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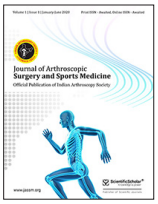

Original Article

Prevalence and factors associated with symptomatic knee osteoarthritis in golfers: A cross-sectional study among professional golfers in Kenya

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ABSTRACT

Objectives: Golf has been associated with abnormal loading conditions to the knee joint due to the repetitiveness and biomechanical requirements of the golf swing. This study seeks to evaluate the prevalence and factors attributing to symptomatic knee osteoarthritis among professional golfers in Kenya.

Materials and Methods: Participants included all professional golfers in Kenya above 18 years. Golfer's demographics and golf-related characteristics were recorded and both knee's function assessed using the Knee Injury and Osteoarthritis Outcome Score (KOOS). Participants with a KOOS <85% in two or more parameters underwent bilateral plain knee radiographic assessment and graded according to the Kellgren and Lawrence (K&L) classification.

Results: Fifty participants were recruited. All male, only two were left handed, median age was 41 years (34–49). More than half were found to have a body mass index (BMI) of greater than 25 kg/m². The average duration of active golf participation was 16.5 years (SD = 4.2). Eighteen out of 100 knees scored <85% in two parameters of the KOOS. According to the K&L, 72% had Grade 2 and above. Duration of active golf involvement (OR – 1.114) and BMI above 25 kg/m² (OR – 1.107) were found to be positively associated with symptomatic knee osteoarthritis although not statistically significant (P = 0.289 and 0.3481).

Conclusion: Golf presents a prevalence of symptomatic knee osteoarthritis of 18% comparable to high-impact sports. The associated factors include BMI >25 kg/m² and longer duration of active golf participation although both not statistically significant.

Keywords: Knee, Osteoarthritis, Golf

INTRODUCTION

Golf is a low-impact sport, whose level of performance is not limited by a person's age and has significantly gained popularity worldwide and in Kenya.[1-3] A golfer's current skill level is measured as one's handicap. A lower handicap allows fewer shots per hole thus implying greater skill.[4] Professional golfers are defined by a handicap of 0 or negative and they play significantly more frequently and for a longer duration than amateurs thus are considered distinct patient groups with different sports profiles.[5,6]

The loading on the tibiofemoral joint during the golf swing causes stresses in the axial and coronal planes imparting strain to both intra- and extra-capsular structures, for example, ligaments, menisci, etc.[7] High compressive and torsional forces have been described in the knee during the golf swing.[8,9] Articular cartilage tolerance is exceeded by the excess stresses and abnormal loading contributing to joint degeneration.[10]

Knee injuries involving the knee ligaments, menisci, and cartilage have also been linked to knee OA.[10,11] A systematic review of golf injuries reported knee injury prevalence rates ranging from 3% to 18% among both advanced and novice players[12,13] which is comparable to prevalence rates in high-impact sports such as soccer and basketball.[12] Studies suggest that this combined with the abnormal loading conditions, regardless of skill level can result in progressive joint degeneration.[12] The incidence and prevalence of KOA have been investigated and reported for other sports such as soccer, rugby, and athletics with minimal data about golf.[14,15] During sports, the musculature around the joints influences the vertical ground reaction force during the impact phase and is seen to protect joints from supraphysiological loading;[16] therefore, conditioning exercises increase

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the likelihood of the golfer to protect their joints from increased loading and hence accordingly reduce the risk of joint injury.[17] Strategies that decrease joint contact forces while still enabling muscle strengthening and conditioning minimize joint loads and beneficial in decreasing pain and improving function. These include cycling, swimming, or other aquatic exercises.[18,19]

The Knee Injury and Osteoarthritis Outcome Score (KOOS) is a validated patient-administered questionnaire used to assess the participants' impression about their knee symptoms. Patients are said to have significant clinical symptoms requiring further evaluation if they have a score of <85% in two or more of the subscale parameters.[20,21]

The Kellgren and Lawrence Grading System (K&L) is a radiological classification of the severity of knee OA on plain radiographs based.[22] A K&L score of 2 and above signifies definite established OA.[21]

There is a paucity of high evidence studies on golfers that are well designed to include radiological and functional evaluation of the knee based on internationally validated measures as the adequate assessment for KOA among golfers.

