

FREQUENCY OF INJURIES IN BASKETBALL - A SYSTEMATIC REVIEW

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ABSTRACT

Basketball is a team sport that is really demanding due to its dynamism and variety of motor, technical and tactical abilities that are necessary for the successful performance of basketball elements. The following databases were used to collect adequate literature: GoogleScholar, PubMed. For the analysis, studies were taken that investigated the frequency of injuries in professional, semi-professional and elite basketball players. In order for the studies to meet the inclusion criteria, they contained complete data on the type of injury, localization, and frequency of injury on the tested sample. The total number of respondents in all surveys was 3,802 respondents from all collected and analyzed previous surveys. In this study, more than 4,260 basketball injuries from 15 analyzed studies were analyzed, and after analyzing the results of these studies, it was noted that the most injuries were in the lower extremities in the amount of (66.6%), and the number of injuries in the ankle joint was (33.6%), while the second most injured part of the body was the knee (19.4%). As for upper extremity injuries, hand, finger and wrist injuries predominate (7.1%) compared to shoulder, hand and forearm injuries (5.8%). This study found that jumping/landing, turning or stopping, or contact with an opponent are the most common causes of injury in basketball players. It can be said that a large number of injuries can occur due to the increased fatigue of basketball players, so it can also be said that a proper training program can be the best prevention of injuries in basketball players. It is concluded that basketball is a sport with a high frequency of injuries.

Key words: *basketball, frequency, injuries, basketball, injuries, prevalence.*

Introduction

Basketball is a team sport that is really demanding due to its dynamism and variety of motor, technical and tactical abilities that are necessary for the successful performance of basketball elements. From a relatively slow and simple game at the very beginning of its existence to today's very complex movement structures that are performed in an unimaginably faster rhythm, the dynamics of the game and dynamic and fast actions are the main feature of contemporary basketball (Spiteri, Nimphius, Hart, Specos & Sheppard, 2014). .

Basketball has become a sport of high physical demands with high injury rates. As the basketball player has changed significantly, so have the players' requirements (physical and functional). The game has become more physically demanding, the workload of training and competition has increased, which has led to an increase in the number of injuries (Drakos, Domb, Starkey & Callahan, 2010). movement structures of extremely high intensity. (Erčulj, Dežman, Vučković & Milič, 2002; Narazaki, Berg, Stergiou & Chen, 2008).

High-intensity activities in basketball usually consist of jumps and accelerations that are sudden, as for example in counterattacks, which are often followed by stops or changes in the direction of movement. During these activities, players very rarely reach their maximum movement speed. These sharp and explosive changes in the direction of movement proved to be the key requirements of basketball as a game (for competitive success). (McInnes, Carlson, Jones & McCenna, 2005)

Explosiveness, speed and agility are motor abilities that distinguish top basketball players (Cronin, McNair & Marshall, 2013) and are of crucial importance for success in modern basketball, but this does not mean that other motor abilities are neglected. The training activities of basketball players should inevitably include movement activities that will develop motor skills and improve technique. The training of basketball players should inevitably include exercises for agility, endurance, strength (explosive), coordination, etc... The most common basketball movements are: sprints (from just a few steps to over 20m), sudden stops, rapid changes in the direction of movement, accelerations, various vertical jumps, quick dribbles as well as different kicks and passes. The successful and efficient execution of all these movements, and therefore the playing performance of basketball players, mostly depend on the previously mentioned motor skills (Narazaki, Berg, Stergiou & Chen, 2008).

"Basketball appears to have the highest incidence of injury among non-contact sports with a higher risk of injury than contact sports" (Starkey, 2010, 162). Accordingly, the intensity and aggressiveness of the game should not be underestimated, because the modern basketball game fully emphasizes the speed and strength of the competitors (Starkey, 2010). Even if an injury occurs in basketball, many of them remain unnoticed until they become severe.

Shoulders, wrists and fingers are the most common locations susceptible to injuries in the upper extremities, while knee and ankle injuries are the most common injuries in the lower extremities. (Deitch, Starkey, Walter & Moseley, 2000). As far as the mechanism of injury is concerned, the most common causes of injury are landings, bounces, contact with the ball, and occasionally, contact with the opponent (Deitch et al., 2000).

