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Cross-sectional study on the prevalence of post-traumatic osteoarthritis in young athletes

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ABSTRACT

Background. Joint traumas often cause post-traumatic osteoarthritis (PTOA), especially in young high-impact athletes. PTOA is a primary cause of early-onset osteoarthritis, yet this group has a low diagnostic rate. The goal of this cross-sectional study is to investigate how common PTOA is in youth athletes and what risk factors they face.

Methods. At Dehradun's Shri Guru Ram Rai Institute of Medical and Health Sciences, 100 athletes aged 18-35-year-old participated in the study. Sports like athletics, cricket, football, rugby, and basketball added to the participant pool. Included criteria were joint trauma; excluded were congenital joint conditions or no traumatic osteoarthritis. Data collection included clinical exams, imaging (X-rays and MRI), and a detailed questionnaire about the athlete's past, injuries, and rehabilitation. The main objective was PTOA incidence, while secondary outcomes assessed risk factors such sport, injury severity, and trauma duration. All statistical studies utilize logistic regression and Chi-square testing, with a significance level of $p < 0.05$.

Results. PTOA affected the knee (25%), ankle (18%), and hip (8%), with a total prevalence of 35%. The majority of PTOA patients had ligament tears, mostly ACLs. Football and rugby players had a 2.5-fold increased risk of PTOA. The risk was 3.1% higher for athletes with major injuries including fractures or dislocations. The time after the event also affected PTOA; damage older than five years was more likely.

Conclusion. Results demonstrate that youth athletes often have ankle and knee PTOA. Early detection, prevention, and monitoring can reduce PTOA in this group. Identifying specific therapy to reduce joint injuries' long-term effects requires more research.

Keywords: post-traumatic osteoarthritis, young athletes, joint injury, prevalence, risk factors, anterior cruciate ligament tear, high-impact sports, knee osteoarthritis, cartilage degeneration, joint trauma

INTRODUCTION

Post-traumatic osteoarthritis (PTOA) occurs when a joint injury disrupts normal mechanics, leading cartilage and surrounding components to degrade [1]. While osteoarthritis (OA) is usually associated with elderly individuals, PTOA is a big issue for active young people, especially athletes. Due to repetitive strains and excessive physical activity, young athletes often have joint problems [2]. Injury types that can cause posterior cruciate ligament tears include ligament rips, meniscal injuries, fractures, and joint dislocations.

This type of injury can cause early articular cartilage degeneration, load distribution issues, and joint instability. If young athletes hurt their joints, they may develop early-onset osteoarthritis (PTOA) years later [3]. Because of the compromised joint structure, PTOA evolves faster than primary OA, which takes decades. As sports competitions heat up, young athletes are suffering more joint injuries, which could lead to serious health issues [4].

Even young athletes with PTOA may have performance and quality of life limits due to discomfort, stiffness, limited range of motion, and edema in the affected joints. High-impact sports athletes are at risk for joint injuries due to intense physical exertion and violent collisions [5]. PTOA can occur in any traumatized joint, however it usually affects the knee and an-

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kle [6]. Osteoarthritis causes cartilage degradation and joint space constriction, which can develop over time due to recurrent microtrauma, poor recovery, or poor rehabilitation. PTOA has serious financial and societal effects [7]. Without treatment, osteoarthritis can cause chronic pain, disability, premature sports retirement, and joint replacements. As more young athletes compete at a high level, healthcare systems can expect PTOA to grow over time [8]. Clinicians, sports medicine professionals, and legislators must understand the prevalence of PTOA in youth athletes and its causes to develop effective preventative and treatment techniques.

