

THE RELATIONSHIP BETWEEN PHYSICAL AND FUNCTIONAL STATUS AND KNEE PAIN IN ADOLESCENT BASKETBALL PLAYERS

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Abstract. Knee pain is one of the most common problems in adolescent basketball players (Harris et al., 2021), especially during periods of rapid growth (Iwatsu et al., 2023). It is relevant to investigate how physical and functional status affects the occurrence of knee pain in this age group. Limited functional movements have been found to be associated with poorer dynamic balance and trunk endurance, leading to increased risk of injury (Ünver et al., 2020). In addition, leg muscle length has also been associated with knee pain risk and injury likelihood (Hanief and Widiawati, 2021). Monitoring the functional and physical status of young basketball players is important in order to develop effective prevention programmes to reduce the incidence of injuries (Huang et al., 2023). It is not clear yet, what the relationship between physical and functional status and knee pain in adolescent basketball players. So the aim of this study was to determine the relationship between physical and functional status and knee pain in adolescent basketball players.

Methods: in this study participated the 19 basketball players boys, 12.2 ± 1.1 years old. All participants actively engaged in basketball for at least 3 years, training 4 times a week for 90 minutes, have not suffered any injuries in the last 6 months, not diagnosed orthopaedics problems. They all were divided into two groups: first - with knee pain ($n=9$) and second - without knee pain ($n=10$). First at all, participants completed a questionnaire about their anthropometrics data, training status and trauma. After that, their pain intensity was assessed by a Numeric Pain Rating Scale, functional status by the Functional Movement Screen Test, and physical status by the Thomas, Ely's and Toes Reach Tests.

Results: participants with knee pain felt 4.2 ± 2.2 p. intensity knee pain, scored less points from functional movement screen test than those who did not feel pain (respectively, 14.4 ± 1.1 p. and 16.6 ± 1.2 p.) ($p<0.05$). From all 19 participants, the m. Rectus Femoris was found to be shortened in 7 basketball players, 6 of whom complained of knee pain, and the m. Iliopsoas in 8, of whom 6 felt knee pain. Fourteen subjects were also found to have shortened Hamstrings, 8 of whom had knee pain. No significant relationships were found.

Conclusion: The intensity of knee pain in adolescent basketball players is not related to their functional and physical status. Although, players who experienced knee pain had limited functional movements and reduced leg muscle length than those who did not experience pain.

Keywords: Adolescents, basketball, functional status, physical status, knee pain

Introduction

Basketball is one of the most popular sports in the world and the most popular sport in Lithuania. According to statistics, 2.4 billion people are interested in basketball (Dzimidas, 2023). Competition in this sport and the associated demanding lifestyle often lead to an increase in sports-related injuries (Chechik et al., 2021).

Basketball is characterized by high loads, sudden changes in direction, various jumps, stepping and landing after jumps, which places a high load on the lower extremities (Borges Gomes et al., 2023). Knee injuries are one of the most common sports-related injuries in young athletes (Chechik et al., 2021). Even about 40 percent adolescent basketball players experience knee pain (Harris et al., 2021), especially during their peak growth period (Iwatsu et al., 2023). Poor functional status (scoring less than 14 on the Functional Movement Assessment Test) has been shown to be associated with poorer dynamic balance and lower trunk endurance, leading to an increased risk of injury (Ünver et al., 2020). The length of the leg muscles is also very important, with shortened muscles the risk of knee pain and injury increases (Hanief and Widiawati, 2021). Recent research suggests that basketball players experience knee injuries more often than their peers (Chechik et al., 2021). Sports injuries have a negative impact on the athlete's results and their participation in sports and daily activities, shorten training time, increase health costs, and create the risk of new injuries (Minghelli et al., 2022).

It is not clear how knee pain experienced by boys' basketball players is related to functional and physical condition. Therefore, it is important to further analyse the impact of this sport on teenagers. Monitoring the functional and physical condition of young basketball players is an important step in developing recommendations for knee pain and injury prevention (Huang et al., 2023). The aim - to determine the relationship between physical and functional status and knee pain in adolescent basketball players.

Research methods and conditions

Nineteen teenagers boys participated and their parents provided informed written consent to participate in this study. All participants had no diagnosed diseases, attended basketball training for at least 3 years, training take place 4 times a week for 90 minutes and have not suffered any injuries in the last 6 months. According to study aim, participants were divided into two groups: 1) with knee pain (n=9) and 2) without knee pain (n=10). Participant characteristics are listed in Table 1. All research protocol procedures were approved by Ethics Committee and provided to all participants before they were tested.