Objectives

The objectives of the study are as follows:

1. To determine the prevalence of symptomatic knee osteoarthritis among professional golfers in Kenya
2. To identify individual and golf-related characteristics associated with symptomatic knee osteoarthritis among professional golfers in Kenya

MATERIALS AND METHODS

Study design

This was a cross-sectional population study. The entire population of professional golfers registered by the Professional Golfers' Association of Kenya were included in the study.

Setting

The professional golfers above 18 years were recruited from Kenya Golf Union (KGU) registered golf clubs between May and July 2021.

Professional golfer was defined by a handicap of zero according to the World Handicap System.

Participants

The study population included golfers above the age of 18 with a handicap 0 in Kenya.

Inclusion criteria

Actively involved in golf for minimum 5 years,[23] that is, at least 3 times a week or a minimum of 200 practice balls per week was included in the study.

Exclusion criteria

The following criteria were excluded from the study:

1. History of previous knee dislocation or fracture around the knee
2. History of any previous knee surgery (unrelated to golf), that is, ligament reconstruction or meniscus surgery, etc.
3. History of rheumatoid joint disease, bone dysplasia, microcrystalline disease, inflammatory joint disease, and metabolic syndrome.

Variables

Data collection included a data collection sheet for all demographic, anthropometric, that is, weight in kg and height in m, handedness and golf-related information, for example, duration and frequency of active golf participation, participation in conditioning exercise, and other sports other than golf and history of golf-related knee injury. The KOOS, which assess five outcomes, that is,

- Pain
- Other symptoms
- Activities of daily living
- Sport and recreation function
- Knee-related quality of life.

Data from both knees were recorded. The time period considered was the immediate week before and standardized answer options were given (5 Likert boxes) and each question was assigned a score from 0 to 4. To calculate the score for each subscale parameter, we applied the mean of the observed items within the subscale (e.g., KOOS pain, other symptoms, etc.) then divided it by 4 and multiplied it by 100 to get a percentage. A score of 100% indicated no symptoms and 0% indicated extreme symptoms.

The knee(s) of a study participant who scored <85% in two or more of the KOOS subscale parameters were subjected to radiographic examination, that is, AP and 45° flexion lateral view. The K&L classification was used to grade the severity of KOA as below

- Grade I – Doubtful narrowing of the joint space and possible osteophytic lipping
- Grade II – Definite osteophytes and possible narrowing of the joint space
- Grade III – Moderate multiple osteophytes, definite joint space narrowing, some sclerosis, and possible deformity of bone ends
- Grade IV – Large osteophytes, marked joint space narrowing, severe sclerosis, and definitive bony end deformity.

The prevalence of symptomatic KOA was defined by the percentage of participants with KOOS of <85% in two or more subscale parameter and K&L classification of <2 for early KOA and two and above for established KOA.

Data sources/management

SPSS version 24 was used for analysis with the baseline descriptive characteristics summarized and presented as median and interquartile range (IQR). The inferential statistics were analyzed through logistic regression utilizing multivariate statistical models to calculate the adjusted odds ratios of the KOOS scores and K&L classification in relation to combined characteristics such as age, body mass index (BMI), and duration of active golf participation. About 5% level of confidence was used (95% confidence interval).

Bias

The entire population of professional golfers in Kenya was included in the study.

Study size

This will be a population study. There are 60 professional golfers registered with the Professional Golfers Association of Kenya and all were included in the study.

RESULTS

Participants

Out of the 60 total population of registered professional golfers in Kenya, that is, handicap of 0, a total of 50 professional golfers were recruited into the study. This represents a response rate of 83%. Of the 10 participants not included, two fulfilled the exclusion criteria and eight declined to give consent or were unavailable for interview.

Descriptive data

All 50 study participants were male with majority of them from golf clubs based within the Nairobi Metropolitan Area, that is, 80% from Nairobi and Kiambu Counties.

The median age was 41 years with a IQR of 34–49 years. About 70% were between 30 and 49 years. The was no statistical correlation between the age of the participant and the occurrence of symptomatic knee osteoarthritis, that is, OR 1.000 ($P = 0.9798$).

