ORIGINAL ARTICLE

Prevalence of Knee Osteoarthritis in Karate Community in Indonesia

¹Feda Makkiyah [ID]*, **¹Diana Agustini** [ID], **¹Pritha Maya Savitri** [ID], **²Rahmah Hida Nurrizka** [ID], **³A. Heri Iswanto** [ID]

¹Faculty of Medicine, Universitas Pembangunan Nasional Veteran Jakarta, Jakarta, Indonesia. ²Faculty of Public Health, Universitas Islam Negeri Syarif Hidayatullah, Jakarta, Indonesia. ³Public Health Department, Faculty of Health Science, University of Pembangunan Nasional Veteran Jakarta, Jakarta, Indonesia.

ABSTRACT

Background. Osteoarthritis (OA) ranks fifth in the most disabling conditions. Karate is an unarmed combat sport that uses hands and feet to deliver and block blows. The karate movements, such as high load and frequent flexion and extension of the knee, make the athletes susceptible to knee injuries and progress to knee OA (KOA). **Objectives.** The study aims to address the prevalence and risk factors of KOA in karate athletes in the Karate Community in Jakarta, Indonesia. **Methods.** Fifty-nine karate athletes were enrolled in this cohort study in November 2018. Body weights and heights were measured, and a physical examination was performed. Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) questionnaires were given. Ultrasound imaging and X-ray of the knee were conducted. All data were analyzed using STATA 15. A descriptive analysis was performed, and correlations between two continuous variables were analyzed using the Pearson Chi squared-test. Logistic regression analysis evaluated associations between knee osteoarthritis and independent variables such as sex, age, BMI, WOMAC score, injury, and ultrasound findings. **Results.** Among 59 karate athletes, 18 (23%) were clinically diagnosed with clinical KOA. Most of them were males (46 instructors). The mean age of KOA was lower than negative KOA (53.61; 54.75 years old) (p=0.332). The WOMAC score was the only variable that showed a difference between the two groups regarding independent variables. **Conclusion.** One-third of karate athletes were diagnosed with clinical KOA. WOMAC showed a significant difference between positive KOA and negative KOA.

KEYWORDS: *Karate, Athletes, Knee, Osteoarthritis.*

INTRODUCTION

Karate is a no-weapon martial art that relies on the hand and foot to deliver strikes. Karate training loads large and heavy pressure on the joints, especially the knee, (1) making the joints susceptible to a knee injury. According to an epidemiological study, the second-highest rank of damage in karatekas are knee joints (32%), and more than 70% of karatekas had knee injuries. (2, 3) A history of knee injury is a significant risk factor for knee OA, regardless of study design and definition of a knee injury. (4)

Osteoarthritis (OA) is a joint inflammation disease that occurs progressively and is characterized by the bone response. OA has ranked fifth in the most disabling conditions, with one-third of the patients >65 years old. (5) Indonesian Ministry of Health held a survey in 2018 and concluded that the prevalence of OA was 7.6%. (6) It appears to be more common among younger men (<45 years) and in older women (> 45 years), and younger individuals may be susceptible to injury-induced OA. (5)

*. Corresponding Author:
Feda Makkiyah, Ph.D.
E-mail: fedaanisah@upnvj.ac.id

The chance of getting injured and then progressing to KOA is increased in young people who engage in many occupational and recreational activities. (7) A study in 2011 demonstrated the influence of occupational and recreational activities on the progression of OA, where military officers were related to significantly higher rates of OA compared to the exact age of the general population. (8)

Karate is an unarmed combat sport that uses the hands and feet to deliver and block blows. Because karate athletes often perform flexion and extension of the knee, they are susceptible to having injuries and progress to knee OA (KOA). The majority of the articles have reported hand osteoarthritis, (9) temporomandibular disorder, (10) shoulder OA, (11) elbow OA (12). KOA was written in running sport, (13) soccer, competitive weight lifting, and wrestling. (14) The prevalence of KOA is still unknown in Indonesia. This study aims to address the prevalence of KOA in karate athletes in Indonesia and correlate the risk factors with KOA. This study might give valuable insight into the occurrence of KOA in the future and warn the athletes about the KOA.