Methods

The following databases were used to collect adequate literature: GoogleScholar, PubMed. All analyzed studies were published in English or Serbian. References from all papers were reviewed in order to find more studies that dealt with this topic. During the search, the following keywords were used: basketball, frequency, injuries, basketball, injuries, prevalence.

Inclusion criteria

The literature for analysis included research on the given topic written and published in English and Serbian. For the analysis, studies were taken that investigated the frequency of injuries in professional, semi-professional and elite basketball players. In order for the studies to meet the inclusion criteria, they contained complete data on the type of injury, localization, and frequency of injury on the tested sample. The time of publication of the study was irrelevant in the selection of studies that were analyzed in detail.

Exclusion Criteria

Studies were not included in the analysis if they were conducted on a sample of recreational players. Also, studies that are of the systematic review type were not analyzed, but studies of the original type were analyzed. Finally, studies that were not published in Serbian or English were not analyzed, nor were studies in which the full text was not available.

Data Extraction The analysis of the selected works on the topic of the frequency of injuries in basketball. With all the necessary data from the study, such as: characteristics of the sample, objective of the work, results on the frequency of injuries in basketball players and the author's conclusions.

Results

Results of the search

Following database searches, 15 papers were identified as relevant and full-text screening of those papers was undertaken (Table 1 for summary of the included papers).

Table 1: Summary of papers included in the review

First author	Year	Sample	Objective of the paper	Locations of Injuries of basketball players	Type of injuries	Conclusion
Moreira et al.	2003	n = 16 (M) 11-31 years	The aim of this study was to evaluate the frequency of injuries in national team basketball players.	Localization, the most common injuries were legs (49/102; 48.0%), arms (14/102; 13.7%), chest/abdomen (14/102; 13.7%), head and neck (3/102; 3.0))	The most common injury was ankle torsion (13/102; 12.8%), followed by hand injury (9/102; 8.8%). By	The authors concluded that this high number of injuries resulted from the fact that basketball is a contact sport
Meeuwisse et al	2003	n = 318 211(M) 107 (F)	They assessed the frequency and risk of injuries during the basketball season	215 injuries reported (44.7% of players). Ankle injuries were dominant	Ankle sprains (64) represented the majority of acute injuries (45.07%)	The authors concluded that the most common site of injury is the ankle joint. The most common cause was a duel with an opponent
Cumps et al.	2007	n = 164 81(M) 83(F) 20-27 years	They determined the frequency of injuries during one basketball season.	Ankle and knee injuries were most reported	Ankle sprains (34) represented the majority of acute injuries, and 52.9% of all players with ankle sprains reported a previous ankle sprain. The second most common injury was an acute knee injury (caused by player hitting player).	The authors concluded that the ankle joint is the most frequent site of injury.

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Khosrozadeh et al.	2008	n = 58 (M) 19-26 years	The aim of the study was to evaluate the frequency of injuries among Super League basketball players.	410 injuries were reported. common injured areas are the ankle joint and the knee.	The most common injuries were sprain 25%, contusion 15%, fracture 12% and dislocation 10%. The most Most of the injuries occurred during training with the most frequent injuries occurring on the tissues of joint ligaments.	The authors concluded that jumping under the basket, receiving the ball with the fingers, and player contact were the causes of the injury
Drakos et al	2010	n = 1094 (M) Seniors in NBI	Determining the frequency of injuries in the basketball association:	Ankles, knees, and hamstrings were most reported sites for injuries.	Lateral ankle sprains (1658; 13.2%), patellofemoral inflammation (1493; 11.9%), hamstring strain (413; 3.3%).	Ankle sprains were the most common among basketball players in the NBA
Owoye et al.	2012	n = 141 75(M) 66(F) 15-18 years	They determined the frequency of injuries during the (2010 National Finals of the Nigeria Nestlé Milo Basketball Competition)	32 injuries were recorded during this period, which was equivalent to 1.0 injuries per competitor's game. Most of the injuries were on the lower extremities (75%, n = 24); with the majority in the knee joint (40.6%, n = 13)		The authors concluded that: Jumping/landing was the most common cause of injuries (28.1%)
Gordon et al.	2014	n = 246 (Female) 18-41 years	Determining the frequency of injuries	Ankle, knee joint, and various ligaments were sites of injury.	Ankle sprains were the most commonly reported injury with	Ankle and knee injuries were the most