Outcome data

More than half had a BMI >25 kg/m², that is, 30% with a BMI of 25–29.9, that is, overweight, and 26% >30 kg/m², that is, obese. [Figure 1] illustrates the BMI distribution. Only two participants were left handed, that is, 96% of the participants having the left knee as the lead knee and the right knee as the trail knee.

The mean duration of active golf participation was 16.5 years with a SD = 4.2 years, that is, with 74% participating 5 or more days a week. [Figure 2] illustrates the distribution of duration of active golf participation and [Figure 3] shows the frequency of active play.

Thirty-seven participants, that is, 74% described their regularity of performing pre-conditioning exercise, for example, stretches and warm up as always[24] and sometimes[10] before a golf game or practice round of which only 30% was for a duration of more than 10 min. More than half of the participants never[15] or rarely[14] actively engaged in any other form of physical exercise other than golf at the time of the study.

About 14% of the participants reported an incident of golf-related knee injury of which more than half implicated the repetitive nature of the golf swing as the cause of the injury. Uneven terrain was cited as another reason. About 64% participated in other sporting activities before the start of golf with only three sustaining knee injuries with the prior sports participation.

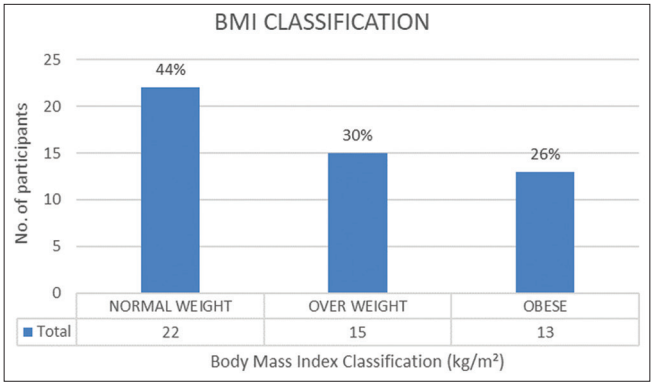

Figure 1: Body mass index of participants.

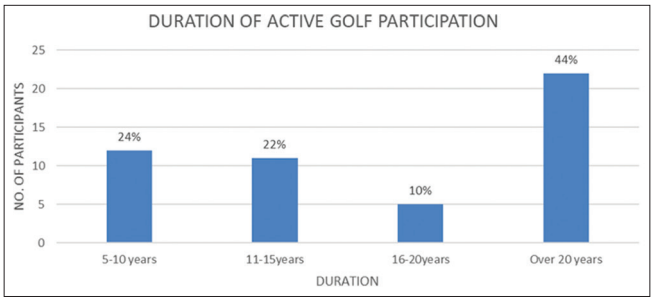

Figure 2: Duration of active golf participation.

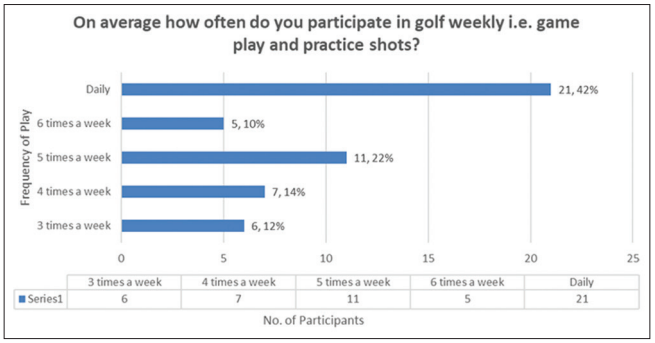

Figure 3: Frequency of golf participation on a weekly basis.

Main results

Eighteen out of the 100 knees analyzed scored <85% in two or more of the subscale parameters of the KOOS. [Figures 4 and 5] illustrate the KOOS scores for the right and left knees, respectively.

A BMI of more than 25 kg/m² and prolonged duration of active golf participation were found to have a OR of 1.107 and 1.144, respectively, as related to the presence of symptomatic osteoarthritis with $P = 0.3481$ and 0.2809. Age as a factor had an OR of 1. [Table 1] illustrates the logistic regression model determining the relationship between symptomatic knee osteoarthritis and indicated factors.

