ORIGINAL ARTICLE

Sex and Body Mass Index Correlate With Western Ontario and McMaster Universities Osteoarthritis Index and Quality of Life Scores in Knee Osteoarthritis

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ABSTRACT. Elbaz A, Debbi EM, Segal G, Haim A, Halperin N, Agar G, Mor A, Debi R. 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.

Objective: To examine the associations of sex, body mass index (BMI), and age with knee osteoarthritis (OA) symptomatic severity.

Design: A cross-sectional retrospective analysis.

Setting: Patients completed the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) questionnaire and Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36). Data were acquired from a stored database of a private therapy center.

Participants: Patients (N=1487) with symptomatic knee OA were evaluated.

Interventions: Not applicable.

Main Outcome Measures: WOMAC questionnaire and SF-36.

Results: BMI correlated significantly with worse knee OA symptoms for all WOMAC and SF-36 subcategories (all $P \le .001$). Age correlated significantly with worse symptoms only for WOMAC function and SF-36 physical functioning ($P = .001$ and $P = .009$, respectively). A significant difference across BMI quintiles was found for all WOMAC and SF-36 subcategories (all $P \le .01$). Women showed worse knee OA symptoms in all WOMAC and SF-36 subcategories (all $P \le .001$). There was a significant interaction of sex by BMI in WOMAC pain and WOMAC function ($P = .01$ and $P = .02$, respectively).

Conclusions: Based on the results of this analysis, it can be concluded that women and patients with a higher BMI with knee OA are at a greater risk for worse symptoms.

Key Words: Body mass index; Gender identity; Osteoarthritis; Pain; Questionnaires; Rehabilitation.

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KNEE OSTEOARTHRITIS (OA) is the most common type of OA, with an estimated 12.1% of adults in the United States suffering from pain and functional limitations.[1] Many studies have attempted to identify factors that are associated with symptomatic knee OA. The most important of these include sex, body mass index (BMI), and age.[1-3]

With regard to sex, several studies have shown that radiographic knee OA is more prevalent in women than in men. In the United States, the prevalence of radiographic knee OA in adults older than 60 is 42.1% in women and 31.2% in men.[1] In Japanese patients aged 60 to 69 years, the prevalence of radiographic knee OA is 57.1% in women and 35.2% in men.[4] With regard to the prevalence of symptomatic knee OA, the Third National Health and Nutritional Examination Study in the United States (1991–1994) found that the prevalence of symptomatic knee OA did not differ by sex.[1] Other studies have examined whether sex differences exist in symptoms among patients already with knee OA.[2,3,5] In a previous study,[2] we found no significant sex differences in symptomatic knee OA severity. This finding, however, may have been due to the small sample size relative to the national studies.[2] Two large national studies in Finland (1996) and France (2009) found that women were associated with greater knee OA pain and disability.[3,5] As a whole, these studies suggest that there is a possible association between sex and knee OA severity and that, if a relationship indeed exists, the specific symptomatic parameters predicted by sex must be clearly defined.

In contrast to sex, research on the association between BMI and symptomatic knee OA is more consistent. The French[5] and Finnish[3] national studies and the Third National Health and Nutritional Examination Study[1] all found a strong link between BMI and knee OA disability. As early as 1992, Felson et al[6] predicted that a 2 BMI unit reduction in women could reduce the risk for developing knee OA symptoms. This was confirmed by Coggon et al,[7] who found that BMI is one of the greatest risk factors in knee OA development and that a 5kg loss could dramatically reduce a patient's need for surgery. Although the association between BMI and symptomatic knee OA is strong, the association may not be linear across all BMI levels. In addition, few studies have examined the strength of this association within different sexes. In 1 study in 1988, Felson et al[8] suggested that the correlation between BMI and knee OA disability is stronger in women.

With regard to age, most knee OA epidemiologic studies have shown that radiographic and symptomatic knee OA is

List of Abbreviations

BMI	body mass index
OA	osteoarthritis
SF-36	Short Form 36 Health Survey Questionnaire
WOMAC	Western Ontario and McMaster Universities Osteoarthritis Index

much more prevalent in the elderly, specifically individuals 60 years of age and older.[1,3-5] There are 2 studies that have shown that knee OA prevalence is even greater in patients 85 years of age and older.[1,4] It has yet to be determined if and how the severity of knee OA worsens with age among patients with symptomatic knee OA.

The objective of this study was to examine the sex differences in knee OA symptomatic severity and the associations between age and BMI with knee OA symptomatic severity. The association between age and BMI and knee OA severity were examined using a correlation analysis. The association between BMI and knee OA were examined in greater depth through an analysis over BMI into quintiles. The analysis over quintiles between BMI and knee OA symptoms was also compared between sexes through interactive models. Knee OA symptomatic severity was evaluated by the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) visual analog scale and the Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36) quality of life health survey.

