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Original Article

Influence of pain severity on health-related quality of life in Chinese knee osteoarthritis patients

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Abstract: Objective: The aim of this cross-sectional study was to examine the relationship among pain and other symptoms intensity, and health-related quality of life (HRQoL) in Chinese patients with knee osteoarthritis (OA). Methods: The study was cross-sectional, descriptive, and correlational. A convenience sample of 466 patients with knee OA was recruited in the study. Age, gender, body mass index (BMI), duration of disease, and Kellgren- Lawrence (KL) scores were recorded. HRQoL and symptoms were assessed using the 36-item Short Form Health Survey (SF-36) and the Western Ontario and McMaster (WOMAC) index in participants. Results: The sample was predominantly female (82%) with mean age 56.56 years and mean BMI 24.53 kg/m^2. We found that WOMAC subscale scores significantly negative correlated with the majority of SF-36 subscale scores in knee OA patients ($P < 0.05$). There were no correlations between BMI, duration of disease, KL score and the vast majority of SF-36 subscale scores in patients ($P > 0.05$). In addition, there was a significant correlation between age and PCS, gender and MCS in patients ($P < 0.05$). Regression analysis showed, WOMAC subscale scores significantly negative correlated with the vast majority of SF-36 subscale scores. WOMAC-pain score had the strongest relationship with SF-36 PCS and MCS scores. Conclusions: In summary, pain severity has a greater impact on HRQoL than patient characteristics, other joint symptoms and radiographic severity in Chinese knee OA patients. Relieving of knee symptoms may help to improve patients' HRQOL. The study provided the evidence that relieving pain should be the first choice of therapy for knee osteoarthritis.

Keywords: Knee osteoarthritis, pain, quality of life, WOMAC, SF-36

Introduction

Osteoarthritis (OA) is the most common degenerative joint disease and a major public health problem throughout the world. Osteoarthritis affects all structures within a joint. Not only is hyaline articular cartilage lost, but bony remodeling occurs, with capsular stretching and weakness of periarticular muscles [1]. Further more, osteoarthritis can occur at almost any joint, osteoarthritis of the knee is the most common type. Most people affected are older than 45 years. Osteoarthritis is also a leading cause of impaired mobility in the elderly [2]. According to data from China [3], the overall prevalence of knee OA was about 13.8%, and there was a tendency of increased knee OA prevalence with age, especially after 40 years old. In consideration of the huge population base of older people in China, he total number of patients will be very astonishing in the future. Now, there are no currently approved OA treatments capable of slowing OA-related structural progression or delaying the need for total knee replacement [4]. Then current guidelines for knee OA care focus on symptoms relief and functional improvement [5]. The final goal of clinical treatment is to improve the health condition of the patient. Quality of life (QoL) is an important outcome measure for health condition and evaluation of treatments. Thus understanding the concepts of QoL, symptoms and their relationship in osteoarthritis patients is of importance.

QoL was defined as either the subjective perception of one's own well-being within sociocultural context or as the satisfaction of desires and pleasures and the accomplishment of the ideal to a standard of perfection [6]. As a multidimensional assessment of physical, psychological, and social functions, QoL was believed

to be a good measure of studying an individual's state of health [7]. QoL also has broadly been categorized into general and health-related QoL (HRQoL), the latter referring to aspects of QoL that are directly related to health [8]. Many disease and treatment-related factors affect QoL. Previous studies have shown that HRQoL measures, although not yet standardized, are valid, reliable, and responsive for the evaluation of health results, especially chronic disease processes. The 36-item Short Form Health Survey (SF-36) is a short-form health survey including 36 questions. It is a well-recognized, self-administered and user-friendly questionnaire for measuring HRQoL in general populations as well as in populations with specific conditions.

Knee OA is characterized by the following symptoms: pain, stiffness, limited motion of knee joint. Pain has been identified as the top concern for osteoarthritis patients [9]. One commonly used disease-specific assessment ins trument in knee or hip osteoarthritis is the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) [10]. Numerous studies have reported on its reliability and validity [11, 12]. There have also been several studies, which have raised issues about the factorial validity of the subscales of WOMAC [13-15]. The scale of WOMAC with three subscales, pain, stiffness and physical function, contain main symptoms of knee OA.

