Original Article

Are Athletes Playing for Osteoarthritis? A Systematic Review

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Abstract

Objective

Athletes frequently experience injuries throughout their sporting careers, which may be caused by trauma or related events. A dilemma about whether physical exercise increases the risk of osteoarthritis as a result of repetitive stress on the joints and muscles. Long-distance runners are one of the susceptible populations to developing knee osteoarthritis and this study aims to synthesize the data on the quantitative relationship between playing particular sports and developing knee osteoarthritis.

Methods: The evidence for this study was collected from three electronic databases including PubMed, Scopus, and Springer Link. This systematic review is based on cohort, case-control, and randomized control trials (RCTs) published within the last 20 years (2000–2022). The primary outcome of the measure was the symptomatic or asymptomatic tibiofemoral knee osteoarthritis changes among runners. The PRISMA checklist and the Cochrane Effective Practice and Organization of Care Risk of Bias Tool were used as a guide to assess the quality of the study methodology. The risk of bias in individual studies was examined using Review Manager, 5.4.1 Cochrane Collaboration.

Results: To summarize the findings of this systematic review, nine publications were chosen from a total of 508 articles that were searched. Using the PICO model, the findings are summarised on the following levels: i) running sports and incidence of knee osteoarthritis; ii) soccer, gender, and incidence of knee osteoarthritis; iii) anterior cruciate injury, effect size, and incidence of knee osteoarthritis; and iv) training and prevention of knee osteoarthritis incidence.

Conclusion: Sports that require more jumping, twisting, and knee traumas increase the likelihood of developing osteoarthritis in the knee. Anterior cruciate ligament and meniscal injuries, in particular, are the most common causes of knee osteoarthritis in sportsmen. Initially remained asymptomatic, this condition only becomes visible 15 to 20 years after the pathogenesis of the disease began.

Keywords: Osteoarthritis, Sports Medicine, Sports Injuries

Introduction

In the course of their athletic careers, athletes frequently suffer injuries that may be traumatic or atraumatic.[1]Long-distance runners are nevertheless worried about knee osteoarthritis (OA), and it is still debatable whether exercise increases the risk of OA or whether athletes are running to prevent it.2 OA is one of the most common synovial joint disorders having the features of generation and degradation imbalance of the joint articular cartilage which lead to the formation of new bone on the joint surface which is brittle and harder known as sclerotic bone along with the spine like bony ends at the margin called the osteophytes.3

Osteoarthritis is categorized into primary and secondary OA with unknown and known (mechanical or metabolic) etiology and pathogenesis respectively.[2] Osteoarthritis is a non-inflammatory articular cartilage disease with the most com- mon prevalence in athletes with post-traumatic injuries of the knee and female gender as a risk factor.4 According to one arthroscopic grading, the cartilage is divided into four different grades based on the outer bridge. Grade 1 has soft and swells cartilage with no damage on the surface. Grade II has the characteristic of fragmentation and fissure in an area of half an inch or less with the fringed and shredded outer surface. When this damage exceeds deeper and greater than halfan inch will attribute the Grade III and Grade IV will have the complete disruption of articular car-tilage.[2,4]

Kellgren-Lawrence grading system based on radiological findings is considered of great significance.[5] OA will be graded as zero: Normal, Grade [1] (doubtful) when minute osteophytes present. Osteophytes with limited joint space narrowing will be classified as Grade II (certain), those with moderate joint space narrowing will be classified as Grade III, and those with severe joint space narrowing will be classified as Grade IV.6 Conversely, sports with a moderate degree of activity are expected to strengthen the articular cartilage. Sports with a high level of intensity and severity are a contributing factor for OA and result in the wear and tear of cartilage[3] Abnormal joint anatomy or alignment, previous trauma or surgery, joint laxity, high body mass index, and decrease muscle strength and coordination are also major contributing factors of O.A in sports.[4]

Sports activity exposed the joint cartilage to high impact and torsion loading which may contribute to the OA prevalence.[6] The damage to the cartilage may occur as a result of single or repetitive impact or torsion loading as a result of direct or indirect trauma.[5] The articular cartilage has a high ability to tolerate mechanical loading. In

some experiments on lower limb loading, it was found that normal physical activities occur in the range of 4-9 N/m^2 (Mega Pascal, Mpa). The activities of the sport like running, jumping, and throwing are within the range of 10 Mpa.[2] The peak value hypothesized for the disruption of normal articular cartilage is around 25 Mpa. When the cartilage is repeatedly exposed to chronic periods of stress loading or with a stress load below this threshold, degenerative changes can be created.[7]

