffi F, Carotti M, Stancati A, Grassi W. Health-related quality of life in older adults with symptomatic hip and knee osteoarthritis: a comparison with matched healthy controls. Aging Clin Exp Res. 2005;17:255-263.
8. Bombardier C, Melfi CA, Paul J, Green R, Hawker G, Wright J, et al. Comparison of a generic and a disease-specific measure of pain and physical function after knee replacement surgery. Med Care. 1995;33:AS131-44.
9. Salaffi F, Carotti M, Grassi W. Health-related quality of life in patients with hip or knee osteoarthritis: comparison of generic and disease-specific instruments. Clin Rheumatol. 2005;24:29-37.
10. 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.
11. Brazier JE, Harper R, Munro J, Walters SJ, Snaith ML. Generic and condition-specific outcome measures for people with osteoarthritis of the knee. Rheumatology (Oxford). 1999;38:870-877.
12. Alghadir A, Anwer S, Iqbal ZA, Alsanawi HA. Cross-cultural adaptation, reliability and validity of the Arabic version of the reduced Western Ontario and McMaster Universities Osteoarthritis index in patients with knee osteoarthritis. Disabil Rehabil. 2015;11:1-6.
13. Angst F, Aeschlimann A, Steiner W, Stucki G. Responsiveness of the WOMAC osteoarthritis index as compared with the SF-36 in patients with osteoarthritis of the legs undergoing a comprehensive rehabilitation intervention. Ann Rheum Dis. 2001;60:834-40.
14. Duygu Geler Külcü, Burcu Yanık, Hakan Atalar, Gülçin Gülşen. Associated factors with pain and disability in patients with knee osteoarthritis. Turk J Rheumatol. 2010;25:77-81.
15. Altman R, Alarcón G, Appelrouth D, Bloch D, Borenstein D, Brandt K. The American College of Rheumatology criteria for the classification of osteoarthritis of the hip. Arthritis Rheum. 1991;34:505-14.
16. Kellgren JH, Lawrence JS. Radiological assessment of osteo-arthrosis. Ann Rheum Dis. 1957;16:494-502.
17. Montazeri A, Goshtasebi A, Vahdaninia M, Gandek B. The Short Form Health Survey (SF-36): translation and validation study of the Iranian version. Qual Life Res. 2005;14:875-82.
18. Nadrian H, Moghimi N, Nadrian E, Moradzadeh R, Bahmanpour K, Iranpour A, et al. Validity and reliability of the Persian versions of WOMAC Osteoarthritis Index and Lequesne Algofunctional Index. Clin Rheumatol. 2012;31:1097-102.
19. Ebrahimzadeh MH, Makhmalbaf H, Birjandinejad A, Keshtan FG, Hoseini HA, Mazloumi SM. The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) in Persian Speaking Patients with Knee Osteoarthritis. Arch Bone Jt Surg. 2014;2:57-62.
20. Pang J, Cao YL, Zheng YX, Gao NY, Wang XZ, Chen B, et al. Influence of pain severity on health-related quality of life in Chinese knee osteoarthritis patients. Int J Clin Exp Med. 2015;8:4472-9.
21. Kao MJ, Wu MP, Tsai MW, Chang WW, Wu SF. The effectiveness of a self-management program on quality of life for knee osteoarthritis (OA) patients. Arch Gerontol Geriatr. 2012;54:317-24.
22. 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.
23. Marks R. Obesity profiles with knee osteoarthritis: correlation with pain, disability, disease progression. Obesity (Silver Spring). 2007;15:1867-74.
24. Elbaz A, Debbi EM, Segal G, Haim A, Halperin N, Agar G, et al. 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;92:1618-23.
25. Faik A, Benbouazza K, Amine B, Maaroufi H, Bahiri R, Lazrak N, et al. Translation and validation of Moroccan Western Ontario and McMaster Universities (WOMAC) osteoarthritis index in knee osteoarthritis. Rheumatol Int. 2008;28:677-83.
26. Ateef MD, ShaziyaKulandaivelan T. Influence of age on self-reported and actual physical performance measures in primary knee osteoarthritis. Indian J Health Wellbeing. 2012;3:1087-9.
27. Salaffi F, Leardini G, Canesi B, Mannoni A, Fioravanti A, Caporali R, et al. Reliability and validity of the Western Ontario and McMaster Universities (WOMAC) Osteoarthritis Index in Italian patients with osteoarthritis of the knee. Osteoarthritis Cartilage. 2003;11:551-60.
28. Bruce B, Fries J. Longitudinal comparison of the Health Assessment Questionnaire (HAQ) and the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). Arthritis Rheum. 2004;51:730-7.
29. Papathanasiou G, Stasi S, Oikonomou L, Roussou I, Papageorgiou E, Chronopoulos E, et al. Clinimetric properties of WOMAC Index in Greek knee osteoarthritis patients: comparisons with both self-reported and physical performance measures. Rheumatol Int. 2015;35:115-23.
30. Bachmeier CJM, March LM, Cross MJ, Lapsley HM, Tribe KL, Courtenay BG, et al. A comparison of outcomes in osteoarthritis patients undergoing total hip and knee replacement surgery. Osteoarthritis and Cartilage 2001;9:137-46.