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THE IMPACT OF RUNNING ON THE DEVELOPMENT OF KNEE OSTEOARTHRITIS: A LITERATURE REVIEW

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ABSTRACT

Osteoarthritis (OA) is a highly prevalent chronic joint disease worldwide that causes pain, disability, and loss of function. The knee is the joint most commonly affected. The link between physical activity and OA remains a topic of debate in the medical community. Since running is one of the most popular forms of physical activity today, we decided to take a closer look at its connection to knee OA. This review synthesizes recent research on this topic. There is a disagreement in the literature: some researchers argue that running increases the risk of knee osteoarthritis, while others suggest it may have a protective effect. In this study, we conducted a comprehensive review of the literature concerning the effects of running on cartilage, as evaluated through imaging modalities and biochemical markers. We further examined its impact on patellofemoral joint pain, as well as the relationship between running duration and intensity. Additionally, we analyzed evidence on other risk factors for the condition and explored potential strategies to mitigate the adverse effects of running, as well as methods for the early detection of changes in the knee joint. We provide a holistic perspective on how running influences the development of knee osteoarthritis and highlight ongoing research directions to further improve outcomes.

KEYWORDS

Osteoartritis, Running, Knee, Physical Activity

CITATION

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Introduction and Background

Osteoarthritis (OA) is a worldwide highly prevalent chronic joint disease, in which knee is the most frequently affected joint. The disease causes pain, disability, and loss of function (Hunter & Bierma-Zeinstra, 2019). Knee OA is not a localized disease of cartilage alone but is considered as a chronic disease of the whole joint, including articular cartilage, meniscus, ligament, and peri-articular muscle that may result from multiple pathophysiological mechanisms. (Heidari, 2011). Age, obesity, occupation, and trauma to the joint because of repetitive movements such as kneeling or squatting have been identified as several risk factors for knee OA (Dhillon et al., 2023).

The association between physical activity and the development of knee OA remains inconclusive. One of the most popular physical activity globally due to its accessibility, low cost, and established benefits is running (Coburn et al., 2023). In general, runners have a 25%-40% reduced risk of premature mortality and live approximately 3 years longer than non-runners (Lee et al., 2017). Moreover, running is considered a factor that elevates mood, reducing depression and anxiety. However, it is also regarded as an important cause of musculoskeletal injuries and may be detrimental to joint health. (Coburn et al., 2023). Over 40% of the public and nearly 10% of healthcare professionals either believe that regular running leads to osteoarthritis or are uncertain about it. (Esculier et al., 2018).

This review provides an overview of the current state of research on the impact of running on knee osteoarthritis development.

Materials and Methods

PubMed and Google Scholar databases were searched. Relevant literature from 2011 to 2026 was selected, giving priority to randomized controlled trials, systematic reviews and meta-analyses to ensure the inclusion of rigorus evidence. Duplicate and irrelevant articles were excluded. The search strategy was based on keywords including ‘’running and knee osteoarthritis” and ‘’ running and Osteoarthritis, Knee” and ‘’ knee OA”.

Results

There is a divergence of opinion within the literature, with some researchers suggesting that running increases the risk of knee osteoarthritis, while others propose that it may exert a protective effect.

The selected publications were divided into three groups:

1. Studies clearly indicate a positive impact of running on the knee joint or suggest a dose-dependent positive correlation.
2. Studies suggesting that running leads to knee osteoarthritis by inducing changes in cartilage.
3. Studies reporting a neutral effect or yielding inconsistent findings.

This classification enables a more in-depth analysis of agreement within the literature and helps identify areas that need further investigation.

1. Studies clearly indicate a positive impact of running on the knee joint or suggest a dose-dependent positive correlation.

