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Risk Factors for Osteoarthritis and Contributing Factors to Current Arthritic Pain in South Korean Older Adults

Kyoung Min Lee,[1] Chin Youb Chung,[1] Ki Hyuk Sung,[2] Seung Yeol Lee,[3] Sung Hun Won,[1] Tae Gyun Kim,[4] Young Choi,[5] Soon-Sun Kwon,[6] Yeon Ho Kim,[1] and Moon Seok Park[1]

Departments of [1]Orthopaedic Surgery and [6]Biomedical Research Institute, Seoul National University Bundang Hospital, Seongnam; [2]Department of Orthopaedic Surgery, Myongji Hospital, Goyang; [3]Department of Orthopaedic Surgery, Ewha Womans University Hospital, Seoul; [4]Department of Orthopaedic Surgery, Gwang Hye Hospital, Busan; [5]Department of Orthopaedic Surgery, Konyang University Hospital, Daejeon, Korea.

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Corresponding author: Dr. Chin Youb Chung, Department of Orthopaedic Surgery, Seoul National University Bundang Hospital, 82 Gumi-ro 173beon-gil, Bundang-gu, Seongnam 463-707, Korea.
Tel: 82-31-787-7193, Fax: 82-31-787-4056
E-mail: chungcy55@gmail.com

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Purpose: Although previous studies have focused on risk factors for osteoarthritis, there is some debate on this issue. Furthermore, associated factors with arthritic symptom (arthralgia) have not been sufficiently investigated, despite its clinical importance in the management of osteoarthritis. This study was performed to examine the risk factors for osteoarthritis and the contributing factors to current arthritic pain in older adults. **Materials and Methods:** The Fourth Korean National Health and Nutrition Examination Surveys was conducted in 2009. Therein, 720 males and 1008 females aged 65 years and older were included. Comprehensive data on habitual, socioeconomic, medical, nutritional, and psychological factors were collected along with the presence of osteoarthritis and arthritic pain. After univariate analysis, binary logistic regression analysis was performed to identify risk factors for osteoarthritis and contributing factors to current arthritic pain. **Results:** Age (p=0.005), female gender (p<0.001), higher body mass index (BMI) (p<0.001), and osteoporosis (p<0.001) were significant risk factors for osteoarthritis, while higher education level (p=0.025) was a protective factor for osteoarthritis. Higher BMI (p=0.047), lack of weekly moderate intensity activity (p<0.001), and unfavorable subjective health status (p<0.001) were significant factors contributing to current arthritic pain among subjects with osteoarthritis. Both osteoarthritis and current arthritic pain adversely affected health related quality of life. **Conclusion:** Higher BMI, lack of weekly moderate intensity activity, and unfavorable subjective health status were significant factors contributing to current arthritic pain. More attention needs to be paid to psychiatric effects on osteoarthritis and joint related pain.

Key Words: Osteoarthritis, joint related pain, risk factors, older adults

INTRODUCTION

Reflecting the impact of osteoarthritis on our lives, numerous studies have set out to investigate the risk factors of the disease.[1-11] However, studies have shown somewhat inconsistent or often conflicting results in terms of body mass index

(BMI), activity, and the involved anatomic structures.[4,12-14] This has provoked the necessity of a more comprehensive study to include as many factors as possible to rule out the effect of known and unknown confounding factors in these studies.

Furthermore, there is little known about the contributing factors to current joint-related pain in patients with osteoarthritis, which is the most important symptom caused by osteoarthritis. Joint-related pain usually triggers those with osteoarthritis to seek medical or surgical treatment. Therefore, we need to focus on investigating the contributing factors related to joint-related pain, along with associated factors in osteoarthritis.

We hypothesized that there are various factors associated with osteoarthritis and current arthritic pain in the elderly Korean population. This study was performed to investigate the associated factors for osteoarthritis and the contributing factors to current arthritic pain in older adults using the Fourth Korean National Health and Nutrition Examination Surveys (KNHNES IV) 2009 data.

