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Runners injuries - main types of injuries of the musculoskeletal system of the lower limb and their treatment and prevention

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Abstract

Introduction and purpose

Running is currently one of the most popular physical activities practiced by people around the world, and the number of runners has been growing significantly for many years. The incidence of running-related lower limb injuries in runners ranges between 19.4% and 79.3% [1].

The paper presents research results on the main types of injuries of the musculoskeletal system of the lower limb in runners, their risk factors, methods of treatment and prevention. The results indicate a significant relationship between regular training and the occurrence of injuries, and also emphasize the importance of prevention through rest, appropriate running technique and the selection of footwear. The work provides practical tips for runners and coaches that can help reduce the risk of injuries and improve the quality of training.

Materials and methods

The review was conducted by searching PubMed and other scientific databases focusing on currently available publications. The literature available in the PubMed database was reviewed using the following keywords: “running”, “running injuries”, “tendinopathy”, "running related injuries”, “running biomechanics”, “musculoskeletal injuries”. The analysis of 38 articles published between 2014-2024 was used to write the paper.

Conclusions

Running has many health benefits, but unfortunately it can also have a negative effect. The development of medical literature regarding appropriate prevention, knowledge of risk factors and treatment methods improves the prognosis of injuries in runners. Evolving diagnostic imaging, body monitoring, prevention, and adequate rest between activities are essential to long-term success in preventing running-related injuries.

Keywords: *running, running injuries, tendinopathy, running related injuries, running biomechanics, musculoskeletal injuries*

Introduction

Running is currently one of the most popular physical activities practiced by people around the world, and the number of runners has been growing significantly for many years. Runners are often motivated by the desire to lead a healthy lifestyle, lose weight, reduce the risk of cardiovascular diseases or improve exercise capacity. Although running is a simple and widely available form of exercise with many health benefits, it is also associated with the risk of musculoskeletal injuries. The incidence rate of lower limb injuries in runners ranges from 19.4% to 79.3%. [1] Such a large variation in the incidence rates of running-related injuries is due to differences in the characteristics of the respondents (recreational runners and ultramarathon runners) and different definitions of musculoskeletal injury taken into account in the studies. Running biomechanics plays an important role in the occurrence of injuries in

active people. Analyzing running biomechanics may allow physicians to develop treatment strategies for injured runners. Most of the current literature has not advanced to the level of proven injury prevention strategies for correcting every aspect of running gait. [2]

The minimum speed at which walking becomes ineffective and too energy-consuming is approximately 8.3 km/h and this is the speed at which we start running. The cycle occurring during running can be divided into the support phase (when the foot is on the ground) and the transfer phase (when the foot is above the ground). In the running cycle, the angles of hip bending (45 degrees; 55 degrees), knee bending (24 degrees; 90 degrees) and ankle joint bending angles (30 degrees; 20 degrees) are important. The percentages in brackets express the corresponding angle of flexion or extension at the given joints. [3] When diagnosing injuries resulting from impaired running technique, attention should be paid to such running parameters as: foot strike, foot inclination angle at first contact, tibia angle during load response, knee flexion while standing, hip extension during standing, torso tilt, step length and center of gravity shift.

While running, the body is exposed to various mechanical loads, which may lead to overloads and injuries, such as: Achilles tendinopathies, medial tibial strain syndrome, patellofemoral pain syndrome (PFPS), plantar fasciitis or iliotibial band syndrome. (ITBS). This occurs especially in the case of improper technique, inappropriate footwear or lack of proper preparation. The aim of this study is to analyze the most common injuries of the musculoskeletal system related to running and to discuss their causes, mechanisms of occurrence, and treatment and prevention options. Understanding these issues is crucial to improving the safety of runners and optimizing training processes, which may contribute to reducing the risk of injuries and improving the effectiveness of rehabilitation.

Patella tendinopathy

The most common knee injury in runners. It presents with pain in the front of the knee at the bottom of the patella and proximal to the patellar tendon. Tenderness is present on examination. The patellar ligament is located at the end of the quadriceps femoris muscle. It is an extension of the common tendon of all four heads and runs in a flat, strong band from the surface of the patella to the tibial tuberosity. On average, it is about 5-8 cm long. [4] According to scientific reports, approximately 30% of athletes suffering from patellar ligament tendinopathy are excluded from practicing sports for 6 months, and 50% of them experience pain in the anterior compartment of the knee even 15 years after diagnosis. [5] The most frequently proposed theory for the occurrence of patellar tendinopathy is chronic,

repeated overuse of the tendon.[6] The increased load is located in the deep posterior part of the tendon, closer to the center of rotation of the knee and the lower pole of the patella, this complaint is greater with increased knee flexion. Patella tendinopathy has been frequently reported in running-related injuries among amateur runners who attempt to run 20 to 50 km per week.[7] Treatment is generally conservative and includes eccentric exercises. You should reduce the bending of your knees and bend and straighten your knees while standing on an inclined board. Discomfort while performing this exercise is a natural state. The literature does not confirm the effectiveness of patellar taping and extracorporeal shock wave therapy. [8] Surgery is performed in patients whose symptoms persist for more than three months despite conservative treatment (approximately 10% of patients). The effectiveness of surgical interventions has been confirmed. [9]