The aim of the systematic review and meta-analysis by Alentorn-Geli et al. (2017) was to evaluate the influence of running intensity on the association of hip and knee osteoarthritis (OA). The researchers found that recreational running was associated with a lower prevalence of OA compared to both sedentary individuals and competitive runners, The duration of running exposure also appears to be an important factor. Shorter participation (e.g., less than 15 years) was associated with a reduced risk of OA relative to non-runners, whereas prolonged and intensive exposure may increase susceptibility. These findings underscore the importance of considering exercise dose when evaluating the long-term joint health implications of running. However, the researchers indicate that the observed associations do not establish causality and may be influenced by confounding variables such as prior joint injuries, body mass index, genetic predisposition, and lifestyle factors.

The findings of Lin et al. (2022) indicate that exercise interventions, including walking, brisk walking, and jogging, have a beneficial effect on patients with early knee osteoarthritis (KOA). All forms of physical activity examined were associated with improvements in functional outcomes, such as activities of daily living and motor performance, alongside reductions in inflammatory biomarkers, including interleukin-6 (IL-6) and tumor necrosis factor-α (TNF-α). Notably, moderate-intensity exercise (brisk walking) demonstrated the most favorable outcomes, yielding the greatest improvements in functional capacity and the most pronounced reductions in inflammatory markers. This suggests that exercise intensity is a critical factor in optimizing therapeutic benefits for individuals with early-stage KOA.

The analyzed systematic review and meta-analysis by Burfield et al. (2023) examined the relationship between weekly running volume and the prevalence of knee osteoarthritis. The included studies compared runners with varying weekly running volumes (8–32.1 km, 32.2–48 km, > 48 km per week) to control groups (typically <8 km/week). The pooled analysis showed no significant difference in knee OA prevalence between runners and non-runners. Furthermore, subgroup analyses revealed that increasing weekly running volume (including >48 km/week) was not associated with a higher prevalence of knee OA. Additionally, limited evidence indicated that runners may report lower levels of pain and disability compared to controls. Overall, the findings suggest that running—regardless of volume—does not increase the risk of knee osteoarthritis and may even have beneficial effects on joint health.

The systematic review conducted by Dhillon et al. (2023) shows that knee pain occurs more frequently in non-runners than in runners. Most studies did not find significant differences between these groups in the patient-reported outcomes or radiological signs, such as cartilage thickness. Some findings even suggest that running may reduce the risk of needing surgery due to OA. However, the impact of running on knee health depends on many factors. Both lack of movement and excessive activity can contribute to joint degeneration, meaning the right intensity of exercise is crucial. Runners often have a lower body mass index, which may help protect their joints. Knee health is influenced by intrinsic factors, such as cartilage structure and muscle strength, as well as extrinsic factors like training technique and nutrition. Moderate running may strengthen joints, but excessive loading can increase the risk of osteoarthritis.

This narrative review by Whitfield & Tomlinson, (2025) synthesizes current evidence regarding the effectiveness and optimal dosing of various exercise modalities in individuals with knee osteoarthritis (KOA). The study found that running five times per week for 30 minutes over six months can improve physical function in people with KOA. However, in more severe stages of KOA, exercise may play a predominantly protective role by attenuating functional decline rather than producing substantial symptomatic improvement. Moreover, effects on knee pain and stiffness is unclear. Researchers suggest longer recovery periods between runs, especially at higher volumes, to avoid worsening the symptoms of KOA, due to running temporaly reduces

cartilage volume. The optimal running dose remain unknown. They concluded that it is crucial to adjust intensity of activity based on symptoms, patient preferences and clinical status.

2. Studies suggesting that running leads to knee osteoarthritis by inducing changes in cartilage.

The aim of the pilot study by Esculier et al. (2019) was to compare the effects of 30 min of running on T2 and T1ρ relaxation times of tibiofemoral cartilage in female runners with and without knee osteoarthritis (KOA), using magnetic resonance imaging. The authors reported no statistically significant differences in cartilage recovery following the 30 min running protocol between the two groups. However, a delayed increase in T2 relaxation times was observed in participants with symptomatic KOA, suggesting slower and sustained alterations in cartilage composition. These findings indicate that female runners with symptomatic KOA may require extended recovery periods. The authors further recommend that future research should examine the effects of repeated running exposure and include older cohorts of runners.