Table 1. Characteristics of participants

Group	Participants number, n	Age, yr.	Height, cm	Weight, Kg
With knee pain	9	12.2 ± 1.6	163.7 ± 10.6	51.2 ± 12.2
Without knee pain	10	12.2 ± 0.4	156.9 ± 6.0	46.1 ± 8.1
All participants	19	12.2 ± 1.1	160.1 ± 8.9	48.5 ± 10.3

The study was conducted from January 8, 2024 to April 31. The testing was one-time. The study consisted of 3 stages. The first stage consisted of searching for subjects according to the selection criteria using a questionnaire. The second stage was testing. Subjects who met the selection criteria and agreed to participate were assessed functional and physical status with tests. First of all, a Functional movement screen test was performed. After that, muscle length measurements were performed using Thomas, Ely's, and Toe reaching tests. The third stage of the research is processing the collected data.

Methods

Questionnaire. Questionnaire compiled by the researcher. The questions are intended to determine the anthropometric data (height, weight), training status (sports period, training frequency, and duration), injuries, and painful areas of teenage basketball players.

Numeric Pain Rating Scale (NRS) - for the assessment of pain intensity. A scale of numbers from 0 to 10, where 0 means no pain, 1,2,3 mean mild pain, 4 and 5 mean moderate pain, 6,7,8 mean severe pain, and 9 or 10 are "the worst pain imaginable" in the past 24 hours (Robinson et al., 2024).

Functional Movement Screen Test (FMS). The basic seven movement patterns consist of: deep squat, hurdle step, inline lunge, shoulder mobility, active straight leg raise, trunk stability push-up, and rotary stability. Active straight leg raise and shoulder mobility let evaluate mobility. Rotary stability and trunk stability push-ups test motor control, while inline lunges, hurdle steps, and deep squats for functional patterning. The score for each test ranges from 0 to 3, where 0 indicates pain, 1 indicates inability to perform the movement correctly, 2 points are given if the person performs the movement but with little compensation, and 3 is for correctly performed movement with no compensation (Chang et al., 2020). Total movement score is 21. Athletes with an FMS score of <13-14 are considered "high risk" (Clark et al., 2022).

Physical status evaluation

Thomas test. The test is intended for the assessment of the length of the iliopsoas muscle. While lying down, the subject bends one leg at the hip and keeps the knee of the same leg maximally bent to the chest. The pelvis is kept in a neutral position at all times. The opposite leg is relaxed and close to the tabletop. A positive test is if one leg lifts off the table while the other is pressed to the chest. The shortened iliopsoas muscle of that side is determined. The test is repeated with the other leg (Terzoni et al., 2021).

Ely's test. Assess the length of the Rectus Femoris muscle. The subject lies prone position, the researcher stands from the side. The researcher holds one leg by the ankle. The knee is passively flexed, bringing the heel towards the buttock, while the other hand stabilizes the pelvis. The test is positive if it is not possible to reach the buttock with the heel or if the pelvis rises from the base (Walli et al., 2023). The test is repeated with the other leg.

Toe Reach Test. Assesses the length of the hamstring muscle group. In the standing position, the subject is asked to bend forward and touch the ground without bending the knees. The distance between the tip of the third finger and the floor was measured and the difference recorded (Taşpınar et al., 2023).

Statistical analysis

IBM SPSS (Statistical Package for Social Science) version 17.0 and Microsoft Excel 2016 were used for statistical processing of research data. Conformity to a normal distribution was determined using the Kolmogorov–Smirnov test. Data that were normally distributed were compared using the independent samples Student's T-test, those that were not distributed were compared using the Kolmogorov \rightarrow Smirnov test. Correlations were assessed using Spearman's coefficient, where very weak correlation is defined as $|r| < 0.4$, weak as $0.4 \leq |r| < 0.6$, moderate as $0.6 \leq |r| < 0.8$, and strong - $|r| \geq 0.8$. Data are considered statistically significant if the p-value is less than 0.05.

Research results and their discussion

Out of 19 participants, 9 basketball players felt knee pain. Pain intensity ranged from 2 to 8 points. On average, pain was felt at 4.2 ± 2.2 b. Most basketball players felt pain in the front of the knee (Fig. 1).