			in elite female basketball players		170/246 (69.11%) basketball players citing at least one during their career. Patellar tendinopathy (28.46%), meniscal injury (22.76%) and ligament tears (21.54%) were also common.	frequently reported injuries
Tufa	2015	n = 130 90(M) 40(F) Senior age	They determined the frequency of injuries among basketball players in the Premier League of Ethiopia From the beginning of the period to the end of the year, .	50 injuries were recorded in men and 36 in women (2013-2014). Knees and ankles were the common sites	Knee injuries were the most common (45.16%), while ankle injuries were a little less common (37.13%).	The results of this study showed that basketball had a high rate of injuries
Carnero et al	2018	n = 243 170(M) 63(F) (17.3 years on average)	They assessed the frequency and localization of injuries in basketball players.	The total frequency was 3.86 injuries/1000 hours of playing or competition. The ankle joint (32.3%) was the most common location of the injury.	Ankle sprain (35.5%) was the most common mechanism.	The authors concluded that men were injured more often than women
Owoye et al	2020	n = 518 417 (M) 201(F) 11-18 years	They determined the frequency and localization of injuries in young basketball players.	The most frequently injured part of the body was the ankle joint (45%) in women		This research showed that the frequency of injuries in basketball is high

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				and the knee (51%) in men.		
Moreno-Pérez et al.	2021	n = 61 (M) 23-28 years	They investigated the frequency of injuries during training and competition	A total of 306 injuries were reported. Most of the injuries occurred without direct contact with another player/object (70.9%) and were located in the ankle joint (74.8%) or in the knee (22.9%).		They concluded that the frequency of a Was higher during the competition seasons.
Šola & Gregov	2021	n = 223 170(M) 53(W)	They determined the frequency of injuries in the 1st Croatian Basketball League	142 (89 men and 53 women) injuries were recorded during one season. Most (80%) of the injuries were to the lower extremities (ankle and knee), and men suffered fewer injuries of the lower extremities than women.		The highest share of injured players is among centers for men (74%) and forwards (70%) for women.
Minghelli et al.	2022	n = 361 238(M) 123(F) 10-51 years	They determined the frequency and epidemiology of injuries in Portuguese basketball players.	239 (66.2%) players reported an injury in 1 year. The most common injuries were sprains (43.8%), the most injured part of the body was the ankle joint (40.1%), and the main mechanism of injury was a collision		The authors concluded that there was a high frequency of injuries in this analyzed sample

				with another athlete (19.4%).		
Conde et al.	2022	n = 117 77(M) 40(F) 18-37 years	They determined the frequency of injuries in players of 10 professional teams in Spain.	Thigh muscle injuries (12.2%) and knee tendinitis (7.4%). The ankle joint was the part of the body with the most frequent injuries with as many as 63.8% of re-injury after a first injury	Knee tendinitis (7.4%).	The authors concluded that there was a high incidence of ankle re-injury after the 1st Injury
Okonkwo et al.	2022	n = 112 (M) 18-36 years	They investigated the frequency of injuries in basketball players from Nigeria	Injuries were reported on right knee (40.27%), left knee (34.96%), right foot (6.06%), left foot (3.96%), right shoulder (3.64%), right wrist (8.60%) and left wrist (2.93%), lower back (0.99%), left thigh (0.92%), left lower leg (0.88%), right thigh (0.71%).		More frequent trainings were associated with musculoskeletal injuries.

Meeuwisse, Sellmer & Hagel (2003) investigated the incidence of injuries in 8 Canadian professional basketball teams. The sample consisted of 318 professional basketball players. The results showed that a total of 142 athletes sustained 215 injuries (44.7% of injured players) during the two-year research period. The largest number of injuries that resulted in players being absent from training for more than 7 training sessions were related to the knee, while the most common injuries that caused the absence of less than 7 training sessions involved the ankle joint. The most common mechanism of injury was contact with another player. Injuries occurred 3.7 times more often in matches than in training. Centers had the highest rate of injuries, followed by defenders, and then forwards. In the end, the most frequent injuries were ankle injuries (19.1%), while the rate of knee injuries was slightly lower (13.5%).