MATERIALS AND METHODS

Study Designs. The purposive non-random sampling was chosen in this study. Fifty-nine karate instructors who have been practicing the sport for more than ten years were enrolled in this study. The analysis was performed in November 2018. They were over 40 years old and practiced karate two or three times a week. Body weights and heights were measured, and physical examination was performed by three general practitioners who were blinded to this study (Figure 1). The participants were given a WOMAC questionnaire and questions about the symptoms (Table 1) and the risk factors associated with KOA (Table 2). WOMAC is a list of questions for evaluating KOA. It consists of 24 items and is divided into three subscales. The pain scale consists of five things asking about pain during inactivity or rest. The stiffness includes two questions and functional questions focused on disabilities in daily activities. The two blinded ultrasonographers examined the participants' knees, and a knee X-ray was conducted on participants with positive KOA.

All data were analyzed using Stata 15. Descriptive analysis was performed, with mean and standard deviation as continuous variables and absolute frequency and relative frequency as categorical variables. Normality of data was measured using the Shapiro–Wilk test, histograms, and multivariate skewness and kurtosis. Pearson's chi-squared test was used to correlate two continuous variables. P values < 0.05 were considered statistically significant. Logistic regression analysis was performed to evaluate the associations between knee osteoarthritis and independent variables such as sex, age, BMI, WOMAC score, injury, risk factors of KOA, and ultrasound findings. This study was approved by the Research Ethics Committee of the Faculty of Medicine, Universitas Pembangunan Nasional Veteran Jakarta, Indonesia (978/UN2.F1/ETIK/2016).
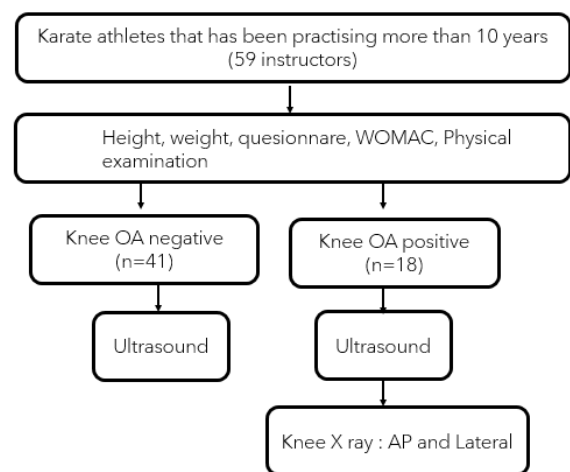
Figure 1. Schematic Data Collection.

Fifty-nine athletes participated in this current study. Among them, 18 were diagnosed with clinical knee OA.

RESULTS

Among the 59 karate instructors, 18 (23%) were clinically diagnosed with KOA, as presented in Table 1. Most of the instructors were males (46 males; 13 female instructors) (Table 3). The relative frequency percentage of KOA was higher in those aged 50-59 years than those between 40-49 and 60-69 years old. Six athletes aged 40-49, nine athletes aged 50–59, and three aged 60-69 were diagnosed with clinical KOA. The mean age of KOA was lower (53.61 years old) than negative KOA (54.75 years old), but the difference was not significant (P = 0.332).

Regarding independent variables, the WOMAC score was the only variable that showed a difference between the two groups (positive and

negative KOA). The mean WOMAC of positive KOA was 47.72, compared to 30.60 (P < 0.01) for negative KOA. Mean systolic and diastolic followed the similar path as the WOMAC score, but the difference between the two groups was not significant (143.5294 ± 21.19587 and 97.05 ± 13.58524; 132.381 ± 15.43 and 85 ± 12.34662).

Variables such as comorbid disease, injury, and having risk factors of KOA did not show significant differences between the two groups. Having comorbid illness and risk factors of KOA did not show any significant difference between the two groups (P = 0.298; P = 0.992).