MATERIALS AND METHODS

Subjects

This cross-sectional study was based on the comprehensive data acquired from the KNHNES IV 2009. The data were publicly available from the Korean Centers for Disease Control and Prevention. The surveys were undertaken from community populations and selected from stratified multistage probability samples of Korean households representing the civilian, non-institutionalized population. The surveys included a health interview survey, a health behavior survey, a health examination survey, and a nutrition survey. In total, 12722 people were invited and 10533 responded, with a response rate of 82.8%.[15,16] Of these, the data of the older adults who are aged 65 years and older were included in this study. The Institutional Review Board of Seoul National University Bundang Hospital exempted the need for approval of this study because it did not involve the possibility of violating human rights.

The health interview survey and the health behavior survey included the following: 1) demographics (age, gender, education level, socioeconomic status, and marital status), 2) health habits (smoking, sleeping hours, and weight change during the past one year), 3) medical diseases (past history and current symptom), 4) activity level using short-form international physical activity questionnaire, 5) health related quality of life (evaluated by using EuroQoL), and 6) psychological aspects (subjective health status using a Likert scale, suicidal ideation, stress, and depressive mood).

The health examination survey included height, weight, waist circumference, BMI, blood test (fasting blood sugar, total cholesterol, HDL cholesterol, LDL cholesterol, triglyceride, glutamic oxaloacetic transaminase, glutamic pyruvic transaminase, hemoglobin, hematocrit, ferritin, blood urea nitrogen, white blood cell count, red blood cell count, vitamin D, alkaline phosphatase, and parathyroid hormone, and urine test [urine acidity (pH), urine specific gravity, cotinine, urine creatinine, and urine sodium].

The nutrition survey analyzed the nutritional ingredients of the foods that the subjects had taken the day before using the Food Composition Table developed by the National Rural Resources Development Institute (7th revision), based on a 24-hour dietary recall questionnaire administered by a dietician. The ingredients included total mass of food, total calories, total water, protein, fat, carbohydrates, calcium, phosphorus, iron, sodium, potassium, vitamin A, carotene, retinol, thiamine (vitamin B_1), riboflavin (vitamin B_2), niacin (vitamin B_3), and vitamin C.

Definition of groups and subgroups

The questionnaire regarding osteoarthritis included presence of osteoarthritis diagnosed by a physician and presence of current arthritic pain. Based on these questions, the subjects were categorized into the osteoarthritis group and non-osteoarthritis group, and the osteoarthritis group was further subgrouped into current arthritic pain and no-current arthritic pain groups.

Statistical analysis

A descriptive analysis was performed for all the variables, including the mean and standard deviation or frequency. Data normality was tested using the Kolmogorov-Smirnov test. Student's t-test was utilized for comparison of continuous variables and chi-square test was used for comparison of categorical variables between the two groups.

The demographic data and medial diseases were compared and analyzed between the osteoarthritis and non-osteoarthritis groups. The variables (continuous variables) that were significantly different or associated (categorical variables) between the groups were subsequently included in the binary logistic regression analysis to investigate the significant associated factors for osteoarthritis.

A subgroup analysis of the osteoarthritis group was performed based on current arthritic pain. The variables that were significantly different or associated between the current and no-current arthritic pain subgroups were included in the binary logistic regression analysis to investigate the significant contributing factors to the current arthritic pain.

Each subscale of the EuroQoL and EuroQoL visual analogue scale (VAS) was compared between the osteoarthritis and non-osteoarthritis groups, as well as between the current and no-current arthritic pain subgroups.

All statistical analyses were performed using SPSS software, version 18.0 (IBM Corporation, Armonk, NY, USA), with statistical significance set at $p<0.05$.

RESULTS

Data from 1728 subjects aged >65 years were selected from the overall dataset. Of these subjects, 58 with incomplete data were excluded, and 1670 subjects were finally included in the data analysis. Mean age of the subjects was 72.7 years (SD 5.7, range from 65 years to 95 years), and there were 720 males and 1008 females. Of these, 476 were diagnosed with osteoarthritis.

In comparing demographics and medical diseases between the osteoarthritis group and non-osteoarthritis group, there were significant differences in gender ($p<0.001$), height ($p<0.001$), waist circumference ($p<0.001$), BMI ($p<0.001$), education level ($p<0.001$), marital status ($p<0.001$), the amount of previous smoking ($p<0.001$), hypertension ($p<0.001$), and osteoporosis ($p<0.001$) (Table 1).