Recently, researchers attached more importance to QoL, symptoms, and their relationship in knee osteoarthritis patients. Several studies have revealed that patients with knee OA had significantly poorer QoL compared with healthy controls [16]. Alkan et al. reported patients with knee OA had lower scores in all subgroups of SF-36 compared with health controls [17]. Moreover, the SF-36 physical function (PF) significantly negatively correlated with WOMAC subgroup scores. Hoogeboom et al. demonstrated that joint pain was negatively associated with HRQoL of individuals with knee OA and not associated with physical activity [18]. But there are few studies from China highlighting this aspect of osteoarthritis.

Therefore, the aim of this study was to examine the relationship among pain and other symptoms intensity, and HRQoL in Chinese patients with knee OA. Moreover, we wished to ascertain the possible influencing factors associated with QoL of knee OA patients.

Methods

Patients and data collection

This study was a single-center prospective cross-sectional survey of patients who attended the outpatient clinic of Shuguang Hospital Affiliated to Shanghai University of Traditional Chinese Medicine. A total of 466 patients with knee OA were consecutively invited to participate between March 2009 and February 2010. The study had approval from the local ethics committee, and written informed consent for participation was obtained from each parti cipant.

All patients met the clinical and radiological criteria of the American College of Rheumatology for knee OA [19]. The criteria for inclusion were primary knee OA, age over 40 years, and competency to complete the questionnaires. Exclusion criteria were presence of other rheumatic diseases responsible for secondary OA, symptoms and signs of acute synovitis, any physical therapy program or intra-articular injections within the previous 6 months. Patients who had traumatic injuries of the lower limb, serious organic disease (for example arrhythmia, angina pectoris, stroke, asthma) with resultant severe dysfunction, more severe pain in other regions than the knee joint, or peripheral vascular diseases were also excluded from the study.

Demographic information, such as gender, age, height and weight, etc., in addition duration of disease was recorded. Body mass index (BMI) was calculated by dividing participants' weight in kg by height in meters squared.

Weight bearing antero-posterior knee radiographs were taken by standard procedures. All the radiographs were evaluated by at least two readers with a third consensus reader for the presence of KOA defined by the Kellgren-Lawrence (KL) radiographic grading scale [20]. The grades for this scale are as follows: 0 = no features of OA, 1 = questionable osteophytes, 2 = definite osteophytes without joint-space narrowing, 3 = definite osteophytes with moderate joint-space narrowing, 4 = definite osteophytes with severe joint-space narrowing.

Table 1. Descriptive statistics of the study sample (n =466)

Demographic factors	
Age (years), median (min-max)	56 (40-73)
Males/females, n (%)	84 (18.0)/382 (82.0)
Body mass index (BMI) (kg/m^2), median (min-max)	24.28 (16.51-36.73)
Duration of disease (months), median (min-max)	24 (0.5-240)
Kellgren-Lawrence scale	
Grade 1, n (%)	28 (6.00)
Grade 2, n (%)	74 (15.87)
Grade 3, n (%)	287 (61.58)
Grade 4, n (%)	77 (16.52)
WOMAC subscale scores, median (min-max)	
Pain	107 (2-448)
Stiffness	43.5 (0-195)
Function	388.45 (0-1490.05)
SF-36 subscale scores, median (min-max)	
Physical components summary (PCS)	70.37 (12.4-97.5)
Mental components summary (MCS)	80.94 (24.8-100)
Physical function (PF)	70 (10-100)
Ability to perform physical role (RP)	75 (0-100)
Bodily pain (BP)	81.5 (0-100)
General health (GH)	60 (0-100)
Vitality (VT)	75 (25-100)
Social function (SF)	77.77 (0-100)
Ability to perform emotional role (RE)	100 (0-100)
Mental health (MH)	76 (24-100)

SF-36 = short form 36; WOMAC = Western Ontario and McMaster Universities Osteoarthritis index.