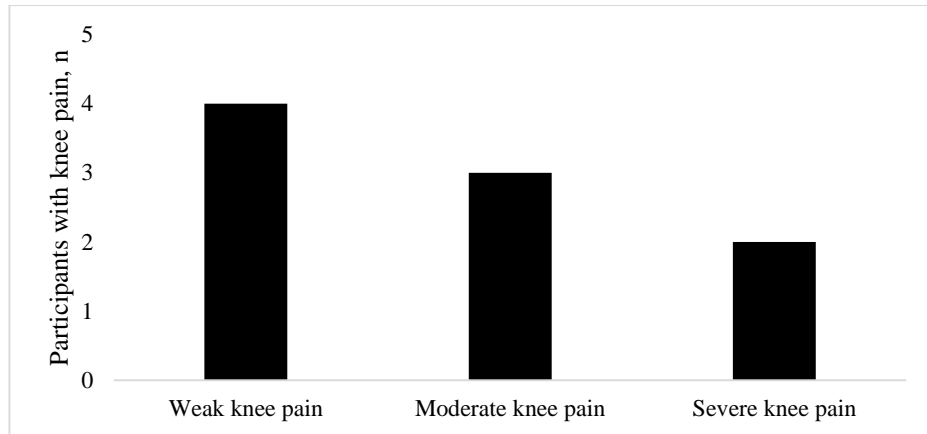


Fig. 1. Distribution of subjects according to pain intensity (n = 9)

The Functional Movement Screen test assessed functional status. The average test scores of the subjects were 15.6 ± 1.6 b. Those who felt knee pain scored significantly fewer points ($p < 0.05$) (Fig. 2). For all participants hardest movement was rotary stability. When comparing the results of individual functional movements, hurdle step, shoulder mobility, and trunk stability push-up movements were significantly lower in the group, who felt knee pain ($p < 0.05$).

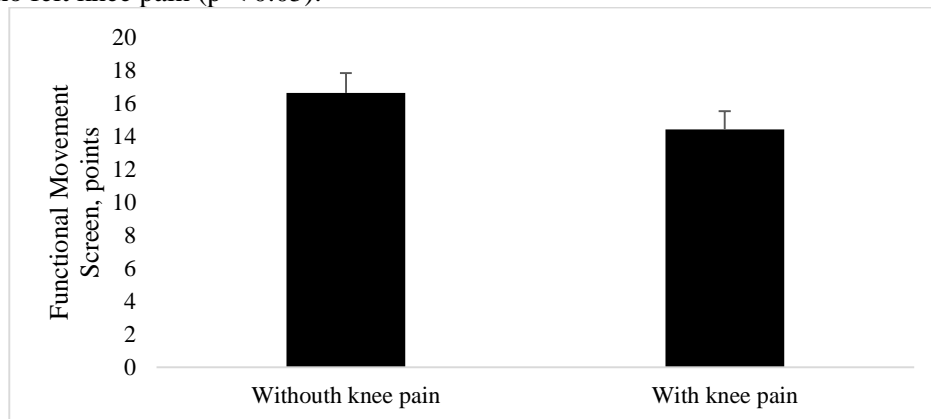


Fig. 2. Functional Movement Screen, * $p < 0.05$ between groups

Physical status was assessed by Thomas, Ely, and Toe reaching tests. The Rectus Femoris muscle was short in seven basketball players, six of whom complained of knee pain, and the Iliopsoas muscle in eight, of whom six felt knee pain. Fourteen subjects were also found short hamstrings, eight of whom had knee pain (Fig. 3).