Moreira, Gentil & Oliveira (2003) evaluated the frequency, etiology and localization of injuries of the Brazilian national basketball team during the 2002 season. All data of this study was collected by a team of doctors. They came to the result that there were up to 6.37 injuries to basketball players per season, i.e. 2.55 injuries of basketball players per month. The most common injury was ankle torsion (13/102; 12.8%), followed by hand injuries (9/102; 8.8%). By localization, the most common injuries were legs (49/102; 48.0%), arms (14/102; 13.7%), chest/abdomen (14/102; 13.7%), head and neck (3 /102; 3.0).

Cumps, Verhagen & Meeusen (2007) aimed to assess the incidence of basketball injuries and to identify risk factors associated with ankle sprains and knee injuries during one competitive season. The sample consisted of 164 senior basketball players (23.7 years \pm 7.0), including male and female basketball players. A total of 226 injuries were recorded with a total incidence of injuries of .8 (8.5 to 11.1) per 1,000 hours of training/matches in basketball. Ankle sprains (n = 34) were the most common injuries, and 52.9% of all players with an ankle sprain reported a previous ankle sprain. The next most frequent injury was related to the knee, i.e. knee injuries (n = 26), such as strains/sprains.

Khosrozadeh, Gholpaiegani, Banitalebi & Ghasemi (2008) investigated the causes and frequency of sports injuries among basketball players in Super Leagues. In this study, there were 58 players who played in Super League teams. Players who had two years of experience in the Super League were randomly selected. The researchers collected data from the players through interviews. It was determined that the total number of injuries among 58 players was 410, of which the most common injuries were ankle injuries. Namely, the most common injuries were ankle sprains (25%) and knee injuries (18%). Most of the injuries occurred during training, when rebounding. The most important causes were the blows of the opponent, physical deconditioning and the surface on which the game was played.

Drakos, Domb, Starkey, Callahan & Allen (2010) investigated injuries (incidence and location) suffered by athletes competing in the NBA over a 17-year period. A total of 1094 players appeared in the database with a reported injury. Ankle sprains were the most common injury (13.2%), followed by knee joint pain (11.9%), lumbar pain (7.9%) and hamstring strain (3.3%). Most of the missed matches were related to pain in the knee joint (17.5%), lateral ankle sprains (8.8%), knee sprains (7.4%). The researchers found no correlations between injury rates and player demographics, including age, height, weight and previous NBA experience.

Owoeye, Akodu & Oladokun (2012) assessed the frequency and pattern of injuries in adolescent basketball players in Nigeria. The sample consisted of 141 basketball players (75 boys and 66 girls; aged 15 to 18) who participated in the national finals of the Nigerian

basketball competition in 2010. (National Finals of the Nigeria Nestlé Milo Basketball Competition). A total of 32 injuries were recorded with an incidence of 22.7 injuries per 100 participants, the same for boys and girls. This is equivalent to 1.1 injuries per game for male basketball players and 0.9 injuries per game for female basketball players. The most common cause of injury was jump/landing (28.1%). The majority of injuries were recorded on the lower extremities (75%), with the majority in the knee joint (40.6%).

Gordon, DiStefano & Craig (2014) investigated the frequency of lower extremity injuries in a sample of 246 elite competitive female basketball players. Ankle sprains were the most commonly reported injury with 170/246 (69.11%) participants citing at least one during their career. Patellar tendinopathy (28.46%), meniscal injury (22.76%) and anterior cruciate ligament tear (21.54%) were also common.