Achilles tendinopathy (AT)

It presents with pain and swelling in and around the tendon, pain in the back of the heel, and tenderness of the Achilles tendon from 2 cm to 6 cm above its attachment to the heel bone. According to the research of Maffuli et al. [10], approximately 25% of cases with pain and swelling at the attachment to the posterior part of the calcaneus are AT. It results from excessive use and is a very common cause of disability in athletes such as track and field athletes, footballers and volleyball players.[10] It probably results from the repetitive movements of running and jumping.[11] Diagnosis is based mainly on clinical examination and medical interview. Diagnostic imaging such as ultrasound or MRI may also be recommended to assess the extent of the damage. Treatment of AT mainly involves conservative therapy (non-steroidal anti-inflammatory drugs), but also eccentric heel lowering exercises.[12] In patients with partial AT, this exercise should be performed with the toes placed on a step so that the heel can be lowered below the toes. Rest and avoiding factors that cause pain are also important.

Medial tibial stress syndrome (MTSS)

It presents with diffuse pain along the posteromedial border of the tibia associated with activity. This is a fairly common bone injury caused by overloads accompanied by periostitis of the tibia and microcracks in the anterior tibia. There is tenderness in the muscle area and slight swelling.[13] The incidence of MTSS ranges from 13.6% to 20% in runners[14] According to Deschmukh et al.[15] the exact cause has not yet been determined, but the most likely cause is micro-damage caused by recurring stressors.

Risk factors include female gender, increased body weight, scaphoid bone damage, previous running injuries, and greater external rotation of the hip joint when flexed in men.[16,17] The diagnosis of MTSS includes MRI, bone scintigraphy, and radiography when suspected. fatigue fracture of the tibia. Treatment is conservative - rest (the most important factor) and stretching of the calves, because the tension of the soleus and tibialis posterior muscles has been proven to be related to MTSS. [18]

Patellofemoral pain syndrome (PFPS)

Also referred to as runner's knee. One of the most common reasons for visiting a doctor in patients with pain in the front of the knee. The incidence in the USA is estimated at approximately 3-6%. [19] It mainly affects young women.[19] PFPS manifests itself by pain in the front of the knee and when the knee is additionally lowered during bending (activities such as climbing stairs or sitting for a long time) - Pain when squatting is characteristic.[20] There is currently no clear evidence in contemporary medical literature to clearly confirm the etiology of this disease, which requires further research in this direction. However, there are hypotheses that important risk factors for PFPS are: improper muscle positioning and imbalance, excessive activity and overload, and mechanical injuries. Biomechanical studies have described patellar malalignment and dynamic valgus in patients with PFPS (functional malalignment). [21] Therefore, it is a diagnosis of exclusion when other intra-articular and peripatellar pathology has been rejected. [22] Imaging diagnostics is not usually used in PFPS, with the exception of X-rays, which are used in this case to exclude other diagnoses, e.g. joints or patella fracture. Treatment is conservative - including rest, a short course of non-steroidal anti-inflammatory drugs (providing short-term pain relief but no benefit compared to placebo after three months - [23]) and physical therapy aimed at strengthening the muscle groups of hip flexors, trunk and knee. Kinesiotaping has not been proven to have a beneficial effect in PFPS, as NSAIDs provide only short-term relief.[23]

Plantar fasciitis

It is a degenerative pathology of the fascia, i.e. the connective tissue (the name suggests inflammation, but it is not primary inflammation - [24]), which runs along the bottom of the foot, connecting the heel with the toes. The plantar fascia plays an important role in supporting the arch of the foot and absorbing pressure while walking. This is a common condition among runners (it affects up to 17.4% of them - [2]), but it also affects people who lead a more sedentary lifestyle. It manifests itself with stabbing pain in the medial tubercle of the heel bone, which intensifies in the evening. It is often accompanied by crackling,

thickening or swelling. There is tenderness on palpation of the proximal insertion of the plantar fascia at the anteromedial calcaneus. Risk factors for plantar fasciitis described in the literature include: excessive body weight (in the population not practicing sports -[25]), reduced mass of the foot muscles responsible for toe flexion and limited mobility in the foot[25,26], weight-bearing physical activities, the presence of a heel spur, long-term standing position, increased thickness of the plantar fascia[27,28]. Ultrasonography is used for diagnostic purposes. In a meta-analysis by McMillan et al, patients with plantar fasciitis had 2.16 mm thicker plantar fascia than controls and tended to have absolute plantar fascia thickness values exceeding 4.0 mm.[27,28] The meta-analysis also proved the effectiveness of the use of ultrasound imaging and confirmed that ultrasound can be an accurate and reliable imaging tool in the diagnosis of plantar fascia. Treatment begins with stretching of the plantar fascia, ice massage, and nonsteroidal anti-inflammatory medications. The literature also suggests passive stretching of the plantar fascia, active strength training (heel raises), foot orthoses (relieving heel pain for up to 12 weeks [29]), extracorporeal shock wave therapy (in case of failure of conservative treatment), and injections. corticosteroids (also provide only short-term relief) [30] However, all the treatment methods mentioned in the last sentence have lower therapeutic significance and are of limited or low quality research.