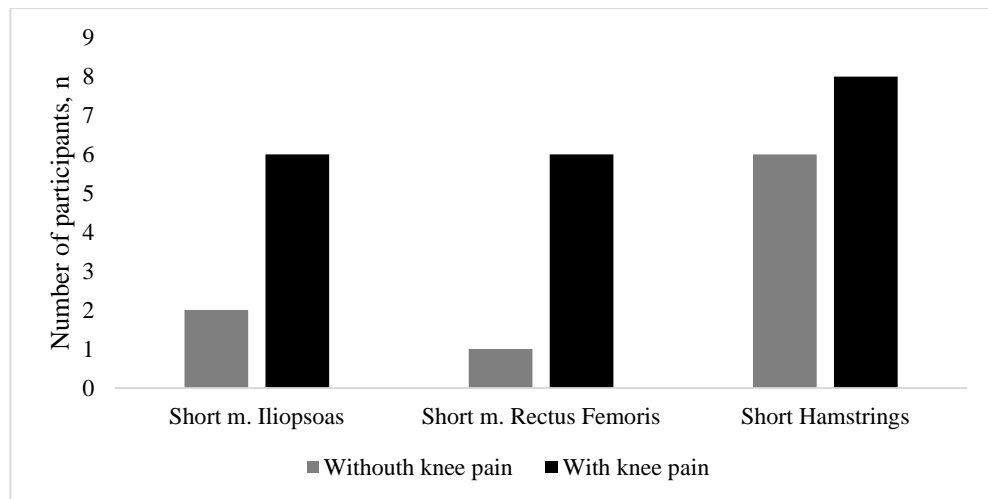


Fig. 3. Distribution of muscle length according to knee pain

During assessing the relationship between knee pain, and functional and physical condition, no significant relationships were found. A negative correlation trend is observed (Table 2).

Table 2. The relationship between knee pain, and functional and physical condition of basketball players

	Pain intensity
Functional Movement Screen test	$r = -3,90$ $p = 0,299$
Iliopsoas muscle length	$r = -0,420$ $p = 0,261$
Rectus Femoris muscle length	$r = 0,326$ $p = 0,391$
Hamstrings length	$r = -0,420$ $p = 0,261$

Discussion

This study aimed to determine the relationship between physical and functional status and knee pain in adolescent basketball players. Boys actively playing basketball for at least 3 years, 4 times a week, 90 minutes each, participated in the study. Scientific literature states that most injuries during basketball occur in the lower extremities (66%), and the knee is the most frequently injured site (Leppänen et al., 2015). During our study, even 9 out of 19 basketball players named feeling of mild to severe knee pain.

Functional movement screen (FMS) tests are very important for the assessment of athlete condition and the prevention of sports-related injuries (Chang et al., 2020). Movement assessment considers limb asymmetry, range of motion, proprioception deficits, posture, and pain (Vehrs et al., 2021). FMS has a maximum score of 21, and a score below or equal to 14 indicates a higher chance of experiencing a sports injury (Chang et al., 2020). In our study, the group without knee pain scored 17, while those with knee pain scored 14. For all participants, the hardest movement was rotary stability. When comparing the results of individual functional movements, hurdle step, shoulder mobility, and trunk stability push-up movements were significantly lower in the group, who felt knee pain. These results are similar to other studies, in which testing for athletes showed a direct and moderately strong relationship between an FMS score ≤ 14 and the risk of injuries. Indeed, regardless of the type of sport, the FMS composite score and asymmetry were stronger in the prediction of injury risk in older athletes compared to younger athletes (Moore et al., 2019).

In our study, the rectus femoris muscle was short in seven basketball players, six of whom reported knee pain. Iliopsoas muscle was short in a total of eight subjects, six of whom experienced knee pain. Meanwhile, the posterior thigh muscles were short in as many as fourteen subjects, eight of whom complained of knee pain. Therefore, the decreased flexibility of the hamstrings may have contributed to the perceived pain. This is supported by the results of another study, which also found a shortened rectus femoris and iliopsoas muscle for basketball players and a moderate relationship between the length of the rectus femoris muscle and pain intensity (Barkus and Šilinić, 2023).

In summary, the results of our study confirm the results of a scientific systematic review, the aim of which was to determine whether the athlete's age, gender, and type of sport contribute to the increased risk of injuries. FMS composite scores and asymmetry were found to be more useful in assessing injury risk in older athletes

compared to adolescent athletes (Moore et al., 2019). Also, a rapid growth spurt occurs during adolescence, which may make it difficult for individuals to adjust to the somatic growth spurt (Brown et al., 2017). In a study conducted by Mickevičius et al., (2017), it was found that knee pain is more common in teenage basketball players who are taller and heavier. The sample size of our study is small to conclude, but the problem of knee pain among adolescent basketball players is very common, and therefore, it calls for larger studies.

Conclusions

This study investigated the relationship between knee pain intensity and functional and physical status in adolescent basketball players. The findings revealed that the intensity of knee pain was not directly related to their overall functional or physical status. However, players experiencing knee pain demonstrated limited functional movements and reduced leg muscle length compared to those without pain.

These results underscore the importance of monitoring functional movements and muscle flexibility in young athletes to identify potential contributors to knee pain, even in the absence of a direct relationship with pain intensity. By integrating these findings into preventive and rehabilitative strategies, coaches and healthcare professionals can better support the physical well-being and performance of adolescent athletes. Future research should explore longitudinal trends in these relationships and the effectiveness of targeted interventions.

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