Tufa (2015) examined the frequency of injuries in male and female basketball players in Ethiopia. These players participated in the national championship during the 2013-2014 basketball season. The sample consisted of 130 national team basketball players. Information that was included in the list: anatomical area of the injury, period in which the injury occurred (training or match), causes of the injury, diagnosis of the injury and type of therapy chosen. The collected data are from the entire season, that is, from September 8, 2013 to June 20, 2014. From the beginning of the period to the end of the year, 50 injuries were recorded for male basketball players and 36 for female basketball players. Men had more medial collateral ligament sprains ($p < 0.05$), while women had more anterior cruciate ligament sprains ($p < 0.005$). Both genders suffered more frequent injuries during the competition period.

Carnero, Soto, Abellan & Zurit (2018) investigated the frequency of injuries in a Spanish professional club during one season. The sample consisted of 230 basketball players (17.3 ± 5.7 years old). The characteristics of injuries and their distribution by gender and type of activity are described. Incidence of injuries is presented as number of injuries/1000 hours of exposure. The total incidence was 3.86 injuries/1000 hours. The most common location of injury was the ankle joint (32.3%), and the most common diagnosis was sprain (35.5%). Wrist injuries were the second most frequent injury (18.12%). Men showed a higher incidence than women, when we talk about fractures and injuries of the upper extremities. During the competition, the incidence of injuries was 11.7 times higher than during training.

Schepens, Vanden, Bossche, Steyaert & De Wilde (2020) investigated the incidence of injuries in professional basketball clubs in Flanders, a province in Belgium. All acute injuries that occurred during 2009-2013, i.e. during 4 seasons, were analyzed. They assessed the frequency of injuries and parameters such as date of birth, date of injury, gender and diagnosis. The incidence of injuries varied from 7.40% to 8.45%. Basketball players aged 16-17, 14-15 and older than 30 years were at a higher risk of injury. The ankle/foot region is the most frequently injured region according to localization. A sprain is the most common type of injury, while the ankle/foot is the most susceptible to injury.

Owoeye, Ghali & Befus (2020) investigated the frequency and characteristics of injuries in youth basketball players. They made a sample of a total of 518 players (16 ± 1.4 years; 38.6% female basketball players), from 63 teams. The players were observed during one competitive season in order to record injuries and total time spent in the game and in training. The total incidence rate of injuries was 14.4 injuries per 1000 hours of training in female basketball players and 14.8 in male basketball players. While injury rates were similar across injury classifications for female and male players, a potentially lower rate of overuse knee injuries was observed in females compared to males. The most frequently injured part of the body was the ankle joint (45%) in women and the knee (51%) in men.

Hanief & Widiawati (2021) investigated the frequency of injuries in adolescent basketball players. The sample consisted of 14 basketball players with an average age of 15.9 ± 1.1 years, an average height of 172.29 ± 9.33 centimeters and an average weight of 65.71 ± 10.06 kilograms. The researchers tracked the frequency and characteristics of injuries over the course of one season. The results showed that 76% of athletes experienced lower limb injuries, and the most common injury was an ankle joint injury (45%). In addition, basketball players stated that knee injuries are the second most common type of injury (42%). Injuries most often occurred during training (79%), while (21%) occurred during matches.

Jadhav & Bhatt (2021) investigated the frequency of musculoskeletal injuries in female basketball players with the aim of determining the most frequent injuries, as well as determining the anatomical location of the injury. The sample consisted of 40 female basketball players who filled out injury forms. The researchers found that the most frequently injured anatomical area is the ankle joint (32%) and the most common nature of the injury is a joint injury (22.2%), followed by a muscle injury (20.9%).

Moreno-Pérez, Ruiz, Vazquez-Guerrero, Rodas & Del Coso (2021) investigated the frequency of injuries in a sample of professional basketball players over a period of 6 seasons. The sample consisted of 61 professional basketball players (25.7 ± 5.1 years). They identified the injuries starting from the 2014/15 season to 2019/2020. The team competed in the top national basketball division and in the Euroleague. As for the injuries, the type, severity, location and mechanism of the injury were recorded. Training and match times were also recorded for each player to calculate injury frequency. The researchers reported a total of 306 injuries, representing 12.59 injuries per 1000 hours of basketball play. Most injuries occurred without direct contact with another player/object (70.9%) and were located in the lower extremities (74.8%), especially in the knee (22.9%). The incidence of injuries was higher during competition than during training: 77.83 vs. 8.29 injuries per 1000 hours of basketball play.