The randomized cross-over trial by Bjerre-Bastos et al. (2021) aimed to examine how moderate-intensity exercise with and without joint impact affects biochemical markers of cartilage turnover in humans with knee osteoarthritis. Twenty subjects were randomized. Blood sample and midstream spot urine was taken before and after activity. The findings suggest that both impact exercise (running) and non-impact exercise (cycling) can induce short-term changes in biochemical markers related to collagen degradation and cartilage metabolism, although the magnitude and pattern of responses differed between exercise modalities. These changes suggest that even low-impact exercise influences joint tissue metabolism. Overall, the findings highlighting the importance of exercise type when considering physical activity interventions for joint health. The findings reflect short-term effects, not long-term outcomes, therefore more research is needed. The researchers indicate that blood-based markers may open the opportunity to guide individuals in safe forms of exercise in the future.

The prospective cohort study by Cloosterman et al. (2022) aimed at evaluating the consequences and prognostic factors of running-related knee injuries (RRKIs) among recreational runners. A total of 138 recreational runners who developed knee injuries while participating in a structured running program were followed for approximately 16 months. The findings indicate that although the majority of individuals achieve full recovery, an approximately one-third continue to experience persistent symptoms over time, highlighting the potential for prolonged impairment. The study further highlights the broader consequences of knee injuries, noting that individuals with incomplete recovery were more likely to modify their running behavior, including reductions in speed, and were more likely to seek medical interventions. These findings emphasize the importance of targeted prevention strategies and early management, particularly in individuals presenting with degenerative knee conditions.

3. Studies reporting a neutral effect or yielding inconsistent findings.

The available evidence from systematic review and meta-analysis by Timmins et al. (2017) indicates that the relationship between running and knee osteoarthritis (OA) remains inconclusive and complex. Some radiographic differences were observed in runners, but only at baseline within some subgroups. Some meta-analysis suggested a protective effect of running against surgery due to OA. Other evidence relating to symptomatic outcomes was inconsistent.

The systematic review with meta-analysis by Hart et al. (2022) investigated patellofemoral joint reaction forces (PFJRF) across a wide range of everyday activities, therapeutic exercises and physical interventions (eg, foot orthotics, footwear, taping, bracing). The primary aim was to compare PFJRF between healthy individuals and those with patellofemoral pain (PFP) or patellofemoral osteoarthritis (PFOA). The results demonstrated that PFJRF varies substantially depending on the type and intensity of activity. Low-load activities such as walking produce relatively small forces, whereas more demanding movements like running, squatting, and jumping generate significantly higher loads. Activities involving greater knee flexion angles and increased quadriceps activation were consistently associated with increased PFJRF. Interestingly, the analysis found no consistent or clinically meaningful differences in peak PFJRF between asymptomatic individuals and those with PFP or PFOA. This suggests that the magnitude of joint loading alone may not fully explain the presence of pain or pathology. The findings support the concept that optimal joint health requires appropriate mechanical loading, and that both excessive and insufficient loading could contribute to patellofemoral joint pathology. The researchers indicate that the information on PFJRF may be used to select appropriate variations of exercises and physical interventions.

Coburn et al. (2023) performed a systematic review and meta-analysis examining both immediate (within approximately 20 minutes post-run) and delayed (up to 48 hours) alterations in cartilage morphology and composition following running. Eligible studies utilized MRI to assess changes in hip or knee cartilage

within 48 hours before and after running, focusing on parameters such as cartilage thickness, volume, and relaxation times indicative of tissue hydration and biochemical properties. Across studies, running was associated with transient reductions in cartilage thickness and changes in MRI relaxation times. These effects were consistently reversible, with cartilage measures generally returning toward baseline within hours, suggesting a capacity for recovery and adaptation in healthy individuals following mechanical loading. However, insufficient data were available to quantitatively synthesize immediate post-running morphological changes in individuals with or at risk of osteoarthritis. Limited evidence comparing clinical osteoarthritis and ACL reconstruction groups with controls indicated differences in delayed cartilage responses (30–91 minutes post-exercise), rather than immediate effects.