In binary logistic regression analysis, the variables that were significantly different between the osteoarthritis and non-osteoarthritis groups were included except for height and waist circumference because these two were represented by BMI. Age was included in logistic regression analysis since it is a well known risk factor for osteoarthritis. The binary logistic regression analysis showed that older age ($p=0.005$), female gender ($p<0.001$), higher BMI ($p<0.001$), and osteoporosis ($p<0.001$) were significant factors associated with osteoarthritis, while higher education level ($p=0.025$) was a significant protective factor for osteoarthritis (Table 2).

Among the osteoarthritis group, current arthritic pain subgroup (n=450) and no-current arthritic pain subgroup (n=26) showed significant differences in BMI ($p=0.031$), proportion of hypertension ($p=0.022$), weekly moderate intensity activity hours ($p=0.033$), stress ($p=0.048$), and subjective health status ($p<0.001$). There were no significantly different laboratory tests and nutrition intake between the current arthritic pain and no-current arthritic pain subgroups (Table 3).

Binary logistic regression analysis showed that higher BMI ($p=0.047$), less weekly moderate intensity activity ($p<0.001$), and unfavorable subjective health status ($p<0.001$) were significant factors contributing to current arthritic pain among the subjects with osteoarthritis (Table 4).

Both osteoarthritis and current arthritic pain adversely affected health related quality of life (Table 5 and 6). However, the self-care subscale of EuroQoL was not significantly different according to the presence of current arthritic pain.

Table 1. Comparison of Demographics and Medial Diseases between the Osteoarthritis Group and Non-Osteoarthritis Group

	Osteoarthritis group (n=476)	Non-osteoarthritis group (n=1194)	*p* value
Age (yrs)	72.9 (5.4)	72.5 (5.6)	0.207
Gender (M:F)	89:387	608:586	<0.001
Height (cm)	152.7 (7.7)	157.5 (9.4)	<0.001
Weight (kg)	57.6 (9.5)	57.8 (10.3)	0.781
Waist circumference	0.558 (0.065)	0.525 (0.060)	<0.001
BMI (kg/cm^2)	24.7 (3.3)	23.2 (3.1)	<0.001
Education level (low/high)	447/29	954/216	<0.001
Income (low/high)	243/230	589/583	0.681
Current marital status (not married/married)	206/270	387/803	<0.001
Total amount of previous smoking (pack yr)	3.8 (19.0)	8.5 (14.1)	<0.001
Hypertension (yes/no)	268/208	545/649	<0.001
Osteoporosis (yes/no)	165/311	185/1009	<0.001
Diabetes mellitus (yes/no)	92/384	196/998	0.155

BMI, body mass index.
Data are presented as mean (SD). Waist circumference was normalized by dividing with height.

Table 2. Binary Logistic Regression Analysis Evaluating Associated Factors for Osteoarthritis

	Exp (B)	95% CI for Exp (B)	*p* value
Age	1.033	1.010–1.057	0.005
Gender (female)	3.322	2.320–4.739	<0.001
BMI	1.131	1.089–1.174	<0.001
Education level (high)	0.509	0.329–0.786	0.025
Marital status	1.271	0.973–1.661	0.375
Total amount of previous smoking	1.000	1.000–1.000	0.848
Osteoporosis	1.844	1.405–2.421	<0.001
Hypertension	1.178	0.929–1.495	0.171
Constant	0.003	-	<0.001

BMI, body mass index; CI, confidence interval.

Table 3. Comparison of Demographics, Current Health Habits, Current Laboratory Tests, and Current Nutrition Intake between the Current Pain Subgroup and No-Current Pain Subgroup within the Osteoarthritis Group