Morris, Chandran, Lempke, Boltz & Robison (2021) investigated the frequency of injuries in the period from 2014-2019 on a sample of top basketball players. The total injury rate was 7.28 per 1000 hours of training/matches of basketball players. Also, the chances of injury are twice as high if it is a basketball game and not a training session. Ankle (22.2%), knee (13.0%), head/face (11.3%) and hand/wrist (10.1%) injuries were the most frequently reported injuries, with sprains (30.4%) , contusions (14.3%).

Šola & Gregov (2021) investigated the frequency of injuries, as well as potential risk factors, during one competitive season among basketball players of the first Croatian national league. The sample consisted of a total of 223 basketball players, of which a total of 142 players were injured during the season. Height, weight and total time spent in training and playing were identified as risk factors for women, while total training/playing time was a risk factor for men. The positions, which were most often injured, in men were centers (74%), while in women they were attacking positions (70%). Forty-three percent of injuries were moderate or severe, 31% were minor, and 20% were severe. Most (80%) of the injuries were localized to the lower extremities and men suffered fewer injuries of the lower extremities compared to women. The most common injury of basketball players was localized on the ankle joint, and then on the knee. However, men suffered fewer knee injuries than women. Those athletes who on average played more than 20 minutes in matches were almost twice as likely to be injured.

Zynda, Wagner & Liu (2022) also investigated the prevalence of injuries in the population of basketball players. They collected data on basketball injuries between January 2012 and

December 2018 among basketball players aged 7 to 11 and 12 to 17 years. The researchers conducted a Z test to compare the incidence of injury between male and female basketball players in each age group and the overall injury rate/incidence between age groups. The most common injuries were ankle sprains/sprains (17.7%), finger fractures or sprains (12.1%), concussion/head injuries (9.4%), knee strains/sprains (4.5%). Also, the researchers noticed that there was a significant increase in the frequency of injuries in adolescents compared to childhood.

Minghelli, Queiroz, Sousa, Trajano & Graça (2022) investigated the frequency of musculoskeletal injuries and risk factors in basketball players during two competitive seasons. The sample consisted of 361 basketball players from southern Portugal, aged between 10 and 53 years. The researchers found that 239 (66.2%) players reported an injury during the season, for a total of 494 injuries, and 174 (48.2%) players reported an injury in the previous season, for a total of 244 injuries. There were 2.72 injuries/1,000 hours of play/training. The most common injuries were sprains (43.8%), the most injured part of the body was the ankle joint (40.1%), and the main mechanism of injury was contact with another athlete (19.4%). Basketball players who trained more than 4 times a week showed a 2.21 higher chance of injury compared to those who trained less often.

Okonkwo, Okereke, Umunnah, Ibikunle & Egwuonwu (2022) investigated the frequency of injuries in basketball players and the association of injuries with socio-demographic factors. The sample consisted of 112 basketball players who volunteered for monitoring and evaluation. The researchers concluded that the largest number of participants' injuries were in: right knee (40.27%), left knee (34.96%), right foot (6.06%), left foot (3.96%), right shoulder (3.64%), right thigh (0, 71%). The researchers came to the conclusion that ankle and knee injuries were associated with body weight, but found no correlation with socio-demographic factors.

Conde, Cabero & Pascual (2022) investigated the frequency of injuries among 117 basketball players from ten professional teams from four leagues in the 2014-2015 season. There were 11.6 injuries per 1000 hours of sports activity. The rate of injuries requiring the interruption of training was 2.99 per 1,000 hours of training. No significant differences were found in the frequency of injuries between the leagues, but the incidence per season is higher in teams that participate in international competitions, due to the increased time of the competition. The most common injuries were sprains, bruises and muscle overloads. 63.8% of players had ≥ 1 injury that could be repeated. The most common injuries were ankle sprains (50%), thigh muscle injuries (12.2%) and knee tendinitis (jumper's knee) (7.4%). The only significant predisposing factor for injury was recurrent injury.