Table 1. Knee Osteoarthritis Diagnostic Criteria ([15])

Presence of Knee Pain Plus at Least Three of the Following
Morning stiffness for less than 30 min
Crepitus on active knee motion
Older than 50 years of age
Bony enlargement
No palpable warmth
Bony tenderness

Table 2. Risk factors of osteoarthritis

Risk Factors Positive at Least Three of the Following
Often knee bending
Step ladder more than ten steps each day
Squat more than 30 min a day
Lift loads more than 15 kg in 30 days
Presence Valgus/valrus

Table 3. Characteristics of Respondents

		OA negative (n = 41)(%)	OA positive (n = 18)(%)	P	Correlation Coefficient (r)
Sex					
	Male	33 (71.7)	13 (28.26)	0.481	0.4975
	Female	8 (61.5)	5 (38.5)		
Mean age		54.7561+ 7.327279	53.61111+ 6.696258	0.332	2.2031
Age					
	40-49	15 (71)	6 (29)		
	50-59	13 (59)	9 (41)		
	60-69	13 (81)	3 (19)		
Mean BMI		26.86756± 3.169384	32.72889± 3.232782	0.438	5.19248
	BMI				
	Normal	6 (60)	4 (40)		
	Overweight	19 (76)	6 (24)		
	Obese	16(67)	8 (33)		
BP					
	Systole	133.1707 ± 15.07299	142.3529 ± 22.50817	0.425	7.0411
	Diastole	86 ± 14.21	92.35 ± 12.31	0.459	4.6585
	Mean WOMAC	30.60 ± 5.98	47.72 ± 9.24	0,000*	58
Comorbid					
	No comorbid	22 (76)	7 (24)	0,298	1.0918
	Yes	19 (63)	10 (37)		
Injury					
	No.	38 (69)	17 (31)	0.804	0.0614
	Yes	3 (75)	1 (25)		
FR OA					
	No risk factor	16 (70)	7 (30)	0.992	0.0001
	Yes	25 (69)	11(31)		

Regarding injury, only four instructors reported damage to the knee, and only one was diagnosed with KOA. The thin femoral condyle, osteophyte, and meniscal extrusion

showed a significant correlation with KOA based on ultrasound findings. (Table 4). After X-ray imaging was performed, only one instructor was diagnosed with KOA grade 1, and the other instructors were diagnosed with KOA grade 2–3.

Regarding analysis association between KOA and independent variables, only BMI correlated significantly with KOA (P < 0.01; odds ratio, 0.59). The increase of 1 unit of BMI increases the chance of developing KOA. The other independent variables showed no significant correlation (Table 5).

Table 4. Ultrasound and Radiographic Findings of Karate Athletes

	OA Negative (n = 41)(%)	OA positive (n = 18)(%)	P	Correlation Coefficient
Femoral Condyle				
Lateral	1.30 ± 0.46	0.25 5± 0.067	0.000*	35.8080
Trochlear	1.30 ± 0.46	0.224 ± 0.08	0.000*	35.8080
Medial	1.30 ± 0.46	0.25 ± 0.08	0.000*	35.8080
Osteophyte				
No	37 (100)	0 (0)		
Yes	4 (19)	18 (81)	0.00*	43.5632
Meniscal Extrusion				
No.	41(74)	14 (26)	0.002*	9.7737
Yes	0 (0)	4 (100)		
Radiographic appearance				
K-L grade 1	N/A	1		
K-L grade 2-3	N/A	17		

Table 5. Logistic Regression Analysis of Associations between Knee Osteoarthritis and Independent Variables

Variable	Odd Ratio (95%CI)	P Value
Sex	0.73 (0 .18-2.92)	0.661
Age	1.08 (0.21-5.59)	0.919
BMI	0.59 (0.46-0.78)	0.000*
Systole	1.02 (0.97-1.07)	0.396
Diastole	0 .95 (0.89-1.01)	0.134
Womac	0.99 (0.75-1.31)	0.954
Comorbid	0.49 (0.06-3.87)	0.498
Injury	1.34 (0.13-13.85)	0.805
FR OA	1.57(0.18-13.51)	0.681
Ultrasound findings		
Femoral Condyle Lateral	2.22e-38(7.5e-256-6.6e+179)	0.734
Femoral Condyle Trochlear	2.29e+31(4.51e-60-1.2e+122)	0.498
Femoral Condyle Medial	3.11e+11(2.31e-75-4.18e+97)	0.794
Osteophyte	1.28(0.39- 4.09)	0.678
Meniscal Extrusion	1.28(0.40-4.09)	0.678
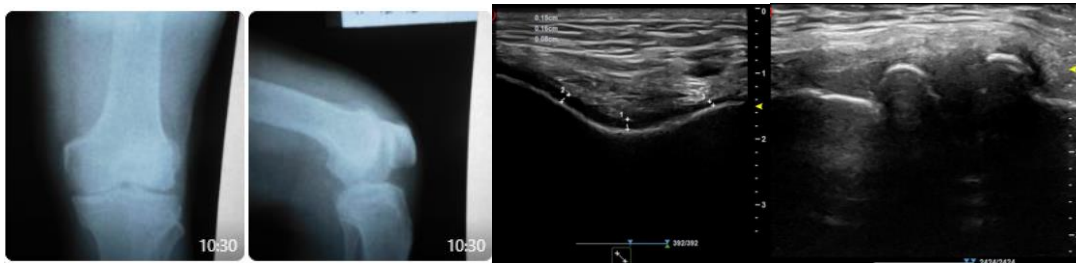
Figure 2. A 68-year-old male instructor who has been practicing karate for more than 30 years.
His BMI is 28.54, and WOMAC score is 40. He has past history of hyperuricemia and hypercholesterolemia. In our study, he was diagnosed with clinical knee OA. His ultrasound findings showed osteophyte and thin cartilage.

