An Underrecognized Risk Factor for the Progression of Knee Osteoarthritis

Diz Osteoartritinin Progresyonunda Göz Ardı Edilen Bir Risk Faktörü

Özlem TAŞOĞLU,[a]
İrfan TAŞOĞLU[b]

[a]Clinic of Physical Medicine and Rehabilitation,
Ankara Physical Medicine and Rehabilitation Training and Research Hospital,
[b]Clinic of Cardiovascular Surgery,
Türkiye Yüksek İhtisas Hospital, Ankara

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Yazışma Adresi/*Correspondence:*
Özlem TAŞOĞLU
Ankara Physical Medicine and Rehabilitation Training and Research Hospital,
Clinic of Physical Medicine and Rehabilitation, Ankara,
TÜRKİYE/TURKEY
ozlem81tasoglu@yahoo.com

ABSTRACT Objective: The aim of the present study is to demonstrate the effect of regularly performed maximal flexion in knee osteoarthritis (OA) progression. **Material and Methods:** One hundred four patients with knee OA were included in this study. Demographic and clinical characteristics, duration of regular 5 time prayer (years) (selected as a frequently performed regular activity, forcing knees to maximal flexion) visual analogue scale (VAS) scores, Western Ontario & Mc Master Universities Osteoarthritis Index (WOMAC) scores, ultrasonographic grading of distal femoral cartilage and Kellgren-Lawrence (KL) grading were recorded. Patients were divided into two groups as patients with KL grade 1-2-3 (mild to moderate) and KL grade 4 (severe) knee OA. **Results:** Mean age (p=0.003), percentage of patients with a body mass index (BMI)≥30 (p=0.03), percentage of patients who perform 5 time prayer regularly ≥40 years (p<0.001), mean duration of regular 5 time prayer (p=0.001) and percentage of patients who had a cartilage degeneration score of 3 on ultrasonography (p=0.001) were significantly higher in severe knee OA. In univariate analysis, age (p<0.005), BMI ≥30 (p=0.04) and regular 5 time prayer ≥40 years (p<0.001) were significantly associated with severe knee OA. In multiple logistic regression analysis, BMI ≥30 (p=0.03) and regular 5 time prayer ≥40 years (p=0.03) emerged as independent predictors of severe knee OA. **Conclusion:** The results of the present study identified regular maximal knee flexion as a risk factor for knee OA progression. Patients with mild/moderate knee OA who perform 5 time prayer regularly should be recommended to pray in sitting position.

Key Words: Maximal knee flexion; independent predictor; gonarthrosis; Kellgren-Lawrence grading; ultrasonographic grading of distal femoral cartilage

ÖZET Amaç: Bu çalışmanın amacı, diz osteoartritinin (OA) progresyonunda, düzenli olarak gerçekleştirilen maksimal diz fleksiyonunun etkisini araştırmaktır. **Gereç ve Yöntemler:** Bu çalışmaya diz OA olan 104 hasta dahil edilmiştir. Hastaların demografik ve klinik özellikleri, düzenli olarak 5 vakit namaz kıldıkları süre (yıl) (sıklıkla ve düzenli olarak gerçekleştirilen, dizleri maksimal fleksiyona zorlayan bir aktivite olarak seçilmiştir), vizüel analog skala (VAS) ve Western Ontario & Mc Master Üniversiteleri Osteoartrit İndeksi (WOMAC) skorları ile ultrasonografik distal femoral kartilaj (UDFK) ve Kellgren Lawrence (KL) evreleri kaydedilmiştir. Hastalar ayrıca KL evresi 1-2-3 (hafif-orta diz OA) ve KL evresi 4 (ileri diz OA) olanlar olmak üzere iki gruba ayrılmıştır. **Bulgular:** İleri diz OA grubunda; ortalama yaş (p=0,003), beden kitle indeksi (BKİ) ≥30 olan hasta yüzdesi (p=0,03), ≥40 yıldır düzenli olarak namaz kılan hasta yüzdesi (p<0,001), ortalama düzenli 5 vakit namaz kılma süresi (p=0.001) ve UDFK evresi 3 olan hastaların yüzdesi (p=0,001) istatistiksel anlamlı olarak daha yüksekti. Tek değişkenli analizde; yaş (p<0,005), BKİ≥30 (p=0,04) ve ≥40 yıl düzenli namaz (p<0,001) ileri diz OA ile ilişkili bulundu. Çoklu lojistik regresyon analizinde, BKİ ≥30 (p=0,03) ve ≥40 yıl düzenli namaz (p=0,03) ileri diz OA için bağımsız prediktör olarak tespit edildi. **Sonuç:** Bu çalışmanın sonuçları; düzenli maksimal diz fleksiyonunun, diz OA'nın progresyonunda bağımsız bir risk faktörü olduğunu göstermiştir. Hafif/orta diz OA olan hastalara namaz kılıyorlarsa, otururak kılmaları önerilebilir.