In order to be included in this analysis, the respondents had to be competitive basketball players (professional, semi-professional and top basketball players). The number of subjects varied from study to study, the smallest number of subjects was included in the study (Moreira et al., 2003) with only 16 subjects, and the largest number in the study (Drakos et al., 2010), as many as 1094 subjects. The total number of respondents in all surveys, the total sample, so to speak, was 3,802 respondents from all collected and analyzed previous surveys. All presented researches evaluated the frequency (rate) of basketball player injuries with presented data on: percentage and numerical frequency, localization and mechanism of basketball player injuries. All surveys contained the basic characteristics of the respondents. As part of this research, and as already mentioned, data on injuries was collected from 3802 (75.49%) respondents, of which 2870 were men and 932 (24.51%) were women. When looking at the age characteristics of the respondents, it can be concluded that there were respondents of different ages from juniors, to seniors and older seniors (age range from 11-51

years), where most of the research was done on a sample of seniors (Meeuwisse et al., 2003; Cumps et al., 2007; Khosrozadeh et al., 2008; Drakos et al., 2010; Gordon et al., 2014; Carnero et al., 2018; Moreno-Pérez et al., 2021; Šola & Gregov, 2021; Conde et al., 2022; Okonkwo et al., 2022), some of them on a sample of juniors and cadets (Owoeye et al., 2020; Carnero et al., 2018; Owoeye et al., 2012), while some research done with combined age categories (Minghelli et al., 2022; Moreira et al., 2003). When looking at studies conducted on a sample of juniors and cadets (Owoeye et al., 2020; Carnero et al., 2018; Owoeye et al., 2012), it can be concluded that in this age category, injuries are present as in seniors, i.e. the most common were ankle joint injuries (39%), while the other most frequent injuries were localized in the knee area (21%), regardless of gender, which means that these types of injuries were equally represented in both genders of juniors and cadets. Also, looking at the total sample of seniors, it is noticed that the most common injuries are lower extremities (66%), primarily ankle joint (38%) of all injuries and knee (21%). Such situations were seen in both sexes, which indicates that injuries of the lower extremities are common in both basketball players and basketball players.

Discussion

It is known that athletes have a higher risk of musculoskeletal injuries (Emery, Meeuwisse & McAllister, 2006). These injuries can put athletes, in this case basketball players, in a very awkward position, where they have to miss training or competition, which can affect their form and psyche. In this regard, the goal of this review was to gain a systematic insight into the literature that investigates injuries in basketball, i.e., to determine the frequency and localization of injuries in basketball based on previous research.

The intensity of performing some activities during training can be equal to the intensity during the game, but the exercises often consist mainly of instructions and performance of technical elements specific to basketball. In other words, a large part of the activity during exercise/training is predictable. The games usually involve fewer players, but the activity is usually at a very high level of intensity. This high-intensity physical effort and fatigue, combined with the competitive environment, can cause injuries in basketball players (Dick et al., 2007). In this study, more than 4,260 basketball injuries from 15 analyzed studies were analyzed, and after analyzing the results of these studies, it was noted that the most injuries were in the lower extremities in the amount of (66.6%), and the number of injuries in the ankle joint was (33.6%), while the second most injured part of the body was the knee (19.4%). When we talk about these injuries, it can be noted that a large number of authors (who are not analyzed in the table) determined that the ankle joint is the most frequently injured part of the body in basketball players (Schepens et al., 2020; Jadhav & Bhatt, 2021; Powell & Barber- Foss, 2021, Dick, Hertel & Agel, 2007), which is consistent with this work. As for upper extremity injuries, hand, finger and wrist injuries predominate (7.1%) compared to shoulder and forearm injuries (5.8%). Similar data were observed in a systematic review published 4 years ago (Andreoli, Chiamont, Burie & Pochin, 2018).