When soccer players collide, the articular cartilage can be damaged by a single blow, but the articular surface is left intact with less Proteoglycan content and stiff cartilage.[3] Due to these changes, the cartilage's capacity to bear mechanical stress will be significantly diminished, making it more susceptible to future harm. Repetitive impact in long-distance sports may rupture the articular cartilage matrix, which causes cartilage to degenerate and develops vertical cartilage fissures from the joint surface to calcified cartilage. This further damages the joint and causes cartilage perforations and loose fragments to form in the joint space.[6]

The incidence of OA in sports has increased in recent years and many studies being conducted on finding a relationship between the OA and sports. Data collected from the four English league soccer players show an incidence rate of injury is 8.5 per 1000 hours.[6]Another study conducted in Sweden on female adolescent soccer players over a season showed an incidence rate of 6.8 per 1000.[8] A similar injury rate of 8.5/1000 hours in competition and 3.5/1000 hours in training was noted by elite soccer players in Hawkins and Fuller, which may be related to the occurrence of OA in soccer players.[7] The Finnish Group presented statistics on the prevalence of OA by sport. They discovered that team activities (soccer, ice hockey, baseball) and those requiring strength (boxing, wrestling, weight lifting, and throwing) have the highest incidence of OA at a young age.[8] It was initially believed that sports like running are responsible for the OA prevalence but recent studies show that the association between OA and running is very weak. High intensity running (i.e., 97 km per week) is has a strong OA prevalence whereas moderate and low-intensity running has a protective effect on the joint cartilage.[9]

A prospective study on men under 50 years of age narrates the increased risk of OA for running greater than 32km per week.10 Hence the mechanical factors on the cartilage metabolism are complex and are dependent on the intensity of loading. Low levels of loading or no loading are detrimental, but moderate levels of loading are necessary and advantageous for good joint function.[10,11]

It is possible to conclude the prevalence of OA in sports based on several parameters, including a joint injury, sport type, exposure time, timing, muscle strength, body weight, alignment, and twisting force on the knee joint.[12] The likelihood of injuryis the main element in athletes. The comparison of sports like running and soccer reflects that soccer has a higher injury incidence and OA rate as compared to running which is considered a safe sport now.[9,12] The objective of this systematic review was to summarise the data on the quantitative relationship between engagement in several sports and the development of knee OA. The impact of sports-related injuries on knee OA will also be examined in this systematic review.

Methods

The evidences and research articles for this study were selected from three electronic databases including PubMed, Scopus, and Springer Link.

Criteria for considering studies for this review

The randomized control trials (RCTs), cohort, and case-control studies evaluating the change in symptomatic or asymptomatic tibiofemoral knee osteoarthritis published in the last 20 years (2000–2022) were used in this comprehensive review. The included studies should be focusing on the prevalence of knee OA (primary outcome) in sports and degenerative changes as a result of sports injuries causing knee OA (secondary outcome).

Study Selection

The selected studies had to fulfill the following criteria to be added in this systematic review; i) The primary outcome of the study was to find the association between knee OA in a sports setting, ii) The OA was diagnosed using the radiographic which could include both Xray or MRI findings, iii) the study design included case-control study, cohort or a randomized control trial, iv) The studies were published in English language, v) The study with sports like soccer and running was given priority.

Results

Out of nine articles chosen from a total of 508 articles, the findings of this review were summarized. The article searched on Pub Med with the term ‘knee osteoarthritis in athletes’ (74 full-text studies), ‘osteoarthritis and sports’ (196 full-text studies), ‘knee osteoarthritis in soccer player’ (5 full-text studies), ‘knee osteoarthritis in runners’ (5 full-text studies) and ‘knee osteoarthritis and its prevention (171 full-text studies) and ‘athletic training in osteoarthritis’ (27 full-text studies). Based on the inclusion criteria, a total of nine papers were chosen to summarize the results. The study's design and the number of included and excluded papers are shown in Graph 1.

A common form of medication, selective serotonin reuptake inhibitor (SSRI) helps in decreasing amygdala reactivity to control anxiety.[7] Escitalopram is the most common psychopharmacological drug with a proven response to treatment for generalized anxiety disorder in different countries without the comorbid disorder.[1] However, another drug Pregabalin has also been proved the effective management of generalized anxiety disorders along with an early response to treatment,[8] reduction in the level of severity and relapse prevention.[9] Other similar treat Risk of bias in individual studies

The Cochrane Effective Practice and Organization of Care Risk of Bias Tool[13] and PRISMA checklist were used as a guide to assess the study methodology's quality. Review Manager, 5.4.1 Cochrane Collaboration was used to assess each study's likelyhood of bias.