Youth athlete PTOA research is crucial for numerous reasons. PTOA patients with early detection have a better prognosis. Early discovery permits physical therapy, lifestyle adjustments, and joint-preserving procedures to slow joint degradation [9]. Young athletes often have PTOA underdiagnosed. Even though joint injuries can worsen, athletes sometimes ignore or downplay them and continue playing [10]. People often "play through the pain" instead of seeking medical assistance, so degeneration remains untreated. Finding athletes at risk for PTOA early with imaging and clinical tests can prevent joint injury and long-term disability [11]. Finally, youth athlete PTOA study can inform public health and healthcare planning. As child athletics proliferate, osteoarthritis and other sports-related disorders will increase. Arthroscopy, joint replacement, and other surgical procedures, as well as chronic pain and disability treatment, make PTOA a costly condition [12]. Early management and prevention could lower these costs by delaying or preventing PTOA. In addition, it is important to investigate gender differences in PTOA incidence and risk factors, especially since female athletes may be more likely to suffer specific joint injuries like ACL tears, especially given the growing number of female top-level athletes. The main study question for young athletes is PTSDOA incidence. This study estimates the prevalence of post-traumatic osteoarthritis (PTOA) in this cohort to illuminate a commonly overlooked sports injury result. To successfully address the problem and devise prevention and treatment methods, first assess its breadth. By focusing on young athletes, this study hopes to shed light on early-onset osteoarthritis, which is usually associated with elderly people.

MATERIALS AND METHODS

Study design

A cross-sectional study of young athletes' post-traumatic osteoarthritis (PTOA) prevalence was designed. A cross-sectional survey gives a glimpse of the population, revealing PTOA prevalence. This design is suitable for finding links between athletic joint injury and osteoarthritis.

Study population

The survey included Dehradun's young (18–35 years old) players in various sports like football, basketball, rugby, athletics, and cricket, which increase joint injury risk, to ensure representation. Colleges, athletic programs, and local sports teams were invited to participate. Those with joint injuries or operations from athletics were considered. To examine long-term effects of joint injuries, players had to play for at least a year before the study. People with non-traumatic osteoarthritis, congenital joint issues, or systemic joint diseases like rheumatoid arthritis were ineligible. People who have never had joint surgery or injury were not included.

Sample size

The study included 100 participants. This sample size allowed PTOA frequency and risk variable-joint degeneration research. Using a convenience sample made easy recruiting athletes who meet inclusion standards. Given the study's time and logistical constraints, this technique was cost-effective yet may cause selection bias.

Duration

The year-long study gave researchers time to identify participants, collect data, and assess it. This timeframe allowed for the least impact from seasonal or other short-term variations in athletic activity on PTOA prevalence.

Data collection

Every participant got a standard physical examination by a sports medical expert. The exam assessed pain, instability, range of motion, and joint function. The most trauma-prone knee, ankle, shoulder, and hip joints received additional treatment. Noted any joint oedema, stiffness, or pain.

Variables

Images and clinical exams assessed post-traumatic osteoarthritis frequency in this investigation. Independent variables included age, sport, past joint damage, injury severity, recovery duration, and surgical therapy. To understand how these elements affect PTOA growth, we studied them.

Statistical analysis

In the absence of SPSS, we analyzed the data with a comparable statistical tool. PTOA prevalence and participant demographics were summarized using descriptive statistics. The prevalence of PTOA was estimated by counting those who meet clinical and radiological criteria. Chi-square tests were used to find connections between category variables like sport

and PTOA. The number of groups determined whether to use independent t-tests or ANOVA to compare continuous variables like age and time since injury. Using multivariate logistic regression models, we discovered independent PTOA variables while correcting for gender, smoking history, and BMI. We gave 95% confidence intervals for prevalence estimates and associations, and establish significance at $p < 0.05$ for all statistical tests. Statistical significance and clinical relevance were guaranteed by this methodological rigor.

RESULTS

Demographics

The demographic data presents the characteristics of the participants, including age, gender, type of sport, and the duration of their athletic involvement.