DISCUSSION

In this present study, the prevalence of OA in karate instructors was 23% (13 males and five females). Based on the Indonesia national survey held by the Indonesia Ministry of Health, the prevalence of KOA is 7.3%. (6) In sports, the

prevalence of KOA was reported in varied numbers. A systematic review in 2017 reported that the overall knee OA prevalence in sport participants was 7.7. (14) Another systematic review in 2018, including 3100 participants, concluded that the overall prevalence of KOA in former athletes was 30%. (16) Previous studies demonstrated the prevalence of KOA in the general population ranged from 19.0%–28.0%. (17, 18) The varied number of KOA prevalence might differ due to the difference in case selection and diagnostic criteria of KOA.

The prevalence of KOA in this karate community was higher than the average Indonesian population, presumably because repetitive and full loading kicking movements resulted in more ligamentous injury, which later developed into KOA. The second plausible reason was abnormal body weight. Due to advanced age, these instructors practiced karate movements less. As a consequence, they gained weight over time and developed KOA. This explanation is by a study that confirmed that more than 80 American football players developed KOA in 10–30 years after retirement. (19) Knee and hip OA are more prevalent in former athletes compared with nonathletes (odds ratio, 1.9) (20).

Athletes are more susceptible to joint damage than average individuals because they are more likely to have ligament injuries and meniscal tears. Around 50% of individuals who developed those injuries will develop OA 10–20 years later with impairment in pain and function (21). The general view is that OA results from "wear and tear." Because athletes and young individuals use their joints more, the risk of developing OA is higher. (7) The most significant damage resulting from KOA is the change in the articular. (22) Karate movements, such as back kick, front kick, and side kick, involve moving the knee with many repetitions and loading. These movements cause susceptible injury and damage to the articular cartilage of the knee (23).

In this study, the majority of instructors were overweight and obese. This fact was surprising because they were athletes for more than ten years. In this current study, the mean BMI of positive KOA instructors was higher than those with negative KOA. These facts aligned with the study that presented good evidence of linear correlation of high body mass indices and KOA. (24) This current study demonstrated that an increase in one unit of BMI would increase the

odds of KOA by 0.5 times. After logistic regression analysis, BMI was the only variable correlated with KOA. Regarding the four instructors with positive KOA positive and average weight, their weight was closed to the lower limit of overweight criteria. Thus, BMI still had a significant role in the progression of KOA.

In this current study, injury did not correlate significantly with KOA. A study in Finland compared karate with six other sports and concluded that karate and judo had the highest rate of injuries, and ice hockey, soccer, and basketball are in the next sequence. Volleyball has the lowest injury rate. (17) which means a higher propensity of developing KOA in karate athletes. The fact that injury did not correlate significantly with KOA in this study was in line with a study that stated American football participants without a history of knee injury had a higher prevalence of KOA than participants who did not practice sport. (14) A study in the general population also showed that injury did not correlate with KOA because only one in four respondents reported knee injury with a high WOMAC score (25). The development of KOA, undoubtedly, results from the interaction between several factors such as injury, getting older, genetics, knee malalignment, biomechanical factors, such as excessive load because of obesity. (26, 27)

In this study, the WOMAC score is demonstrated to be significantly different between positive and negative KOA. This result is consistent with a study that showed that the WOMAC score is helpful in screening KOA in rural healthcare in Tamil Nadu, India (25).