	Current pain subgroup (n=450)	No-current pain subgroup (n=26)	*p* value
Age (yrs)	72.9 (5.4)	73.0 (5.7)	0.873
Gender (M:F)	81:369	8:18	0.104
BMI (kg/cm^2)	24.7 (3.3)	23.3 (3.1)	0.031
Education level (low/high)	424/26	23/3	0.232
Income (low/high)	234/213	9/17	0.079
Current marital status (not married/married)	198/252	8/18	0.186
Current average daily smoking (pieces)	0.6 (3.1)	2.1 (8.0)	0.370
Weight change during past 1 yr (loss/none/gain)	92/313/45	6/20/0	0.238
Hypertension (yes/no)	259/191	9/17	0.022
Osteoporosis (yes/no)	156/294	9/17	0.996
Diabetes mellitus (yes/no)	90/360	2/24	0.123
Sleeping hrs	6.4 (1.8)	6.5 (1.6)	0.699
Activity (wks hrs)			
High intensity	1.6 (5.7)	1.2 (4.3)	0.738
Moderate intensity	2.4 (6.5)	8.5 (13.8)	0.033
Walking	4.6 (7.4)	5.2 (5.2)	0.656
Ideation of suicide during past 1 yr (yes/no)	162/288	8/18	0.588
Stress (yes/no)	133/317	3/23	0.048
Depressive mood (yes/no)	120/330	6/20	0.687
Subjective health status (very poor/poor/fair/good/very good)	1.44 (1.01)	2.35 (0.89)	<0.001
Blood test			
FBS (mg/dL)	102.8 (21.6)	98.9 (14.1)	0.391
Total cholesterol (mg/dL)	195.9 (34.3)	196.6 (35.0)	0.928
HDL cholesterol (mg/dL)	49.0 (11.6)	46.2 (10.2)	0.249
LDL cholesterol (mg/dL)	114.5 (33.4)	140.5 (39.9)	0.077
Triglyceride (mg/dL)	156.0 (82.4)	131.6 (59.0)	0.153
GOT (IU/L)	23.5 (9.2)	22.1 (6.7)	0.468
GPT (IU/L)	19.7 (10.9)	18.5 (9.4)	0.586
Hemoglobin (g/dL)	13.1 (1.2)	13.5 (1.2)	0.117
Hematocrit (%)	39.5 (3.4)	40.8 (3.6)	0.065
Ferritin (ng/mL)	87.7 (78.6)	85.8 (72.6)	0.908
BUN (mg/dL)	17.1 (6.0)	15.7 (3.7)	0.260
WBC count (thousands/uL)	6.2 (1.7)	5.6 (1.4)	0.065
RBC count (millions/uL)	4.3 (0.4)	4.5 (0.5)	0.115
Vit D (ng/mL)	18.9 (6.6)	18.9 (8.8)	0.973

Table 3. Continued

	Current pain subgroup (n=450)	No-current pain subgroup (n=26)	*p* value
ALP (IU/L)	251.9 (74.3)	235.3 (51.5)	0.281
PTH (pg/mL)	74.2 (31.4)	75.8 (29.3)	0.813
Urine test			
pH	5.9 (0.9)	5.9 (0.9)	0.987
Urine specific gravity	1.016 (0.005)	1.017 (0.005)	0.414
Cotinine (ng/mL)	70.5 (269.7)	227.4 (511.5)	0.214
Urine creatinine (mg/L)	98.5 (61.2)	102.9 (51.3)	0.724
Urine sodium (g/day)	127.4 (46.3)	135.8 (45.2)	0.375
Daily nutrition intake (per kg)			
Total food mass (g)	16.2 (8.6)	19.1 (8.5)	0.111
Total calories (kcal)	25.1 (10.1)	28.4 (7.7)	0.121
Total water (g)	10.0 (6.7)	12.1 (7.5)	0.137
Protein (g)	0.79 (0.42)	0.89 (0.33)	0.294
Fat (g)	0.30 (0.23)	0.34 (0.19)	0.335
Carbohydrate (g)	4.8 (2.0)	5.4 (1.6)	0.163
Calcium (mg)	6.7 (10.5)	7.5 (4.5)	0.717
Phosphorus (mg)	14.9 (6.9)	17.3 (5.3)	0.088
Iron (mg)	0.21 (0.21)	0.20 (0.14)	0.792
Sodium (mg)	60.3 (41.6)	63.4 (33.7)	0.719
Potassium (mg)	39.3 (23.6)	46.7 (27.1)	0.142
Vit A (μg RE)	10.2 (13.5)	9.1 (9.3)	0.705
Carotene (μg)	56.8 (80.2)	50.0 (55.9)	0.685
Retinol (μg)	0.53 (0.89)	0.63 (1.01)	0.591
Vit B_1 (thiamine) (mg)	0.015 (0.008)	0.017 (0.007)	0.174
Vit B_2 (riboflavin) (mg)	0.013 (0.008)	0.015 (0.007)	0.203
Vit B_3 (niacin) (mg)	0.18 (0.10)	0.21 (0.09)	0.208
Vit C (mg)	1.3 (1.2)	1.6 (2.0)	0.205