According to the Kellgren and Lawrence Grading Scale, the severity of KO for the 18 knees subjected to plain radiograph evaluation, 72% had a K&L score of Grade 2 and above.

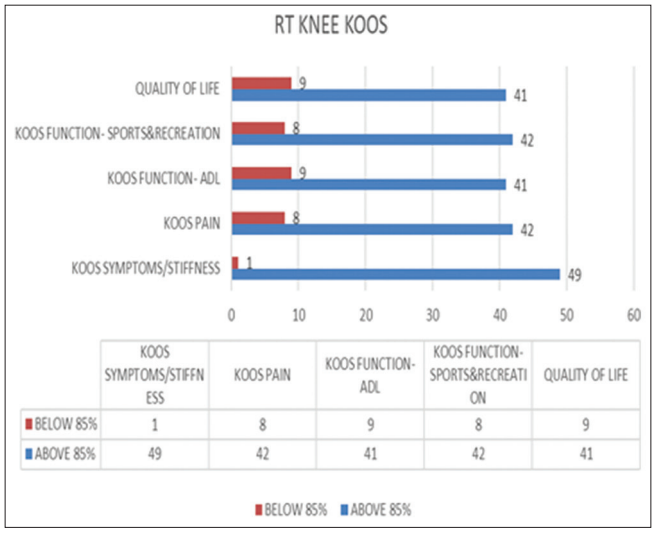

Figure 4: Knee Injury and Osteoarthritis Outcome Score for the right knee.

DISCUSSION

Half of participants in this study were 40 years and above, that is, median age (IQR) of 41 (34–49). This correlates with the average age of professional golfers worldwide as reported by Baker *et al*.[5] The estimated median age at knee OA diagnosis in the US is 55 years[25] but has been shown to occur up to 10 years earlier in sports participants, particularly at an elite level, thus the professional golfers at this age due to their high skill play level may be at risk of symptomatic KOA.[15,26,27]

More than half of the participants are overweight and obese. Several studies have shown that there is a positive correlation between increased body weight and the development of osteoarthritis particularly in weight-bearing joints such as the knee.[24] Combining sports participation and increased body weight, the relative contributions of etiological fraction relating to the development of osteoarthritis are estimated to be 55% for sports participation and 15% for being overweight.[28,29] This, therefore, puts the overweight and obese professional golfers studied here at a higher risk of developing KOA.

The relationship between the development of knee osteoarthritis and involvement of elite sports for a prolonged duration was described by Vingard *et al*. in two publications analyzing OA of the hip in women and its relationship to physical loading due to sporting activities. The men who had high total number of hours had a 4.5 times ([CI] 2.7–7.6) greater risk of developing osteoarthritis at the hip compared with those with low exposure.[30,31] Spector *et al*. also showed an increased risk of both knee and hip OA in long-distance runners and tennis players with prolonged years of training 15 and 19 years, respectively, and also with increased frequency of training, that is, 25 km/week and 5.2 h/week, respectively.[27] Therefore, the prolonged involvement in golf at a professional level and high frequency as reported among