Anahtar Kelimeler: Maksimal diz fleksiyonu; bağımsız değişken; gonartroz; Kellgren-Lawrence evrelemesi; ultrasonografik distal femoral kartilaj evrelemesi

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Osteoarthritis (OA) is one of the leading causes of disability especially in the elderly. It is estimated that with the aging population, OA prevalence will be in rise. Increased age, female gender, obesity, racial/genetic factors, knee joint injury, menisectomy, injurious physical activities are well known risk factors for knee OA development. Apart from these; ethnic, environmental and cultural differences may also play a role in OA development.[1-3]

Regular maximal knee flexion is also thought to be associated with knee OA but the relation is indefinite. Maximal knee flexion is a part of prayer which is a performed frequently in Turkish population on a regular and continuous basis. So it seems practical to investigate the relationship of regular maximal knee flexion and knee OA, via 5 time prayer. In the literature there are a few studies with conflicting results investigating the effects of prayer on knee OA. Scientific work regarding the role of regular maximal knee flexion/5 time prayer on knee OA progression may help developing preventive strategies (such as close follow-ups or performing the prayer in sitting position) which can improve the quality of life of a considerable amount of people, and therefore important for public health. So the aim of the present study is to elucidate the role of regular maximal knee flexion in knee OA progression.

MATERIAL AND METHODS

One hundred and twenty-two consecutive patients with knee OA were enrolled in this cross-sectional study. All patients were diagnosed with knee OA according to the American College of Rheumatology clinical criteria.[4] The participants who had post-infectious or post-traumatic arthropathy (n=10), systemic inflammatory or infectious diseases (n=5) and active malignancy (n=3) were excluded from the study. Thus 104 patients (20 males, 84 females) were included into the study. The study was approved by hospital ethics committee which was performed in accordance with the Helsinki Declaration and informed consents were obtained from all participants.

Age, sex, height, weight, body mass index, duration of regular five time prayer (in years), existence of night pain, visual analogue scale (VAS) scores during activity, Western Ontario & Mc Master Universities Osteoarthritis Index (WOMAC) scores, ultrasonographic grading of distal femoral cartilage and Kellgren-Lawrence (KL) grading were recorded. Patients were divided into two groups as patients with Kellgren and Lawrence grade 1-2-3 (mild to moderate) knee OA and patients with a Kellgren and Lawrence grade 4 (severe) knee OA.

Five time prayer is the main act of worship in Islam which is performed 5 times a day by bodily movements. It constitutes repetitive periods of standing, knee bending, squatting, kneeling and sitting on heels and prostration. The prayer must perform 4-13 sets of these movements at a time to complete the worship. The total number of sets performed in a day is 40.

Activity pain was assessed by using (0-100 mm) VAS. Scores were expressed in milimeters (0: no pain, 100: intolerable pain).

WOMAC was also used to assess pain, stiffness and physical function. It consists of 24 items divided into 3 subscales: pain (5 items) as pain during walking, using stairs, in bed, sitting/lying and standing; stiffness (2 items) as stiffness after first walking and later in the day and physical function (17 items) as physical function during stair use, rising from sitting, standing, bending, walking, getting in/out of car, shopping, putting on socks, taking off socks, rising from bed, lying in bed, getting in/out of bath, sitting, getting on/off toilet, heavy household duties and light household duties. The WOMAC score is between 0-100, with higher scores indicating more severe impairment.[5]

Ultrasonographic examination of the knee joints was conducted for each patient after the physical examination, before radiographic assessment was performed. While the patient was in supine position and the knee was fully flexed, distal femoral articular cartilage was evaluated with a linear probe (7-12 MHz Logiq P5, GE Medical Systems, California, USA) located in transverse position on the suprapatellar fossa. The cartilage was

fully scanned by sweeping the probe from proximal to distal, always in transverse position. It appears as a hypoanechoic band which overlies the hyperechoic line of subchondral bone. Cartilage degeneration was graded as 0, 1, 2A, 2B or 3. Grade 0 means normal with a monotonous anechoic band having sharp hyperechoic anterior and posterior interfaces. Grade 1 means mild degenerative changes with loss of the sharpness of the cartilage interfaces and/or increased echogenicity of the cartilage. Grade 2 A means moderate degenerative changes in addition to the changes in Grade 1 with <50% local thinning of the cartilage. Grade 2 B means local thinning of the cartilage >50 but <100%. Grade 3 means severe degenerative changes with 100% local loss of cartilage tissue.[6]