Symptoms and quality of life measures

Pain and other symptoms were assessed using the WOMAC index. In OA clinical trials, outcomes are often disease-specific questionnaires, such as the WOMAC index, when assessing the symptoms [21]. The WOMAC index is a three-dimensional, disease specific, self-administered health status measure. It evaluates clinically important, patient-relevant symptoms in the areas of pain, stiffness, and physical function in patients with osteoarthritis of the hip or knee. The instrument consists of 24 items on three subscales: pain (5 items), stiffness (2 items), and physical function (17 items). In this study the WOMAC index was used in its VAS format, and all 24 items are rated by the subject on a 100 mm VAS ranging from 0 (indicating no pain, stiffness, or difficulty) to 100 (indicating extreme pain, stiffness, or difficulty). The range of the WOMAC subscale scores is: pain (0-500); stiffness (0-200), and function (0-1700).

The HRQoL was measured using a Chinese version of SF-36, which was a standardized and validated tool and had been widely used to evaluate patient's health [22, 23]. The SF-36 Chinese Version consists of 36 items divided into eight domains that are aggregated into two summary scores, a mental component summary (MCS) and a physical component summary (PCS). PCS and MCS make it possible to reduce the number of statistical comparisons needed and provide greater precision. The eight domains range from reflecting predominantly physical well-being, that include physical function (PF), the ability to perform expected physical roles (RP), the degree of bodily pain (BP) and overall sense of general health (GH) to those reflecting predominantly social and emotional well-being that inclu de overall sense of vitality (VT), ability to function in social roles (SF), ability to perform expected emotional and social roles (RE) and overall sense of mental health (MH)

Statistical analysis

SPSS 17.0 statistical software was used for all data management and analyses. Descriptive analyses were performed to investigate the participants' characteristics. The Spearman's correlation analysis was used to assess the correlation between parametric variables. Multi ple stepwise regression was used to determine the relationship of symptom data to PCS and MCS. The level of significance was set at $P < 0.05$.

Results

Sample characteristics

Of the 466 participants, 84 (18%) were male and 382 (82%) female. The ages of the partici-

Table 2. Correlations between demographic data, KL score and WOMAC index with SF-36 subscale scores

		PCS	MCS	PF	RP	BP	GH	VT	SF	RE	MH
Age	*r*	-0.192	-0.086	-0.142	-0.192	-0.082	-0.122	-0.066	-0.100	-0.077	-0.030
	P	0.000	0.064	0.000	0.000	0.075	0.008	0.154	0.030	0.096	0.516
Gender	*r*	-0.082	-0.106	-0.098	-0.020	-0.062	-0.132	-0.113	-0.052	-0.061	-0.100
	p	0.076	0.022	0.035	0.666	0.178	0.004	0.150	0.259	0.189	0.031
BMI	*r*	0.010	0.043	-0.011	-0.004	-0.077	0.112	0.067	-0.040	0.048	0.046
	p	0.831	0.356	0.819	0.938	0.098	0.016	0.146	0.394	0.306	0.323
Duration of disease	*r*	-0.080	-0.057	-0.063	-0.060	-0.070	0.070	-0.075	-0.043	-0.013	0.031
	p	0.086	0.218	0.180	0.198	0.133	0.133	0.106	0.354	0.783	0.500
KL Scale	*r*	-0.073	0.016	-0.125	-0.039	-0.077	-0.030	0.024	-0.047	-0.051	0.055
	p	0.118	0.739	0.007	0.400	0.097	0.516	0.611	0.309	0.274	0.240
WOMAC-Pain	*r*	-0.333	-0.230	-0.366	-0.255	-0.424	-0.085	-0.127	-0.406	-0.179	0.032
	p	0.000	0.000	0.000	0.000	0.000	0.067	0.000	0.000	0.000	0.489
WOMAC-Stiffness	*r*	-0.248	-0.145	-0.303	-0.166	-0.325	-0.057	-0.085	-0.325	-0.052	-0.010
	p	0.000	0.002	0.000	0.000	0.000	0.217	0.066	0.000	0.263	0.828
WOMAC-Function	*r*	-0.414	-0.282	-0.484	-0.288	-0.482	-0.163	-0.203	-0.429	-0.185	-0.064
	p	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.170