The limitation of this study is the selection of the sample was not randomly chosen. The prevalence presented here might not represent the facts. However, this study might be the one that first shows the majority of knee OA in Indonesian karatekas. This valuable information gives valuable insight into the prevention of KOA in the Indonesian community. The future study should be performed randomly and emphasize more on the injury cases in the development of KOA.

CONCLUSION

This study showed a high prevalence rate of KOA in karate athletes. WOMAC score and ultrasound findings such as thinning of femoral condyles, osteophyte, and meniscus extrusion show significant differences between positive and

negative KOA. There should be more information regarding the susceptibility of the development of KOA to karate practices, and several precautions should be undertaken to prevent the development of this disease.

APPLICABLE REMARKS
- One-third of karate athletes in this study were diagnosed with clinical KOA.
- WOMAC showed a significant difference between positive KOA and negative KOA.

ACKNOWLEDGMENTS

AUTHORS' CONTRIBUTIONS
Study concept and design: Feda Anisah Makkiyah. *Acquisition of data:* Pritha Maya Savitri. *Analysis and interpretation of data:* Feda Anisah Makkiyah. *Drafting the manuscript:* Diana Agustini. *Critical revision of the manuscript for important Intellectual content:* Pritha Maya Savitri. *Statistical analysis:* Rahma Hida Nurrizka. *Administrative, technical, and material support:* Rahma Hida Nurrizka. *Study supervision:* Feda Anisah Makkiyah.

CONFLICT OF INTEREST
No potential conflict of interest relevant to this article was reported.

REFERENCES
1. Probst MM, Fletcher R, Seelig DS. A comparison of lower-body flexibility, strength, and knee stability between karate athletes and active controls. *J Strength Condition Res*. 2007;**21**(2):451. **doi:** 10.1519/R-19125.1
2. Caine DJ, Maffulli N. Epidemiology of pediatric sports injuries: Karger Medical and Scientific Publishers2005.
3. Mistry H, Connock M, Pink J, Shyangdan D, Clar C, Royle P, et al. Autologous chondrocyte implantation in the knee: systematic review and economic evaluation. *Health Technol Assess*. 2017;**21**(6):1-294. **doi:** 10.3310/hta21060 **pmid:** 28244303
4. Muthuri SG, McWilliams DF, Doherty M, Zhang W. History of knee injuries and knee osteoarthritis: a meta-analysis of observational studies. *Osteoarthritis Cartilage*. 2011;**19**(11):1286-1293. **doi:** 10.1016/j.joca.2011.07.015 **pmid:** 21884811
5. Bhatia D, Bejarano T, Novo M. Current interventions in the management of knee osteoarthritis. *J Pharm Bioallied Sci*. 2013;**5**(1):30-38. **doi:** 10.4103/0975-7406.106561 **pmid:** 23559821
6. Dasar RK. Kementerian Kesehatan Republik Indonesia. Jakarta Balitbang Kemenkes RI2018.
7. Amoako AO, Pujalte GG. Osteoarthritis in young, active, and athletic individuals. *Clin Med Insights Arthritis Musculoskelet Disord*. 2014;**7**:27-32. **doi:** 10.4137/CMAMD.S14386 **pmid:** 24899825
8. Cameron KL, Hsiao MS, Owens BD, Burks R, Svoboda SJ. Incidence of physician-diagnosed osteoarthritis among active duty United States military service members. *Arthritis Rheum*. 2011;**63**(10):2974-2982. **doi:** 10.1002/art.30498 **pmid:** 21717422
9. Crosby AC. The hands of karate experts. Clinical and radiological findings. *Br J Sports Med*. 1985;**19**(1):41-42. **doi:** 10.1136/bjsm.19.1.41 **pmid:** 3995229
10. Bonotto D, Namba EL, Veiga DM, Wandembruck F, Mussi F, Afonso Cunali P, et al. Professional karate-do and mixed martial arts fighters present with a high prevalence of temporomandibular disorders. *Dent Traumatol*. 2016;**32**(4):281-285. **doi:** 10.1111/edt.12238 **pmid:** 26511663
11. Ogawa K, Yoshida A, Ikegami H. Osteoarthritis in shoulders with traumatic anterior instability: preoperative survey using radiography and computed tomography. *J Shoulder Elbow Surg*. 2006;**15**(1):23-29.
12. Oka Y. Debridement for osteoarthritis of the elbow in athletes. *Int Orthop*. 1999;**23**(2):91-94. **doi:** 10.1007/s002640050315 **pmid:** 10422023
13. Timmins KA, Leech RD, Batt ME, Edwards KL. Running and Knee Osteoarthritis: A Systematic Review and Meta-analysis. *Am J Sports Med*. 2017;**45**(6):1447-1457. **doi:** 10.1177/0363546516657531 **pmid:** 27519678
14. Driban JB, Hootman JM, Sitler MR, Harris KP, Cattano NM. Is Participation in Certain Sports Associated With Knee Osteoarthritis? A Systematic Review. *J Athl Train*. 2017;**52**(6):497-506. **doi:** 10.4085/1062-6050-50.2.08 **pmid:** 25574790