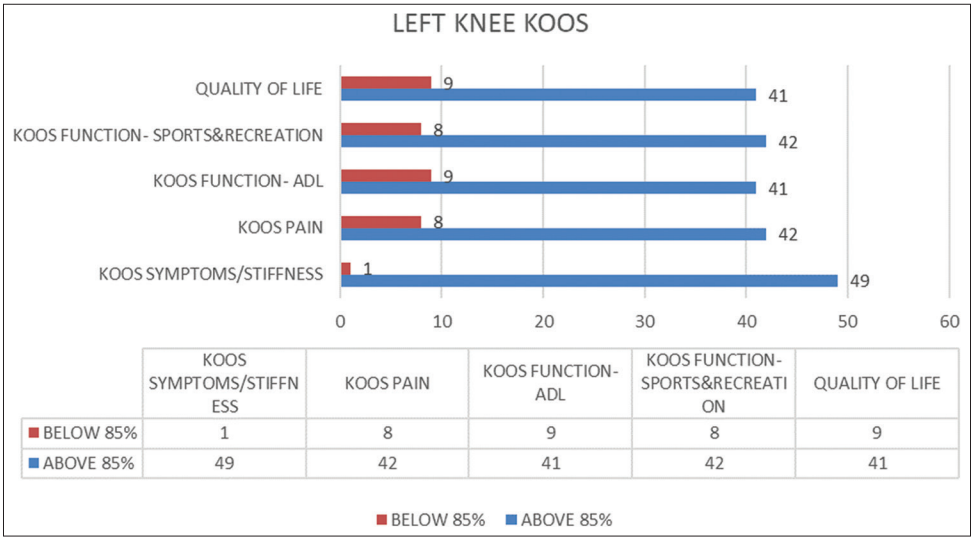

Figure 5: Knee Injury and Osteoarthritis Outcome Score for the left knee.

Table 1: Correlation of the relationship between symptomatic knee osteoarthritis and specified participant characteristics.

Factor	Odds ratio	95% confidence interval	*P*-value
Duration of active golf participation	1.144	0.917–1.528	0.2809
Body mass index	1.107	0.893–1.385	0.3481
Age	1	0.067–1.007	0.9798

the study participants may lead to an increased risk for development of KOA.

The recommended pre-game conditioning duration is at least 10 min and this facilitates proper muscle and ligament stretching useful in maintenance of proper joint mechanics and alignment thus less likelihood of injuries.[7,12] The results also show that only 16% of the professional golfers recruited in this study regularly participate in other forms of physical activities other than golf. Muscular contraction is known to be protective to excessive knee loads applied across the knee joint; therefore, resistance and conditioning training of the muscles around the knee are important and have been particularly shown to contribute positively to functional and symptomatic outcome.[18,32]

Knee injury due to sports participation is a known risk factor for the development of knee osteoarthritis due to damage to joint stabilizing structures such as the ACL and meniscus which alter knee joint biomechanics, cause instability, abnormal loading, and eventually KOA. The results here present a prevalence of 14% when it comes to golf-related knee injury among professional golfers in Kenya a value that is reflective of the work done by Baker *et al*. in a systematic review in 2017. He reported an injury rate that varied from 3 to 18% with a career rate among professionals being noted at 5.5–15% proposing a by and large higher injury rate in the professionals when contrasted with the amateurs.[13,33,34]

This prevalence of 18% is comparable to the prevalence rates of KOA in contact sports as Vannini *et al*. published in 2016 illustrating that OA incidence in current and former soccer players ranges between 16 and 80%[10] while Driban *et al*.[35] showed an overall knee OA prevalence in sports participants as 7.7% with high-impact sports such as football having higher prevalence. Therefore, a prevalence of 18% for golf is akin to that of high-impact sports such as soccer.

The factors that correlate most with the prevalence of KOA among the study participants were found to be duration of active golf participation (OR – 1.114, CI – 0.917–1.528) and BMI (OR – 1.107, CI – 0.893–1.385). They were, however, not statistically significant, that is, $P = 0.2809$ and 0.3481, respectively. Of the participants found to have symptomatic knee osteoarthritis, 72% were graded as established OA based on a Kellgren and Lawrence classification of Grade 2 and above.

Limitations

The small population of professional golfers registered in the country and lack of comparison with amateur or non-golfers.

CONCLUSION

Golf albeit a low-impact sport presents a prevalence of symptomatic knee osteoarthritis of 18%, majority of whom had established knee osteoarthritis which is comparable to other sports. This is due to the biomechanical demands on the golf swing on the knee joints compounded by and increased risk of knee injury. The main factors associated with symptomatic knee osteoarthritis were found to be a BMI greater than 25 and longer duration of active participation in golf although both were not found to be statistically significant.

Ethical approval and patient consent

The study was performed in accordance with the ethical principles of the Declaration of Helsinki, obtaining the participant's informed consent, and was approved by the Kenyatta National Hospital-University of Nairobi Ethics and Research Committee (KNH-UoN ERC) (Ref: KNH-ERC/A/141 dated April 16, 2021).

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Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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