BMI = body mass index; KL = Kellgren-Lawrence scale; PF = physical function; RP = ability to perform physical role; BP = bodily pain; GH = general health; VT = vitality; SF = social function; RE = ability to perform emotional role; MH = mental health; VAS = visual analog scale; PCS = physical components summary; MCS = mental components summary; SF-36 = short form 36; WOMAC = Western Ontario and McMaster Universities Osteoarthritis index; WOMAC-pain = WOMAC subscale score for pain; WOMAC-stiffness = WOMAC subscale score for joint stiffness; WOMAC-function = WOMAC subscale score for daily living activities.

pants were between 40 and 73 years (mean 56.56 ± 7.28 years, median 56 years). BMI were between 16.51 and 36.73 kg/m^2 (mean 24.53 ± 3.12 kg/m^2, median 24.28 kg/m^2), and duration of disease was ranged from 0.5 to 240 months (mean 38.24 ± 44.83 months, median 24.00 months). **Table 1** presents the main demographic data, WOMAC subscale scores, KL score and SF-36 subscale scores in patients with knee OA.

Correlations between SF-36 subscales and demographic data, clinical data, WOMAC subscales in patients with knee OA

As showed in **Table 2**, we have found that WOMAC subscale scores significantly negative correlated with the majority of SF-36 subscale scores in knee OA patients ($P < 0.05$). There were no correlations between BMI, duration of disease, KL score and the vast majority of SF-36 subscale scores in patients ($P > 0.05$). In addition, there was a significant correlation between age and PCS, gender and MCS in patients ($P < 0.05$).

Stepwise regression analysis

Multicollinearity is a common problem when estimating linear or generalized linear models. It occurs when there are high correlations among predictor variables, leading to unreliable and unstable estimates of regression coefficients. Before regression analysis, we found that there might be severe multicollinearity among WOMAC subscale scores. Although it was considered that there was no clear-cut criterion for evaluating multicollinearity of linear regression models, we made a judgment by checking related statistics with Eigenvalue and Condition index. The results of collinearity diagnosis by SPSS showed evidence of multicollinearity among WOMAC-pain score (Eigenvalue =0.040; Condition index =13.596), WOMAC-stiffness score (Eigenvalue =0.014; Condition index =22.892), and WOMAC-function score (Eigenvalue =0.005; Condition index =37.648). Previous study has demonstrated joint pain intensity is influencing factor of joint function in knee osteoarthritis [24]. Therefore WOMAC-function score was eliminated in the following regression analysis.

The results of final regression models for the relationships among age, gender, BMI, duration of disease, KL score, WOMAC subscale scores and HRQOL (PCS and MCS) are presented in **Table 3**. Age, duration of disease, and WOMAC-pain score all had negative influences on the

Table 3. Standardized Regression Coefficients for Final Models Relating WOMAC scales to SF-36 (PCS and MCS)

	PCS	MCS
Adjusted R^2	0.143	0.06
WOMAC-pain	-0.299**	-0.166**
Age	-0.170**	-0.108*
Duration of disease	-0.104*	
Gender		-0.099*

PCS = SF-36 physical components summary; MCS = SF-36 mental components summary; Gender: 0 for male, 1 for female. *$P < 0.05$, **$P < 0.001$.

PCS score, with older age, longer duration of disease, and severer pain symptoms being associated with lower PCS score. The WOMAC-pain score had the strongest relationship with the PCS score of all variables evaluated. For the MCS model, age, gender and pain had negative influences on the PCS score. Women showed had lower MCS score than men. The WOMAC-pain score had an stronger relationship with MCS score than did gender and age.