15. Altman R, Asch E, Bloch D, Bole G, Borenstein D, Brandt K, et al. 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**(8):1039-1049. **doi:** 10.1002/art.1780290816 **pmid:** 3741515

16. Madaleno FO, Santos BA, Araujo VL, Oliveira VC, Resende RA. Prevalence of knee osteoarthritis in former athletes: a systematic review with meta-analysis. *Braz J Phys Ther*. 2018;**22**(6):437-451. **doi:** 10.1016/j.bjpt.2018.03.012 **pmid:** 29636304

17. Kujala UM, Taimela S, Antti-Poika I, Orava S, Tuominen R, Myllynen P. Acute injuries in soccer, ice hockey, volleyball, basketball, judo, and karate: analysis of national registry data. *BMJ*. 1995;**311**(7018):1465-1468. **doi:** 10.1136/bmj.311.7018.1465 **pmid:** 8520333

18. Neogi T, Zhang Y. Epidemiology of osteoarthritis. *Rheum Dis Clin North Am*. 2013;**39**(1):1-19. **doi:** 10.1016/j.rdc.2012.10.004 **pmid:** 23312408

19. Rall K, McElroy G, Keats T. A study of long term effects of football injury to the knee. *J Missouri Med*. 1964;**61**:435-438.

20. Tveit M, Rosengren BE, Nilsson JA, Karlsson MK. Former male elite athletes have a higher prevalence of osteoarthritis and arthroplasty in the hip and knee than expected. *Am J Sports Med*. 2012;**40**(3):527-533. **doi:** 10.1177/0363546511429278 **pmid:** 22130474

21. Lohmander LS, Englund PM, Dahl LL, Roos EM. The long-term consequence of anterior cruciate ligament and meniscus injuries: osteoarthritis. *Am J Sports Med*. 2007;**35**(10):1756-1769. **doi:** 10.1177/0363546507307396 **pmid:** 17761605

22. Buckwalter J, Mankin H. Articular cartilage: part I. *J Bone Joint Surg*. 1997;**79**(4):600. **doi:** 10.2106/00004623-199704000-00021

23. Buckwalter JA, Lane NE. Athletics and osteoarthritis. *Am J Sports Med*. 1997;**25**(6):873-881. **doi:** 10.1177/036354659702500624 **pmid:** 9397280

24. Lau EC, Cooper C, Lam D, Chan VN, Tsang KK, Sham A. Factors associated with osteoarthritis of the hip and knee in Hong Kong Chinese: obesity, joint injury, and occupational activities. *Am J Epidemiol*. 2000;**152**(9):855-862. **doi:** 10.1093/aje/152.9.855 **pmid:** 11085397

25. Sathiyanarayanan S, Shankar S, Padmini S. Usefulness of WOMAC index as a screening tool for knee osteoarthritis among patients attending a rural health care center in Tamil Nadu. *J Int J Comm Med Pub Health*. 2017;**4**:4290-4295. **doi:** 10.18203/2394-6040.ijcmph20174846

26. Eaton CB. Obesity as a risk factor for osteoarthritis: mechanical versus metabolic. *Rhode Island Med J*. 2004;**87**(7):201.

27. Zhang Y, Jordan JM. Epidemiology of osteoarthritis. *Clin Geriatr Med*. 2010;**26**(3):355-369. **doi:** 10.1016/j.cger.2010.03.001 **pmid:** 20699159