BMI, body mass index; FBS, fasting blood sugar; Vit, vitamin; GOT, glutamic oxaloacetic transaminase; GPT, glutamic pyruvic transaminase; BUN, blood urea nitrogen; WBC, white blood cell; RBC, red blood cell; ALP, alkaline phosphatase; PTH, parathyroid hormone.
Data are presented as mean (SD). Waist circumference was normalized by dividing with height. Nutrition intake was normalized by dividing with body weight.

Table 4. Binary Logistic Regression Analysis for Factors Contributing to Current Joint Related Pain in Osteoarthritis Group

	Exp (B)	95% CI for Exp (B)	*p* value
BMI (kg/cm^2)	1.172	1.002–1.371	0.047
Hypertension	1.965	0.787–4.902	0.147
Weekly moderate intensity activity (hrs)	0.934	0.900–0.970	<0.001
Stress	2.066	0.572–7.463	0.268
Subjective health status	0.332	0.201–0.550	<0.001
Constant	0.055	-	0.174

BMI, body mass index; CI, confidence interval.

DISCUSSION

This study investigated the associated factors for osteoarthritis and contributing factors to current arthritic pain in community-based older population. Older age (p=0.005), female gender (p<0.001), higher BMI (p<0.001), and osteoporosis (p<0.001) were found to be significant factors associated with osteoarthritis, while higher education level (p=0.025) was a significant protective factor against osteoarthritis. Higher BMI (p=0.047), less weekly moderate intensity activity (p<0.001), and unfavorable subjective health status (p<0.001) were found to be significant contributing factors to current arthritic pain among the older adults with osteoarthritis. Presence of osteoarthritis and current arthritic pain adversely affected health related quality of life.

Table 5. Comparison of Health-Related Quality of Life between the Osteoarthritis Group and Non-Osteoarthritis Group

EuroQoL	Osteoarthritis group	Non-osteoarthritis group	*p* value
Mobility	1.75 (0.54)	1.42 (0.53)	<0.001
Self-care	1.24 (0.46)	1.14 (0.38)	<0.001
Usual activities	1.52 (0.64)	1.32 (0.57)	<0.001
Pain/discomfort	1.86 (0.71)	1.47 (0.64)	<0.001
Anxiety/depression	1.26 (0.51)	1.17 (0.43)	0.001
EuroQoL VAS	62.55 (23.65)	68.75 (21.69)	<0.001

VAS, visual analogue scale.
Data are presented as mean (SD). Higher scores are more unfavorable in each subscale of EuroQoL and more favorable in EuroQoL VAS.

Table 6. Comparison of Health-Related Quality of Life between the Current Pain Subgroup and the No-Current Pain Subgroup within the Osteoarthritis Group

EuroQoL	Current symptom subgroup	No-current symptom subgroup	*p* value
Mobility	1.78 (0.53)	1.23 (0.51)	<0.001
Self-care	1.24 (0.46)	1.15 (0.46)	0.330
Usual activities	1.54 (0.64)	1.23 (0.43)	0.002
Pain/discomfort	1.89 (0.70)	1.35 (0.56)	<0.001
Anxiety/depression	1.27 (0.52)	1.08 (0.27)	0.003
EuroQoL VAS	61.97 (23.61)	72.65 (22.53)	0.025

VAS, visual analogue scale.
Data are presented as mean (SD). Higher scores are more unfavorable in each subscale of EuroQoL and more favorable in EuroQoL VAS.