Discussion

In the current study, HRQoL was evaluated with SF-36 in patients diagnosed with knee OA. Meanwhile, WOMAC index was examined as a disease-specific assessment of patients. Acco rding to the results of this study, a statistically significant correlation was found between each subscale scores of WOMAC and subscale scores of SF-36 ($P < 0.05$). In the past, Alkan et al. has reported the SF-36 physical function was significantly negatively correlated with WOMAC subscale scores in patients with knee osteoarthritis [17]. Figueiredo et al. also found pain severity was negatively associated with the quality of life in patients with osteoarthritis [25]. The SF-36 was originally developed as an instrument for health surveying which was widely used in studies of health-related QoL and medical outcomes surveys. Therefore, the items in the SF-36 reflect mainly toward the scope of health statuses of individuality. As to WOMAC index, it was developed in the early 1980s as a disease-specific measure for knee and hip osteoarthritis, was designed to provide a standardized assessment of self-reported osteoarthritis status [26]. The presence of symptoms, regardless of their source, may influence the HRQOL of patients. A previous study have also provided a framework for demonstrating the relationship between symptoms and HRQOL [27]. Therefore, now there is evidence that knee osteoarthritis symptoms evaluated with WOMAC index are correlated with HRQoL variation.

In order to identify which variables were most significantly correlated with HRQoL, stepwise regression analysis was used. We found that WOMAC-pain score, age, and duration of disease were the most powerful influence factors of PCS. Meanwhile, WOMAC-pain score, age, and gender were significantly accounted for MCS. In line with previous studies [28, 29], the current study showed pain severity were significantly associated with worse HRQoL.

In this study, there was a significant correlation between age and MCS or PCS. On the contrary, a recent study [30] showed there was not a significant correlation between age and any subscale of QoL in knee OA, except the role physical subscale score. However, It has been shown in other studies that there was a significant negative correlation between age and physical functioning, indicating deterioration of this domain as patients become older [31, 32]. It was well known, the rare cases of OA diagnosed in young individuals. In addition, many studies also have showed that increased age is the most prominent risk factor for the initiation and progression of primary OA.

As reported by previous study [30], BMI did not show correlation with any subscale scores of HRQoL in knee OA, except GH. The association between BMI and the risk of developing knee OA was demonstrable in various other studies [33, 34]. Moreover, Rogers et al. reported elevated BMI had a greater likelihood of knee pain compared to subjects with a normal BMI in persons with radiographic knee osteoarthritis [35]. Weight loss has been shown to reduce the incidence of knee OA in a cohort study, and high weight is one of the most important preventable risk factors for knee OA [36]. In contrast, a previous study reported that BMI is associated with quality of life. Derraik et al. reported increasing BMI is associated with a progressive reduction in physical quality of life, even within a relatively narrow BMI range encompassing only overweight middle-aged men [37]. In our view, the differences of the research objects, may be the cause of the diversity of results. In

addition, gender did not show correlation with any subscale scores of SF-36 also in this study.

Notably, the results of the present study demonstrated that part of influencing factors of QoL in Chinese knee OA patients differs from patients in other countries. This could be explained by differences of country, culture, and race, which may influence subjective feeling to disease and QoL. Such differences also were found in other studies [38].

One limitation of the present study was that all participants enrolled in the survey were from a single center, and with a relatively small sample size. Another limitation of this study was that we did not detect the impact of swelling on QoL. Recent study reported that swelling was correlated with the SF-36 physical function and pain scores [30]. Although the American College of Rheumatology has provided criteria for diagnosis of OA, which did not include swelling.

Conclusions

Our study indicated that WOMAC subscale scores significantly negative correlated with the vast majority of SF-36 subscale scores in Chine se knee OA patients. WOMAC-pain score had the strongest relationship with SF-36 PCS and MCS scores. In summary, pain severity has a greater impact on HRQoL than patient characteristics, other joint symptoms and radiographic severity. Relieving of knee symptoms may help to improve patients' HRQoL. The study provided the evidence that relieving pain should be the first choice of therapy for knee osteo arthritis.

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Disclosure of conflict of interest

None.

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References

[1] Felson DT. Clinical practice. Osteoarthritis of the knee. N Engl J Med 2006; 354: 841-848.

[2] Guccione AA, Felson DT, Anderson JJ, Anthony JM, Zhang Y, Wilson PW, Kelly-Hayes M, Wolf PA, Kreger BE, Kannel WB. The effects of specific medical conditions on the functional limitations of elders in the Framingham Study. Am J Public Health 1994; 84: 351-358.