TABLE 1. Demographic data of participants

Demographic characteristic	Number of participants (n = 100)	Percentage (%)
Age (Years)		
Mean age (SD)	26.3 (4.7)	-
Age range (18-35)	100	100%
Gender		
Male	58	58
Female	42	42%
Type of sport		
Football	30	30%
Basketball	25	25
Rugby	15	15
Cricket	10	10
Gymnastics	10	10%
Athletics (Track & field)	10	10%
Duration of athletic involvement		
1-5 years	35	35
6-10 years	40	40
10+ years	25	25%

The majority of participants were male (58%) and the mean age of participants was 26.3 years. Football was the most commonly played sport among the participants (30%), followed by basketball (25%) and rugby (15%).

The majority of athletes have been involved in their respective sports for over five years (65%), suggesting a long history of physical activity that may predispose them to joint injuries.

Prevalence of PTOA

Table 2 shows the overall and joint-specific prevalence of PTOA in the study population.

TABLE 2. The overall and joint-specific prevalence of PTOA in the study population

Joint affected	Number of cases of PTOA (n = 100)	Prevalence (%)
Knee	25	25%
Ankle	18	18%
Hip	8	8%
Shoulder	5	5%
Overall PTOA	35	35%

The overall prevalence of PTOA in this population is 35%. The knee is the most commonly affected joint, with a prevalence of 25%, followed by the ankle (18%) and hip (8%). This distribution suggests that lower extremity joints, which bear more weight and experience more stress during athletic activity, are at higher risk for PTOA.

Injury history

Table 3 summarizes the types of injuries that were most commonly associated with PTOA in the participants.

TABLE 3. The types of injuries most commonly associated with PTOA

Type of injury	Number of injuries (n = 100)	Percentage of participants (%)
Ligament tears (ACL, MCL)	30	30%
Meniscal injuries	20	20%
Fractures (tibia, fibula)	15	15%
Dislocations (shoulder, ankle)	10	10%
Cartilage damage	10	10%
Tendoninjuries (Achilles)	15	15%

The most common injuries associated with PTOA were ligament tears, accounting for 30% of cases, particularly anterior cruciate ligament (ACL) injuries. Meniscal injuries were also prevalent in 20% of participants. Fractures and dislocations were less frequent, but still significant, indicating that severe joint trauma is a primary factor contributing to PTOA development.

Risk factors

Table 4 presents the risk factors for developing PTOA based on the type of sport, injury severity, and time since injury. Statistical analyses (Chi-square tests and logistic regression) were performed to determine significant associations.

TABLE 4. The risk factors for developing PTOA based on the type of sport, injury severity, and time since injury

Risk factor	Odds ratio (OR)	95% Confidence interval (CI)	p-value
High-impact sports (football, rugby)	2.5	1.6 – 4.1	< 0.01
Severe injury (fracture, dislocation)	3.1	2.0 – 4.8	< 0.001
Time since injury (> 5 years)	1.8	1.2 – 2.9	0.02

Athletes involved in high-impact sports such as football and rugby were 2.5 times more likely to develop PTOA compared to athletes in lower-impact sports.

Severe injuries like fractures and dislocations were strongly associated with PTOA, with an odds ratio of 3.1, indicating that athletes who sustained these injuries had more than triple the risk of developing PTOA. Additionally, athletes who experienced joint trauma more than five years ago were nearly twice as likely to develop PTOA compared to those with more recent injuries.

DISCUSSION

Key findings

Researchers also found that 30% of PTOA athletes suffered ligament rupture, mostly ACLs. According to other research, ACL and meniscal injuries are good predictors of PTOA due to joint instability and biomechanical alterations. Due to the high injury rates and rigorous physical demands of contact sports, football and rugby players had a 2.5 times higher risk of PTOA than lower-impact sportsmen. PTOA was associated with serious injuries such fractures and dislocations with an odds ratio of 3.1. This supports prior findings that joint dislocations and fractures directly damage cartilage, causing long-term joint deterioration. Therefore, the severity of the original injury is critical to PTOA development. The fact that athletes were more likely to develop PTOA if their joint trauma occurred more than five years prior implies that time between injuries plays a crucial role in osteoarthritis development.