Iliotibial band syndrome

The iliotibial band is part of the fascia lata of the thigh. Specifically, it is a fibrous structure that runs along the outside of the thigh and ends at the shin. It transfers forces from the hip to the knee, acts as a lateral stabilizer of the knee, and also has an important postural function.[31] Iliotibial band syndrome is a condition that most often occurs in physically active people, especially runners (it was reported as a cause of knee pain in 62% and 38% of male and female runners, respectively).[32] It presents as lateral knee pain caused by pressure of the iliotibial band against the lateral condyle of the femur when the knee is bent at an angle of 20 to 30 degrees.[33] The pain is located approximately 2 cm from the lateral joint line, increases during running and may be associated with a popping sensation.[34] Risk factors for this syndrome include: running on an inclined surface, running on hills, errors in training technique and sudden changes in training intensity. Diagnosis begins with a clinical examination. If this is a relapsing or refractory case, then radiological imaging of the knee is used as part of the team's diagnostic imaging, which is useful to rule out other pathologies that may be causing lateral knee pain, such as osteoarthritis, fracture or malalignment of the patella .[35] Magnetic resonance imaging and ultrasound can also be used to confirm the

diagnosis. Treatment is mainly non-operative. The patient should avoid activities that cause pain and undergo exercise therapy, which aims to strengthen the hip abductor muscles and improve the flexibility of the hamstring tendon and iliotibial band [36]. In the vast majority of cases (50 to 90% of PR), non-invasive treatment leads to resolution pain symptoms within 4 to 8 weeks.[37,38] Medical literature also suggests the use of non-steroidal anti-inflammatory drugs and corticosteroid injections, which help reduce inflammation and provide long-term pain relief. In a situation where non-operative treatment does not bring the desired results for more than 6 months [34], surgical treatment is performed. Its aim is to release the iliotibial band, excise the iliotibial band and resection the lateral recess of the synovial membrane.

Statistics

According to research, the incidence of running-related injuries ranges between 19.4%-79.3% (as above [1]) of runners. According to Arnold et al.[16] the frequency of injuries to individual parts of the lower limbs among the total number of these injuries is: knees - 28%, feet and ankles - 21-38%, hamstring (!) - 19%, tibia - 14%. If we are talking about specific diseases most frequently occurring in runners and related to running (the frequency of their occurrence among all running-related injuries is expressed in brackets), they are: patellar tendinopathies (12%), Achilles tendinopathy (6-9%), overload syndrome medial tibia (10%), patellofemoral pain syndrome (6%), plantar fasciitis (5-18%), iliotibial band syndrome (10%), ankle sprains (10%).

Less common running-related injuries include: quadriceps muscle injuries, greater trochanteric bursitis, iliopsoas bursitis, extensor tendonitis, gastrocnemius muscle damage, and damaged extensor hallucis longus muscle. However, they are less common among runners than the previously mentioned examples of injuries.

Conclusion

Running has a positive impact on the quality of life, translating into better physical performance, reduced risk of cardiovascular diseases, prevention of obesity, as well as greater bone mineralization and renewal. However, despite its undoubted advantages, running also has a negative impact on the body, is traumatic and leads to many injuries such as those discussed above. It has been shown that these injuries may result primarily from excessive joint load and improper running technique. However, individualization of activity adapted to abilities, age and preferences reduces the risk of the most common injuries, so the positive impact of running definitely outweighs the negative aspects.

Author's Contribution

Conceptualization: Marta Głąbień Methodology:Marta Głąbień, Paweł Miłkowski Software: Aleksandra Rajewska, Joanna Długosz Check: Justyna Drużyńska, Jędrzej Rajewski, Agnieszka Jolanta Łoś Formal analysis: Marta Głąbień, Justyna Drużyńska Investigation: Marta Głąbień, Dagmara Ragan Resources: Maciej Bara, Paweł Staszczak Data curation: Jędrzej Rajewski, Dagmara Ragan Writing - rough preparation: Marta Głąbień Writing - review and editing: Marta Głąbień, Paweł Miłkowski Visualisation: Marta Głąbień, Maciej Bara, Paweł Staszczak Supervision: Aleksandra Rajewska, Joanna Długosz Project administration: Marta Głąbień, Paweł Miłkowski, Agnieszka Jolanta Łoś

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