[3] Zhang J, Song L, Liu G, Zhang A, Dong H, Liu Z, Li X, Luo J. Risk factors for and prevalence of knee osteoarthritis in the rural areas of Shanxi Province, North China: a COPCORD study. Rheumatol Int 2013; 33: 2783-2788.

[4] Losina E, Daigle ME, Suter LG, Hunter DJ, Solomon DH, Walensky RP, Jordan JM, Burbine SA, Paltiel AD, Katz JN. Disease-modifying drugs for knee osteoarthritis: can they be cost-effective? Osteoarthritis Cartilage 2013; 21: 655-667.

[5] Hochberg MC, Altman RD, April KT, Benkhalti M, Guyatt G, McGowan J, Towheed T, Welch V, Wells G, Tugwell P; American College of Rheumatology. American College of Rheumatology 2012 recommendations for the use of nonpharmacologic and pharmacologic therapies in osteoarthritis of the hand, hip, and knee. Arthritis Care Res (Hoboken) 2012; 64: 465-474.

[6] The World Health Organization Quality of Life assessment (WHOQOL): position paper from the World Health Organization. Soc Sci Med 1995; 41: 1403-1409.

[7] Valenti M, Porzio G, Aielli F, Verna L, Cannita K, Manno R, Masedu F, Marchetti P, Ficorella C. Physical exercise and quality of life in breast cancer survivors. Int J Med Sci 2008; 5: 24-28.

[8] Ferrans CE, Zerwic JJ, Wilbur JE, Larson JL. Conceptual model of health-related quality of life. J Nurs Scholarsh 2005; 37: 336-342.

[9] Hawker GA, Badley EM, Croxford R, Coyte PC, Glazier RH, Guan J, Harvey BJ, Williams JI, Wright JG. A population-based nested case-control study of the costs of hip and knee replacement surgery. Med Care 2009; 47: 732-741.

[10] Bellamy N, Buchanan WW, Goldsmith CH, Campbell J, Stitt LW. Validation study of WOMAC: a health status instrument for measuring clinically important patient relevant outcomes to antirheumatic drug therapy in patients with osteoarthritis of the hip or knee. J Rheumatol 1988; 15: 1833-1840.