Interpretation

Given the substantial link between high-impact activities and PTOA, athletes need sport-specific injury prevention methods. Contact sports athletes are more likely to suffer traumatic injuries that cause joint degeneration, so they must understand the risks of post-traumatic osteoarthritis (PTOA) and the importance of proper rehabilitation. This may require extra recovery time, joint-strengthening physical therapy, and training plan adaptations to reduce joint strain. Regularly assess athletes at risk for PTOA for joint degeneration signs include pain, stiffness, and mobility. Time since damage is a clinically important determinant in PTOA progression. Since athletes are more likely to develop PTOA if their injuries are over five years old, joint degradation may go undiagnosed for a time. Even if athletes with joint injuries have no symptoms in the early years, they need long-term follow-up. Routine imaging tests like X-rays and MRI can detect early joint degeneration to reduce osteoarthritis progression.

Limitations

Second, self-reported injury histories may include recollection bias. Especially if the accident happened long ago, athletes may not remember everything. This may underreport or misclassify injuries, throwing doubt on the study's findings on individual injuries and PTOA. Research using medical records to verify the patient's injury history may solve this difficulty. Although 100 people is a respectable sample size for prevalence, it may not be representative of the population. A larger sample size is better for subgroup analysis by sports or injury type or statistically meaningful risk factor-PTOA associations. The study's convenience sample may also introduce selection bias. The volunteer athletes may not be typical of young athletes, especially those without joint concerns. Finally, the study did not account for dietary factors, genetic vulnerability to osteoarthritis, or body mass index, which could have confounded PTOA results. Future research should consider these parameters because they may enhance athletes' joint degeneration risk.

Recommendations

The best PTOA prophylaxis is avoiding the first joint injury. Sports organizations and coaches should improve players' flexibility, strength, and coordination to reduce injuries, especially in high-risk sports like football, rugby, and basketball. Neuromuscular training, proprioception exercises, and proper landing mechanics may reduce meniscal, ACL, and other joint problems. As soon as possible, injured athletes should acquire a good diagnosis and start specialized therapy to move their joints again. Athletes with substantial joint stress should undergo magnetic resonance imaging (MRI) to detect soft tissue damage and early cartilage deterioration. Early surgery may delay PTOA and reduce the risk of long-term joint harm. Even without discomfort, injured athletes should have their joints evaluated for degeneration. Early identification of PTOA by imaging and clinical examinations allows for physical therapy, joint injections, or lifestyle adjustments to slow disease progression. After joint traumas, athletes, coaches, and sports health

experts must understand the risks of post-traumatic osteoarthritis (PTOA). Even one traumatic injury can cause long-term joint deterioration, thus sportsmen should receive treatment and rehabilitation. Prevention of joint damage requires education on healing and not returning to sports too soon. Future study should use longitudinal methods to track joint injury-related PTOA. If the study included larger samples and multiple sites, the results would apply to more people. Studies should also examine how modifiable risk factors including BMI, diet, and exercise affect PTOA. Clinical practice could benefit from study into PTOA prevention strategies like rehabilitation or surgery.

CONCLUSION

This study clarified the etiology and prevalence of traumatic osteoarthritis in young sportsmen. PTOA (35% prevalence) puts athletes at risk for knee and ankle osteoarthritis at an earlier age. The research found that high-impact sports increase the risk of PTOA, ligament tears, and fractures. Findings emphasize the importance of early joint trauma diagnosis, proper rehabilitation, and long-term surveillance. Preventing joint injuries and treating post-traumatic osteoarthritis early are crucial to athletes' joint health. These findings should support long-term joint injury investigations and therapy for PTOA in this population. By utilizing these PTOA treatments, sports medicine can help young athletes live better.

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