METHODS

Design

This was a retrospective cross-sectional survey of OA symptoms reported by patients with knee OA, who were evaluated for treatment at the All Phases of Step Cycle Therapy Center, Israel. Data were collected retrospectively from a secure database system.

Recruitment of Participants

The clinic treats patients throughout Israel using a customized biomechanical gait therapy for patients with musculoskeletal disorders. The majority of patients arrive from Tel Aviv and Haifa. The database was reviewed for all knee OA patients arriving to the clinic for an initial visit during July 2007 to October 2009. There were 10,554 patients registered in the AposTherapy database between these dates. Excluded from analysis were 5528 patients with other lower-extremity pathologies, 1570 patients with unilateral knee OA, and 1969 patients due to other exclusion criteria. There were 1487 patients eligible for analysis in the present study.

All patients provided written informed consent prior to the study using forms approved by the investigators' institutional review board. Inclusion criteria included: patients suffering from symptomatic bilateral knee OA of the medial compartment for at least 6 months and qualifying under the American College of Rheumatology clinical criteria for OA of the knee.[9] Exclusion criteria included: acute septic arthritis, inflammatory arthritis, corticosteroid injection within 3 months of the study, avascular necrosis of the knee, history of knee buckling or recent knee injury, any joint replacement, neuropathic arthropathy, tendency to fall, lack of physical or mental ability to perform or comply with the study procedure, history of pathologic osteoporotic fracture, symptomatic degenerative arthritis in lower limb joints other than the knees, spinal, or vascular claudication, and other lower-extremity problems. This protocol is similar in style to that used by the French[5] and Finnish[3] national studies.

During the initial visit at the clinic, patients completed the WOMAC questionnaire[10,11] and the SF-36[12] in a private room, and the therapy staff recorded their age and measured their BMI. These surveys were chosen because these are the most commonly used questionnaires to evaluate the symptoms of knee OA[13] and were used by previous studies that examined sex, age, and BMI in knee OA patients.[2,5] Both questionnaires

are supported by evidence of reliability, validity, and responsiveness to symptoms.[14]

The WOMAC is a self-administered questionnaire consisting of questions answered on a visual analog scale from 0mm to 100mm. A score of 0mm reflects an absence of the symptom. The questionnaire consists of sets of questions on pain, function, and stiffness that analyze subscales as well as add for a total score.[10] A valid Hebrew translation of the WOMAC questionnaire (version 3.1) was used in the present study.[15]

The SF-36 is a quality of life questionnaire. A valid Hebrew translation of the SF-36 original Likert scale was used.[16] The results range between 0 to 100, where 0 indicates poor quality of life and 100 indicates excellent quality of life. The questionnaire is divided into 8 subcategories: physical functioning, role limitation due to physical health, role limitation due to emotional health, energy/fatigue, emotional well-being, social functioning, pain, and general health.

Ethical Approval

This study was approved by the Helsinki Committee of Assaf Harofeh Medical Center in Zerifin, Israel. The registration number is 141/08. The study's NIH clinical trial registration number is NCT00767780.

Statistical Analysis

Data were analyzed with SPSS software version 17.0.[a] The distributions of WOMAC and SF-36 subcategories were first examined using histograms and the Kolmogorov-Smirnov nonparametric test. The results of the surveys, age, and BMI were measured as continuous variables and were described with mean±SD. Sex was measured as a categorical variable. BMI was also divided into categorical levels in additional statistical analyses.

Sex differences in knee OA severity were examined using the differences calculated in WOMAC and SF-36 subcategories between men and women. Differences were described by means and 95% confidence intervals, and were tested with an independent t test.

Associations between age and BMI with knee OA severity were determined by nonparametric Spearman rank correlation calculations between age, BMI, and the WOMAC and SF-36 subcategories.

The association between BMI and knee OA severity was then examined over BMI quintiles. The Kruskal-Wallis 1-way analysis of variance by ranks test was calculated to test for differences in the WOMAC and SF-36 subcategories between quintiles of BMI. This test demonstrates whether the relationship between BMI and knee OA symptoms is linear across all BMI levels.

The association between BMI and knee OA was also compared between sexes. A univariate general linear model was performed to analyze the WOMAC pain and function subcategories by 2 factors: BMI quintile and sex. Using this general linear model procedure, we investigated interactions between BMI and sex for the WOMAC subcategories. The interaction test demonstrates whether the differences in BMI quintiles are equivalent among men and women. This analysis was applied successfully in a previous study of ours which examined differences between BMI quintiles in gait parameters in both men and women.[2]

A P value of .05 or less was considered statistically significant for all statistical tests.