[11] Thumboo J, Chew LH, Soh CH. Validation of the Western Ontario and Mcmaster University osteoarthritis index in Asians with osteoarthritis in Singapore. Osteoarthritis Cartilage 2001; 9: 440-446.
[12] Xie F, Li SC, Goeree R, Tarride JE, O'Reilly D, Lo NN, Yeo SJ, Yang KY, Thumboo J. Validation of Chinese Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) in patients scheduled for total knee replacement. Qual Life Res 2008; 17: 595-601.
[13] Faucher M, Poiraudeau S, Lefevre-Colau MM, Rannou F, Fermanian J, Revel M. Assessment of the test-retest reliability and construct validity of a modified WOMAC index in knee osteoarthritis. Joint Bone Spine 2004; 71: 121-127.
[14] Guermazi M, Poiraudeau S, Yahia M, Mezganni M, Fermanian J, Habib Elleuch M, Revel M. Translation, adaptation and validation of the Western Ontario and McMaster Universities osteoarthritis index (WOMAC) for an Arab population: the Sfax modified WOMAC. Osteoarthritis Cartilage 2004; 12: 459-68.
[15] Stratford PW, Kennedy DM, Woodhouse LJ, Spadoni GF. Measurement properties of the WOMAC LK 3.1 pain scale. Osteoarthritis Cartilage 2007; 15: 266-272.
[16] 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.
[17] Alkan BM, Fidan F, Tosun A, Ardicoglu O. Quality of life and self-reported disability in patients with knee osteoarthritis. Mod Rheumatol 2014; 24: 166-71
[18] Hoogeboom TJ, den Broeder AA, de Bie RA, van den Ende CH. Longitudinal impact of joint pain comorbidity on quality of life and activity levels in knee osteoarthritis: data from the Osteoarthritis Initiative. Rheumatology (Oxford) 2013; 52: 543-546.
[19] Altman R, Asch E, Bloch D, Bole G, Borenstein D, Brandt K, Christy W, Cooke TD, Greenwald R, Hochberg M; 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.
[20] Kellgren JH, Lawrence JS. Radiological assessment of osteo-arthrosis. Ann Rheum Dis 1957; 16: 494-502.
[21] Bruyere O, Cooper C, Pavelka K, Rabenda V, Buckinx F, Beaudart C, Reginster JY. Changes in structure and symptoms in knee osteoarthritis and prediction of future knee replacement over 8 years. Calcif Tissue Int 2013; 93: 502-507.
[22] Liu C, Li N, Ren X, Li J, Zhang J, [Feasibility of using short form 36 in Chinese population]. Hua Xi Yi Ke Da Xue Xue Bao 2001; 32: 39-42.
[23] Tan ML, Wee HL, Lee J, Ma S, Heng D, Tai ES, Thumboo J. The Short Form 36 English and Chinese versions were equivalent in a multiethnic Asian population. J Clin Epidemiol 2013; 66: 759-767.
[24] Riddle DL, Stratford PW. Unilateral vs bilateral symptomatic knee osteoarthritis: associations between pain intensity and function. Rheumatology (Oxford) 2013; 52: 2229-2237.
[25] Figueiredo Neto EM, Queluz TT, Freire BF. Physical activity and its association with quality of life in patients with osteoarthritis. Rev Bras Reumatol 2011; 51: 544-549.
[26] Ackerman I. Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). Aust J Physiother 2009; 55: 213.
[27] Wilson IB, Cleary PD. Linking clinical variables with health-related quality of life. A conceptual model of patient outcomes. JAMA 1995; 273: 59-65.
[28] Skevington SM. Investigating the relationship between pain and discomfort and quality of life, using the WHOQOL. Pain 1998; 76: 395-406.
[29] Tavoli A, Montazeri A, Roshan R, Tavoli Z, Melyani M. Depression and quality of life in cancer patients with and without pain: the role of pain beliefs. BMC Cancer 2008; 8: 177.
[30] Alkan BM, Fidan F, Tosun A, Ardicoglu O. Quality of life and self-reported disability in patients with knee osteoarthritis. Mod Rheumatol 2014; 24: 166-171.
[31] Robinson ME, Gagnon CM, Riley JL 3rd, Price DD. Altering gender role expectations: effects on pain tolerance, pain threshold, and pain ratings. J Pain 2003; 4: 284-288.
[32] 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.
[33] Felson DT, Zhang Y, Hannan MT, Naimark A, Weissman B, Weissman BN, Aliabadi P, Levy D. Risk factors for incident radiographic knee osteoarthritis in the elderly: the Framingham Study. Arthritis Rheum 1997; 40: 728-733.
[34] Mili F, Helmick CG, Zack MM. Prevalence of arthritis: analysis of data from the US Behavioral Risk Factor Surveillance System, 1996-99. J Rheumatol 2002; 29: 1981-1988.
[35] Rogers MW, Wilder FV. The association of BMI and knee pain among persons with radiographic knee osteoarthritis: a cross-sectional study. BMC Musculoskelet Disord 2008; 9: 163.

[36] Felson DT, Zhang Y, Anthony JM, Naimark A, Anderson JJ. Weight loss reduces the risk for symptomatic knee osteoarthritis in women. The Framingham Study. Ann Intern Med 1992; 116: 535-539.

[37] Derraik JG, de Bock M, Hofman PL, Cutfield WS. Increasing BMI is associated with a progressive reduction in physical quality of life among overweight middle-aged men. Sci Rep 2014; 4: 3677.

[38] Shen B, Tan W, Feng G, He Y, Liu J, Chen W, Huang X, Da Z, Xu X, Liu H, Gu Z. The correlations of disease activity, socioeconomic status, quality of life, and depression/anxiety in Chinese patients with systemic lupus erythematosus. Clin Dev Immunol 2013; 2013: 270878.