Kellgren-Lawrence grading system was used for classifying radiographic OA. It uses 4 radiographic features; joint space narrowing, osteophytes, subchondral sclerosis and subchondral cysts. The severity of radiographic changes increases from grade 0 to 4 with grade 0 means no radiographic features of OA whereas grade 4 means large osteophytes, marked joint space narrowing, severe sclerosis and definite bony deformity.[7]

Although the ultrasonographic and KL grading of a separate patient's both knees were usually the same, if obvious difference was present between knees, the most severely effected knee's grading was recorded.

Statistical analyses were performed using SPSS. Continuous data were presented as mean ± SD. Categorical variables were summarized as percentages. Comparisons between groups were made using Chi-square tests for categorical variables, independent-samples Student's *t* tests for normally distributed continuous variables and Mann-Whitney U tests when the distribution was skewed. A p value <0.05 was considered statistically significant.

Effects of different variables on severe knee OA were calculated in univariate analysis for each. Variables for which the unadjusted p value was <0.10 in logistic regression analysis were identified as potential risk markers and included in the full model. We reduced the model using stepwise multivariate logistic regression analyses and eliminated potential markers using likelihood ratio tests. A p value <0.05 was considered statistically significant and the confidence interval was 95%. An exploratory evaluation of additional cut points was performed using receiver operating characteristics curve analysis.

RESULTS

Of the 104 patients, 20 (19.2%) were men and 84 (80.8 %) were women and mean age was 59.53 years (range 37 to 82 years). Mean BMI of the patients was 31.77±6.54. Seventy-five percent of the patients had night pain. Mean VAS and WOMAC scores were 70.48±22.17 and 42.52±19.30 respectively. Mean duration of 5 time regular prayer was 21.72±18.80 years. All patients were grouped into two groups, those with KL grade 1-2-3 (mild to moderate) knee OA and those with a KL grade 4 (severe) knee OA. The demographic and clinical characteristics of the patients according to the groups were presented in Table 1.

Mean age (p=0.003), percentage of patients with a BMI ≥30 (p=0.03), percentage of patients who perform 5 time prayer regularly ≥40 years (p<0.001), mean duration of regular 5 time prayer (p=0.001) and percentage of patients who had a cartilage degeneration score of 3 on ultrasonography (p=0.001) were significantly higher in severe knee OA group (Table 1). Percentage of patients who had night pain, VAS and WOMAC scores were similar in both groups (Table 1).

In univariate analysis, age (p<0.005), BMI ≥30 (p=0.04) and regular 5 time prayer ≥40 years (p<0.001) were significantly associated with severe knee OA (Table 2). In multiple logistic regression analysis, BMI ≥30 (p=0.03) and regular 5 time prayer ≥40 years (p=0.03) emerged as independent predictors of severe knee OA (Table 2).

When the patients were grouped into two according to the duration of regular 5 time prayer as who perform 5 time prayer <40 years and ≥40 years, the percentage of patients who had a cartilage degeneration score of 3 on ultrasonography and the percentage of patients with a KL score 4,

TABLE 1: Demographic and clinical characteristics and laboratory findings of the patients according to knee OA severity.

	All patients (n=104)	Mild-moderate knee OA (n=91)	Severe knee OA (n=13)	P
Gender (% female)	80.8	82.4	69.2	0.25
Age (year)	59.53+9.86	58.45+9.43	67.15+9.77	**0.003***
Height (cm)	158.75+7.41	158.72+6.93	159,00+10,51	0.82
Weight (kg)	80.90+13.09	80.52+13.07	83.53+13,41	0.44
BMI	31.77+6.54	31.58+6.75	33.12+4.87	0.43
BMI ≥ 30 (%)	56.7	52.7	84.6	**0.03***
VAS	70.48+22.17	70.84+22.87	67.92+17.04	0.65
WOMAC	42.52+19.30	41.24+19.45	51.53+16.10	0.07
Wpain	9.28+4.49	9.09+4.58	10.61+3.68	0.25
Wstiffness	2.70+2.20	2.55+2.17	3.69+2.28	0.08
Wfunction	30.75+14.16	29.83+14.31	37.23+11.57	0.07
Night time pain (% present)	75.0	73.6	84.6	0.39
CGS=3 (%)	15.4	11.0	46.2	**0.001***
Mean duration of 5 time prayer (years)	21.72+18.80	19.46+17.32	37.53+21.72	**0.001***
5 time prayer ≥ 40 years (%)	17.3	11.0	61.5	**<0.001***