This study found that jumping/landing, turning or stopping, or contact with an opponent are the most common causes of injury in basketball players. Such observations have already been recorded in other existing studies (Messina, Farney, Delee, 1999). There is also a study on a sample of professional basketball players that showed that a collision with a teammate or an opponent is the main cause of injuries (Akinbo, Odebiyi, Adebayo, 2008). It is assumed that the way the injury occurred, as well as the localization and frequency of the injury may depend on the rank of the game, the frequency of training and the training program. Namely, it is logical to conclude that injuries will be more frequent if basketball players train constantly, if they participate in high-ranking competitions (where the prizes are big, and with

it the motivation), if the training program is not adequate (if the tendons and ligaments are not strengthened) and many others factors, such as: stress, carelessness and aggressiveness in the game. Based on the data presented, it can be concluded that basketball is a sport with a high frequency of injuries, especially among younger basketball players. The focus in basketball should be on technique development and strengthening of muscles, ligaments and tendons in order to train their neuromuscular system to control the biomechanical load (Emery, Rose, McAllister, Meeuwisse, 2007) imposed by basketball. Also, most of the injuries in the analyzed studies were characterized as acute injuries, which is a logical conclusion given that it was shown that the most common cause of injuries is contact, jumping and landing, or stopping or turning (change of direction).

Also, looking at the total sample of seniors, it is noticed that the most common injuries are lower extremities (66%), primarily ankle joint (38%) of all injuries and knee (21%). Such situations were seen in both sexes, which indicates that injuries of the lower extremities are common in both male basketball players and female basketball players.

When looking at studies conducted on a sample of juniors and cadets (Owoeye et al., 2020; Carnero et al., 2018; Owoeye et al., 2012), it can be concluded that in this age category, injuries are present as in seniors, i.e. the most common were ankle joint injuries (39%), while the other most frequent injuries were localized in the knee area (21%). These data were independent of gender, which means that these types of injuries were equally represented in both genders of juniors and cadets. All studies presented and analyzed in the table (Moreira et al., 2003; Meeuwisse et al., 2003; Cumps et al., 2007; Khosrozadeh et al., 2008; Drakos et al., 2010; Owoeye et al., 2012; Gordon et al., 2014; Tufa, 2015; Carnero et al., 2018; Owoeye et al., 2020; Moreno-Pérez et al., 2021; Šola & Gregov, 2021; Minghelli et al., 2022; Conde et al., 2022; Okonkwo et al., 2022) showed that basketball is a sport with a high frequency of injuries, and that the greatest number of injuries occur in the lower extremities, i.e. in the ankle joint, then in the knee.

Conclusion

Athletes have a higher risk of musculoskeletal injuries. These injuries can put basketball players in a very awkward position, where they have to miss training or competition, which can affect their form and psyche. Determining the general epidemiology and rate of injuries in basketball is the first step for effective preventive measures that should be applied in order to reduce the frequency of injuries and the consequences caused by injuries, including costs related to doctors, hospitals and the absence of athletes from training or competition (Andreoli et al., 2018). Basketball is an unpredictable high-speed game with a lot of contact, high jumps and sudden changes of direction, which means that there can be a large number of injuries that cannot be prevented. In this study, more than 4,260 basketball injuries from 15 analyzed studies were analyzed, and after analyzing the results of these studies, it was noted that the most injuries were in the lower extremities in the amount of (66.6%), and the number of injuries in the ankle joint was (33.6%), while the second most injured part of the body was the knee (19.4%). This study revealed that jumping/landing, turning or stopping or contact with the opponent are the most common causes of injuries in basketball players, and such situations are unpredictable in basketball, which is why it is difficult to influence this phenomenon. In the end, it can be said that a large number of injuries can occur due to the increased fatigue of the basketball player, because then he is more susceptible to injury due to a large number of factors. That's why it can be said that a proper training program, which includes strengthening tendons and ligaments and getting basketball players in sports shape, can be the best prevention of injuries in basketball players. Based on all the information presented, it can be said that basketball is a sport with frequent injuries.

Importance of Research

In top and professional basketball, injuries can have serious consequences for the entire team, as well as for the career of a particular basketball player. It has been shown that injuries to the lower extremities (ankle and knee) are the most prevalent in basketball. The practical value of this work is reflected in the possibility of using the materials and results of various researches found in the improvement of the training process in basketball in order to prevent injuries (at least when talking about situations where training can affect injury prevention). The results contribute to a better picture of all the research found that is related to the given topic. The research is of great importance, not only for experts in the field of physical education, but also for other researchers, athletes, coaches.

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