Female gender, age, and BMI are well known risk factors for osteoarthritis, as shown in previous studies,[2-4,6,7,9,11,14] as well as in this study. A low level of education was also found to be a significant factor associated with osteoarthritis from our data. We do not know if subjects with a lower level of education were involved in work requiring more physical labor or joint loading, although it is a possible explanation since overload on the joints could be a risk factor for osteoarthritis.[1,5,8,17]

Osteoporosis was another factor associated with osteoarthritis in this study. The relationship between osteoarthritis and osteoporosis has been somewhat controversial. There is a clinical implication that osteoarthritis and osteoporosis might have opposite effects on each other,[18,19] as an increased physical load on the skeletal structure is thought to be a risk factor for osteoarthritis, while also a protective factor for osteoporosis.[1,2,5,8,17,20] On the other hand, age and female gender are concurrent risk factors for both osteoarthritis and osteoporosis.[2,20-22] Our logistic regression model showed that osteoporosis is an associated factor for osteoarthritis, when adjusted for age and gender, which concurred with previous studies.[23,24] A recent trial showed that osteoporosis medication improved arthritic pain but failed to prevent structural progression of hip osteoarthritis.[25] Therefore, this issue is still inconclusive and needs further investigation.

Higher BMI was another significant factor associated with osteoarthritis and a contributing factor to current arthritic pain at the same time. Overweight is thought to cause osteoarthritis by increasing the load exerted on the joints.[26,27] However, it is also known to be associated with hand osteoarthritis, where being overweight does not necessarily cause increased joint load.[28-30] Previous studies have suggested that systemic and metabolic factors associated with overweight might play a role in inflammatory processes.[31,32] Weight control is believed to be a treatable issue for both osteoarthritis and current arthritic pain. In our data, no subject in the no-current arthritic pain subgroup showed weight gain during the past 1 year (Table 3), which supports this concept.

The amount of moderate intensity activity on a weekly basis was found to be significantly associated with current arthritic pain among the subjects with osteoarthritis. Although it was difficult to ascertain whether the reduced weekly amount of moderate activity in symptomatic subgroup was the cause or the result in this cross-sectional study, previous studies have suggested that an appropriate physical activity is beneficial for functioning.[33-35] We believe that moderate intensity activity is more beneficial for maintaining muscle mass than walking, and does not cause joint overload, compared with high intensity activity. Therefore, moderate intensity activity could be cautiously recommended for those with osteoarthritis to reduce their arthritis-related joint pain; a well-designed longitudinal study is needed to clarify this issue.

Studies have suggested that nutrition plays a role in osteoarthritis.[36-39] For example, antioxidants were found to re-

duce the progression of osteoarthritis, although they did not significantly reduce the initiation of osteoarthritis.[37] In addition, some nutritional factors have been found to exhibit a relationship with the inflammatory process and modulating chronic pain.[39-41] However, this study failed to reveal the role of nutrition intake in current arthritis pain among older adults with osteoarthritis. Our data on nutritional intake were based on the recall of food intake during the past day. A more intensive and detailed study design would be needed to investigate the relationship between osteoarthritis and nutritional state.

In the present study, the presence of osteoarthritis and current arthritic pain adversely affected health-related quality of life in older subjects. The subjects with osteoarthritis showed a 6.2 lower EuroQoL VAS score than those without osteoarthritis (p<0.001), and those with current arthritic pain showed 10.68 lower EuroQoL VAS score than those without pain (p=0.025). In addition, subjective health status significantly affected current arthritic pain in subjects with osteoarthritis. Previous studies have reported an association between osteoarthritis and psychosocial factors, such as depression and catastrophizing,[42-44] which supports our study results. Therefore, more attention needs to be paid to psychiatric causes and outcomes of osteoarthritis and arthritis related joint pain.

This study has some limitations that need to be addressed. First, the information on the medical conditions of the participants were based on self-reports. The validity of self-reported medical conditions is not established for our study cohort. Second, current medication, alternative therapy, or other treatment for osteoarthritis was not included in the data analysis, which could have affected the presence of osteoarthritis-associated pain.

In conclusion, older age, female gender, higher BMI, and osteoporosis were significant factors associated with osteoarthritis, while higher education level was a protective factor for osteoarthritis in South Korean older adults. Higher BMI, less weekly moderate intensity activity, and unfavorable subjective health status were significant contributing factors to current arthritic pain. More attention needs to be paid to psychiatric effects on osteoarthritis and joint related pain, and a more detailed study is needed to address this issue.

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