BMI: Body mass index; VAS: Visual Analogue Scale; WOMAC: Western Ontario McMaster Universities Osteoarthritis Index; Wpain: WOMAC pain subscale; Wstiffness: WOMAC stiffness subscale; Wfunction: WOMAC function subscale; CGS: Cartilage Grading System; *: p<0.05, significant; OA: Osteoarthritis.

TABLE 2: Results of univariate and multivariate regression models.

	Univariate analysis		Multivariate analysis	
	OR (95% CI)	p	OR (95% CI)	p
5 time prayer ≥ 40 years	12.96 (3.54-47.37)	<0.001*	5.39 (1.18-24.60)	0.03*
Age (year)	1.09 (1.02-1.16)	<0.005*	1.08 (0.99-1.18)	0.70
BMI 30	4.92 (1.03-23.49)	0.04*	7.47 (1.13-49.10)	0.03*

OR: Odds ratio; CI: Confidence interval; *:p<0.05, significant.

TABLE 3: Clinical characteristics of the patients according to the duration of 5 time praying.

	5 time prayer <40 years (n=86)	5 time prayer ≥ 40 years (n=18)	p
Night pain (% present)	75.6	75.2	0.76
CGS=3 (%)	10.5	38.9	0.002*
VAS	71.12+22.30	67.38+21.91	0.51
WOMAC	41.77+19.19	46.11+19.98	0.38
Wpain	9.27+4.36	9.33+5.20	0.96
Wstiffness	2.63+2.20	3.00+2.27	0.53
Wfunction	30.09+14.26	33.94+13.57	0.29
KL=4 (%)	5.8	44.4	<0.001*

CGS: Cartilage Grading System; VAS: Visual Analogue Scale; WOMAC: Western Ontario McMaster Universities Osteoarthritis Index; Wpain: WOMAC pain subscale; Wstiffness: WOMAC stiffness subscale; Wfunction: WOMAC function subscale; KL: Kellgren-Lawrence grading; *:p<0.05, significant.

were significantly different between two groups. On the other hand percentage of patients with night pain, VAS and WOMAC scores did not differ between the groups (Table 3).

Receiver operating characteristics curves explored the relation between regular 5 time prayer and severe knee OA. For severe knee OA, area under the curve was 0.74 (95% confidence interval 0.58 to

0.90) (p=0.004). Using a cut of point of 40 years, regular 5 time prayer predicted severe knee OA with a sensitivity of 61% and specifity of 89% (Figure 1).

DISCUSSION

According to the results of the present study age, BMI ≥30 and regular maximal knee flexion/5 time prayer ≥40 years are significantly associated with severe knee OA. Of these, the last two ones seem to be independent predictors of knee OA severity. Altough increasing age and BMI are already known risk factors for knee OA as mentioned in the introduction part, regular maximal knee flexion/5 time prayer over 40 years is firstly identified as a risk factor for severe knee OA.

In the literature there are few number of studies investigating the effect of 5 time prayer on knee OA development, and these have conflicting results. In a population based study from Turkey, 655 individuals >50 years were evaluated and advanced age, female gender and 5 time prayer were found to be associated with knee OA. Altough the findings of this study were compatible with ours, 5 time prayer was not found as an independent predictor of knee OA in this study. As a consequence the authors interpreted 5 time prayer is a factor aggravating the symptoms of knee OA rather than taking part in its pathogenesis. But the duration of regular worship is lacking making harder to analyse the exact effect of praying on knee OA, since 5 it probably has a cummulative loading effect on knees.[8] In another study from Turkey, Yılmaz et al. investigated the effect of 5 time prayer on knee and hip osteoarthritis and found that it has no effect on both of them. In this study, the participants were grouped as the ones performing the 5 time prayer for at least 10 years and the ones who had never performed the 5 time prayer. Grouping the participants this way may again miss out the cumulative effect of 5 time prayer in time, especially in the participants who are performing 5 time prayer for much more than 10 years. Moreover, in this study participants with knee or hip pain were interestingly excluded, and this can also cause misinterpretation of the results as the most of the patients with OA couldn't be included into the study group et al.[9] On the other hand, Hameed and collegue compared 44 patients with OA from Pakistan and 44 patients with OA from Britain. According to their results, in Pakistani patients generalized osteoarthritis was exceptional compared to British ones. The disease was found to be exclusively confined to the knee and become symptomatic at a younger age in Pakistan. When OA patients from Pakistan were compared with their healthy counterparts (again from Pakistan), the authors did not find any difference between praying habits of the two groups. So the frequency of knee OA in Pakistani patients at younger ages compared to British patients was attributed to the genetic differences between the races. It seems that the duration and regularity of 5 time prayer was not taken into account in this study too and when thought with the few number of subjects analyzed, it is difficult to interprete these results.[10] While the above mentioned studies' results seem to be opposite to ours, they all have some methodological short-comings as represented above, especially about identifying the duration of 5 time prayer, making the results unreliable.