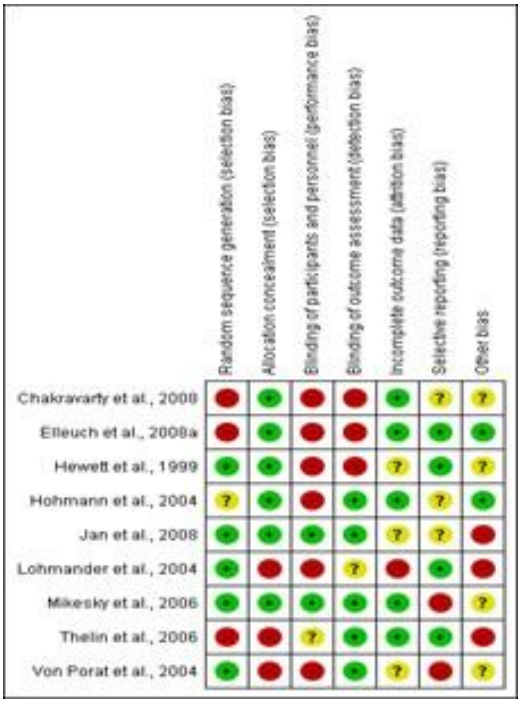

Figure 02: Summary of risk of bias: Evaluate each item's risk of bias for each included study.

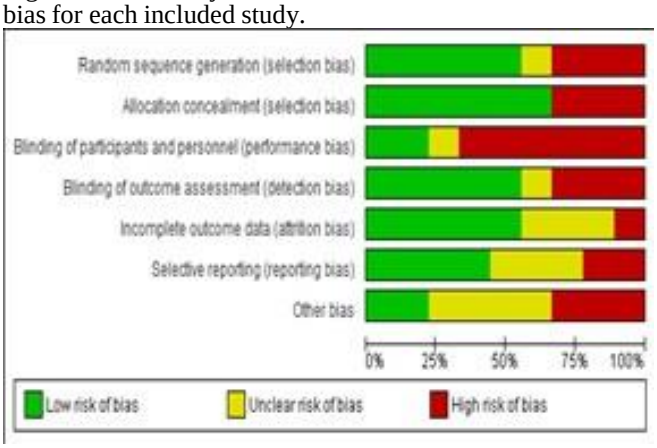

Figure 3 Risk of bias graph: Percentages representing the review authors' assessments of each risk of bias item across all included studies.

Synthesis of Results

Using the PICOS model, the findings are summarised on the following levels: i) running sports and incidence of knee osteoarthritis; ii) soccer, gender, and incidence of knee osteoarthritis; iii) anterior cruciate injury, treatment effect and incidence of knee osteoarthritis; and iv) training and prevention of knee osteoarthritis incidence.

Discussion

Running and knee osteoarthritis

The relation between the running and prevalence of knee osteoarthritis still requires many questions to answer but the articles are in support of running and habitual recreational non-contact sports. In order to solve this problem, it is crucial to conduct a cohort study on runners and nonrunners to determine whether there is a connection between running and knee osteoarthritis.[14] Even though there were only 98 participants in the intervention

Table-3: Summary of symptoms after treatment in both groups

			Frequency(%)	Total
GIT	E	Y	5(11.9%)	42
		N	37(88.1%)	
	P	Y	11(27.5%)	40
		N	29(72.5%)	
H	E	Y	6(14.2%)	42
		N	36(85.5%)	
	P	Y	9(22.5%)	40
		N	31(77.5%)	
SI	E	Y	4(10.1%)	42
		N	38(15%)	
	P	Y	6(39.9%)	40
		N	34(40%)	
SW	E	Y	8(19%)	42
		N	34(81%)	
	P	Y	20(50%)	40
		N	20(50%)	
US	E	Y	2(4.7%)	5
		N	3(95.3%)	
	P	Y	40(7.5%)	77
		N	37(92.5%)	

group, the study's randomised control trial produced the results of a total knee replacement and radiographic findings. The research reveals several limitations, such as a change in the knee angle for radiographs during the course of the trial, but it also has positive effects on body mass index, lower limb alignment, and age.The findings are clearly in support of long-distance running and conclude that running may not be a risk factor for knee osteoarthritis.

Similar, finding from MRI suggested the improvement in the joint condition after exercise and running.[15] These findings were derived from a smaller group of eight participants butstill the results revealed that there is no periosteal edema, stress reaction, or joint effusion notice after running. This study also reflected the importance of muscles surrounding the joints to absorb the shock of the force generated by ground reactions and it is essential to have stronger muscles to sustain heavy joint loading.[15]

The findings of these studies give the impression that running activity is not dangerous for the knee structure but body mass index, muscle power, and knee alignment are important factors to prevent the biomechanical stress and prevalence of knee osteoarthritis in later stages of life.