The purpose of the crossover study by Jeon et al. (2023) was determine if a single session of rehabilitative exercises alters femoral cartilage morphology. The researchers enrolled 12 participants with patellofemoral pain (PFP) and 12 matched healthy participants. Femoral cartilage ultrasonographic images were used. The study suggests that a single session of different types of exercise, including running, strengthening, and plyometric training, does not lead to measurable structural changes in femoral cartilage thickness or echo intensity in individuals with patellofemoral pain compared with healthy controls. Although participants with patellofemoral pain reported increased pain following exercise, ultrasound measurements of cartilage morphology remained stable. These findings indicate that acute mechanical loading during common rehabilitation exercises may not negatively affect femoral cartilage structure. Additionally, patient-reported outcome measures such as the Anterior Knee Pain Scale (AKPS), Knee injury and Osteoarthritis Outcome Score (KOOS) may be useful for monitoring potential early changes in cartilage health in individuals with patellofemoral pain.

The Mendelian randomization study by Huang et al. (2024) found that the present evidence does not support the classification of physical activity as an independent risk factor for knee osteoarthritis. Moreover, the researchers indicate that physical activity did not lead to an increase in the prevalence of knee OA due to body mass index (BMI). They consider obesity as an independent risk factor for the development of knee OA. Physical activity also has the potential to cause knee injury, which is also a risk factor for knee OA. Researchers suggest that a good solution to prevent knee OA would be to implement an injury prevention programs. The consistency of results across multiple analytical approaches, including inverse variance weighting, MR-Egger regression, and weighted median methods, as well as sensitivity analyses, reinforces the robustness of the findings. As the researchers used GWAS data from individuals of European ancestry, further studies in other populations are warranted.

The prospective cohort study by Hartwell et al. (2024) investigated whether long-distance running is associated with an increased risk of hip and knee osteoarthritis. The authors conducted a survey of 3,804 participants of the Chicago Marathon, collecting data on demographics, running history, and joint health. They included data from beginners to high-volume marathon runners. The prevalence of knee osteoarthritis in the study population was relatively low (5.1%). The analysis showed that traditional risk factors, including older age, higher body mass index (BMI), prior joint injury or surgery, and family history, were significantly associated with the presence of osteoarthritis. Importantly, running-related variables—such as the number of marathons completed, years of running, weekly mileage, and running pace—were not statistically significantly associated with an increased risk of osteoarthritis.

Is it possible that appropriate footwear constitutes a viable solution?

The systematic review with meta-analysis by Kayll et al. (2023) aimed to evaluate the effects of biomechanical foot-based interventions on patellofemoral loads during walking or running in adults with and without patellofemoral pain or osteoarthritis. The study shows that minimalist footwear may reduce peak patellofemoral joint loads slightly compared with conventional footwear during running only. Medial support insoles may not alter patellofemoral joint loads during walking or running and the evidence is very uncertain about the effect of rocker-soled shoes during walking and running combined. In conclusion, the researchers suggest that clinicians aiming to reduce patellofemoral joint loads during running in people with patellofemoral pain or osteoarthritis may consider minimalist footwear.

Discussion

The purpose of this study was to examine a potential association between running and the development of knee osteoarthritis, given the ongoing controversy surrounding this topic in sports medicine.

A substantial body of research indicates that running is associated with beneficial effects on joint health. The evidence suggest that exercise interventions confer benefits across heterogeneous patient populations, including older adults, individuals with obesity, and those with advanced disease severity. Moreover, exercise contributes to broader health benefits, including improved quality of life and modification of key risk factors (Whitfield & Tomlinson, 2025).