Meanwhile there is also information in the literature supporting our results. In a study demonstrating the clinical characteristics of Jordan

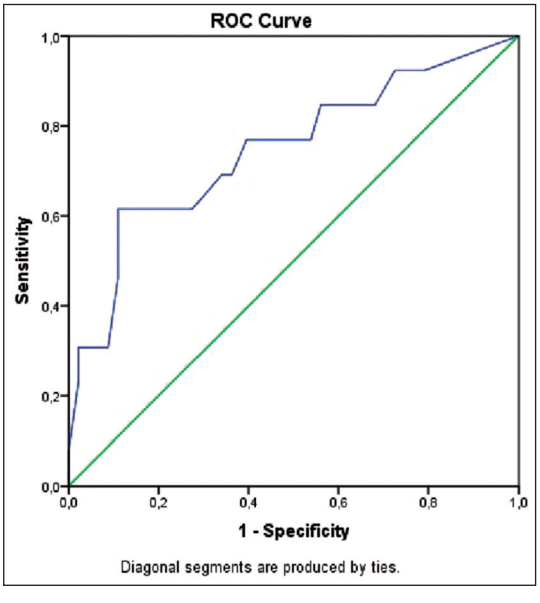

FIGURE 1: Roc curve presenting the effect of 5 time prayer in patients with severe knee OA.

patients with knee OA, mean age was 55.27 years and of 214 patients 53% had severe form (KL grade 4) of the disease. The high frequency of severe knee OA in such a young population, compared to the other studies in the literature was related with the Arabic cultural and religious factors such as sitting in a kneeling position for long periods of time during the day and praying five times a day which causes severe mechanical overloading of the joint. So from this point of view the results of this study are in accordance with ours.[11]

Apart from the above mentioned studies, performed in Muslims, data from the studies performed in populations who kneel or squat for long periods of time during their works also support our findings. Coggon et al. identified squatting and/or kneeling as independent risk factors for knee OA.[12] Moreover obesity or heavy lifting combined with squatting/kneeling lead to a multiplicative interaction.[12,13] The pathomechanics of the disease are same in both prayers and those who work kneeling or squatting for long periods. Flexing the knee beyond 90° places greater load across the entire joint and cause damage to the articular cartilage. According to a study published by Virayavanich et al. on 2013, frequent kneeling, deep knee bending and squatting is associated with increased risk of knee cartilage abnormality on both tibio-femoral and patello-femoral compartments, besides ligamentous and meniscal damage.[14]

There are also some limitations of our study. One of them is the lack of information about the sportive activities, toilet habits (european toilet/squat toilet), stair climbing of the participants in the past and at the time of the interview. The other limitation is the relatively few number of patients for such a common disease especially in the severe knee OA group. So it can be said that future studies in larger patient groups with a better control of the confounding factors should be performed to generalize the results of this study.

In conclusion, the present study demonstrated that regular maximal knee flexion/5 time prayer over 40 years is an independent risk factor for severe knee OA and identified a new risk factor for knee OA progression for middle eastern communities. Altough there is similar literature investigating the effects of 5 time prayer on OA development, they had some methodological short-comings especially about identifying the duration of worship and consequently had contradictory results. The clinical consequence of the present study is that; since 5 time prayer is a commonly practiced essential worship for a considerable amount of people on the world, physicians should be alert about the symptoms of knee OA in patients who perform prayer on a regular basis for many years. Patients with mild/moderate OA should be followed-up closely for disease progression and recommended to pray in sitting position. This kind of awareness will hamper OA progression, reduce the necessity of early surgical interventions and improve the quality of life in knee OA.

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