Prevalence of knee Osteoarthritis in other sports

Athletes who participate in sports with a high level of chronic repeated stress and overuse injuries are more prone to develop knee osteoarthritis.[7] When athletes have a deformity like genu varus/varum in the leg, it will put more stress on the knee joint and cause repetitive degenerative effects on the joint cartilage, resulting in decreased joint space and a high prevalence of knee osteoarthritis in the later stages. Body mass index and leg align-

ment are important determinants for knee osteoarthritis.6 Aging is the natural pathogen for the degeneration of joint cartilage, but when an athlete experiences a single large trauma or repeatedly little injuries in the joint, this exacerbates the degeneration of the joint cartilage and increases the risk of OA.6 An analysis of former football players with a mean age of 49.2 years revealed that these players frequently acquire knee osteoarthritis, and those who do either have genu varum or have experienced knee injuries in the past. Although these football players' bones get stronger and can withstand more shear strain in the joint, the degenerative process remains asymptomatic in them.1[5]

Prevalence of osteoarthritis with ACL injuries in sports

Injuries are common in the contact sports like soccer, handball, and hockey. The incidences of these injuries are important for the future and career of an athlete and when it comes to the injury of the knee joint particularly ACL and menisci tear will leave long-term effects on the joint condition. The importance of ACL injuries leads to the occurrence of knee osteoarthritis in male soccer players.[16] An average injury rate is about 8-30 per thousand games hours in males which increases the chances of knee osteoarthritis. These injuries are marked and leave the symptomatic effects of degeneration in the joint which reduces the physical function after 15-18 years. Treatment strategy for the ACL reconstruction is proven of no significance, Similarly, the female soccer players showed the same results but the incidence of injury is higher in female soccer player as 14-35 injury per thousand hours of the game.5

Exercise training and knee Osteoarthritis incidence

It has been documented from the earlier studies that the incidence of knee injury is related to knee osteoarthritis prevalence. The knee injury rate is more pronounced in females as compared to men.[17] A previous study reflected a 4-6-fold higher incidenceof injury in female athletes as a result of hormonal, anatomical differences in the pelvis and difference in lower extremity alignment. Neuromuscular training and injury prevention showed a significant difference between the female athletes who underwent a neuromuscular training program for 6 weeks as compared with the non-trained athletes which reduce the incidences of injury rate in female trained athletes.[10]

Strength training of the muscle surrounding the knee joint is important in the shock absorption of the pressure generated during strenuous activity. We did not find any study on the effectiveness of strength training in athletes or on the younger age group to support the evidence of this training program in prevention or progression of knee OA. Strength training on adults with a mean age of 69 years with known knee OA evident the decrease in the rate of joint space narrowing in these patients and concludethe importance of strength training in decreasing the pain and joint space narrowing.[18] The condition of the patient with kneepain, lower extremity function, walking speed, and knee muscletorque are all improved by resistant training.[19]

There remain numerous unsolved questions, thus more research is required. The studies chosen to determine the prevalence of knee osteoarthritis are not randomized control trials, and their conclusions may be biased or misleading. These studies do not show the pattern of injuries incidence, surgical and conservative treatment approach, the importance of nutrition in osteoarthritis progression and inside pathology of the joint structure during the progression of osteoarthritis.

All the findings on muscle strength and its importance in knee osteoarthritis are derived from the semiprofessional athletes, which may not be supported for elite athletes. Further work is needed to measure the influence of exercise training programmes on the athletes. We are unable to find randomised control trials on athletes in the prevention and progression of knee osteoarthritis. Future research should focus on more biomechanical studies to enhance methods of measuring impact forces, which may also be crucial in identifying the precise adaptation and compensatory mechanisms that are most effective in reducing the prevalence of knee osteoarthritis in athletes and preventing it from occurring.

Limitations

We could not include any study conducted in Pakistan for this review as there was none. It still remains an unexplored research area in our country.

Conclusion and future direction

Activities that involve more jumping, twisting, and knee traumas increase the likelihood of developing osteoarthritis in the knee. ACL and menisci injuries, in particular, are the most common causes of knee osteoarthritis in sportsmen. Initially asymptomatic, this condition only becomes visible 15 to 20 years after the pathogenesis of the disease began. Females are more prone to develop knee osteoarthritis because of higher and early age incidence of knee injuries in sport. Endurance sports like running are not dangerous for the knee joint structure but body alignment and strength of the muscles surrounding the knee joint are important factors that can prevent the degenerative changes in the knee joint cartilage by shock-absorbing from the ground reaction force. Training is important for the athlete especially the focus should be on lower limb strengthen and neuromascular training which can prevent the higher incidence of knee injury and increase the muscle strength to support the knee joint structure.

Author Contributions

- MSB made substantial contributions to the conception and design of the work. Has a significant role in acquisition and interpretation of data for the work.
- JS, SS drafted the work and revised it critically.
- II and JF assisted in literature search.

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