It remains common that healthcare providers suggest patients to either stop or reduce their amount of running (Hartwell et al., 2024). According to researchers, running itself is not a direct cause of knee osteoarthritis (Huang et al., 2024). Instead, the cause lies in running-related injuries, which is why injury prevention is extremely important (Cloosterman et al., 2022). Furthermore, giving up physical activity can lead to obesity, which is a significant risk factor for knee osteoarthritis (Huang et al., 2024). Other researchers also indicate that the most significant risk factors for developing knee arthritis are age, BMI, previous injury or surgery, and family history, while number of marathons completed, years of running, weekly mileage and running pace is not contributing factor to joint degeneration (Hartwell et al., 2024). These results have important implications for clinical practice and public health recommendations, supporting the continued promotion of physical activity without concern for increasing osteoarthritis risk.

Researchers discused the intensity and volume of running. The findings of some reviews indicate a dose–response relationship, whereby increased cumulative mechanical loading associated with higher training volumes and longer durations of participation may elevate the risk of osteoarthritis (Alentorn-Geli et al., 2017; Dhillon et al., 2023). However, moderate or self-selected running may be safe and beneficial, provided adequate recovery time is allowed (Whitfield & Tomlinson, 2025). Regarding exercise dosage, consistent participation seems to be more important than the specific intensity of running. Nevertheless, moderate-intensity exercise carried out around three times per week for 20–60 minutes is commonly regarded as an effective and practical approach (Whitfield & Tomlinson, 2025). The other researchers suggest that running, irrespective of volume, does not raise the risk of knee osteoarthritis and may even support joint health (Burfield et al., 2023). Other researchers propose that walking, brisk walking, and running each exert beneficial effects on joint health with a marginal advantage of brisk walking compared to other forms of physical activity (Lin et al., 2022). Moreover, some aimed that there was no identified association between cumulative running history and the risk for arthritis. (Hartwell et al., 2024). In summary, further high-quality prospective studies are needed to better understand the mechanisms underlying these associations and to define optimal levels of running for joint preservation.

Excessive patellofemoral joint contact pressure might be harmful to the patellofemoral joint and may contribute to the development and progression of patellofemoral pain and osteoarthritis (Esculier et al., 2018; Hart et al., 2022). To investigate the potential association between running and knee cartilage damage several researchers have assessed biochemical markers of cartilage using blood and urine samples, while the others have used magnetic resonance imaging or ultrasound imaging. Although participants with patellofemoral pain may experience increased discomfort after exercise, ultrasound assessments indicate no changes in cartilage morphology (Jeon et al., 2023). Across studies using MRI, running led to temporary decreases in cartilage thickness and relaxation changes that reversed within hours, indicating recovery and adaptive capacity in healthy individuals, while insufficient data were available to quantitatively synthesize immediate post-running morphological changes in individuals with or at risk of osteoarthritis (Coburn et al., 2023). Due to the inconclusive results of imaging studies, researchers point to the need to use other methods. Patient-reported outcome measures are considered useful for recognizing early changes in cartilage in patients with knee pain. Future investigators should consider including depression and quality-of-life measures to better understand knee pain (Jeon et al., 2023).

The researchers in the cited studies considered whether physical interventions could offset the likely negative impact of running on the joints. Barefoot running has been proposed as a potential strategy to decrease the risk of running injuries due to its effects on the biomechanics of running and joint loading (Hansen et al., 2012). Although, many single studies reported patellofemoral joint reaction forces during running with variations such as gait speed, step length and strike pattern, and physical interventions such as foot orthotics, knee brace and footwear, the findings were inconclusive (Hart et al., 2022). Recent research suggests that minimalist footwear during running may be considered by people with patellofemoral pain or osteoarthritis (Kayll et al., 2023).

Conclusions

Therapeutic exercise is widely recommended as a first-line intervention due to its effectiveness and low risk compared to pharmacological or surgical treatments (Whitfield & Tomlinson, 2025). Overall, current evidence does not support a clear causal relationship between running and the development of knee osteoarthritis. The heterogeneity in study design, population characteristics, and outcome measures, as well as the predominance of moderate- to low-quality evidence, limits the ability to draw definitive conclusions. Conflicting findings may also reflect differences in running exposure, including intensity, duration, and history of injury. Further high-quality, prospective longitudinal studies are required to clarify this association and to better define the conditions under which running may be beneficial or potentially harmful to joint health.

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