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Chapter 2

Ankle Injuries Associated with Basketball Practice: Current Situation and Literature Review

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Abstract

Introduction: Basketball is one of the most practiced sports in the world. Traditionally, it has been considered that it is a sport of low physical contact, and that sports injuries occur less frequently than in other sports such as football or rugby. However, we have seen the appearance of several recent studies that count basketball as one of the sports with higher injury rates, and among them, especially ankle injuries. **Material and methods**: In our study, we performed a literature review on ankle injuries associated with basketball practice. We selected the relevant articles of Pubmed using the keywords "basketball", "ankle" (ankle) and "injury", published between 2006 and 2015. We limited the selection to those studies that dealt with injuries associated with basketball, whether descriptive or analytical, without taking into account the populations that the authors studied or whether in addition to basketball, other sports were included. The exclusion criteria were as follows: experimental studies, case reports and then whose text is impossible to obtain. **Results and discussion**: Initially 114 studies were obtained, of which 13 were selected applying the previously mentioned criteria. They observed the incidence of ankle injuries during basketball practice in different population groups, different levels of practice (professional and amateur) and during different periods of time. Among professional athletes, we could observe that ankle sprains account for more than 20% of the injuries suffered by athletes that they are accountable for almost 10% of the matches that a professional player loses because of an injury, and that only about half of them take place during a game, which increases the importance of injuries that occur during practice. When it comes to amateur level basketball, we can observe in several studies that, while the male population is more prone to need medical assistance for ankle injuries during the practice of this sport (from 18.3% of injuries associated with basketball, up to 52%, according to the series), the female population has a greater predisposition for knee

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injuries (63% of injuries associated with basketball for only 21% of ankle injuries in some jobs). **Conclusions**: After analysing the recent literature, we could draw among others the following conclusions: basketball is a sport which is closely linked to the appearance of ankle injuries; the most prevalent ankle injury is sprain; the incidence of injuries increases the higher the level of practice, being maximum in professionals; these injuries have an evident impact on the athlete's usual sports and extrasports practice; and gender may have an influence on the joint affected by basketball related injuries. Basketball is a rising sport at the moment, with a great social and economic impact in the world of today. Its practice is becoming more frequent, and with it the incidence of injuries associated with it, especially those occurring in the ankle joint. It is therefore expected that in the coming years, we are likely to observe the appearance of more works in the literature that confirm this fact, as well as advances in the treatment and recovery of the athletes who suffer them.

Keywords: basketball, ankle, sprain, injury

1. Introduction

Basketball is one of the most popular sports worldwide. [1] In some countries, such as the USA, it occupies the first place in the sport popularity rank, while on many others, if not the first, it holds one of the top positions.

Those who practice basketball tend to start at early ages, and from that moment on, this sport allows many different degrees of dedication, which extend from sporadic practice to professional basketball. As it is obvious, higher levels of competition associate with an increased incidence of injuries. Professional basketball today has become a highly physical, high-contact sport.

Traditionally, basketball was regarded as a safe sport in terms of risk of injury, mainly because it is a non-contact sport. However, it has drawn attention in the scientific literature of injury surveillance during the last years, and now it is considered the most dangerous non-contact sport in terms of injury [1].

Among all the different kinds of injuries that one can suffer during basketball practice, ankle injuries are perhaps the most frequent. Depending on the series, more than 50% of time loss due to an injury in professional basketball players derives directly from ankle injuries. In addition, all through the actual bibliography one can find that ankle injuries are also the most frequent in those who practice it outside the professional sphere. These numbers become more preoccupying when we find that many of these cases those who suffer ankle injuries do not seek professional care [2].

Several risk factors have been associated with the odds of suffering an ankle injury during basketball practice [2], the main listed: first, having suffered a previous ankle injury. Second, not using proper equipment specially referred to footwear. Last, performing an improper stretching and/or warm-up before the game.

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As we can see, ankle injuries may result from many different kinds of basketball practice. The aim of this study is to perform a bibliographic review on the prevalence of ankle injuries that take part during basketball practice.

2. Materials and methods

A literature search was conducted using the PubMed database. We used the following keywords: basketball, ankle and injury, in order to obtain as much relevant literature as possible. In order to limit the search to the most recent articles, we limited our search to the last 10 years (2006–2015).

After the search was finished, we ended up with 114 results. All abstracts and titles were analysed in order to identify those articles that had studied the prevalence of ankle injuries during the practice of basketball, in any kind of population or in association with any other sport. Only descriptive or analytical studies were included. Case reports, literature reviews and experimental studies were discarded, where the full text of the article was unobtainable for any reason. All phases of the selection process are detailed in **Figure 1**.

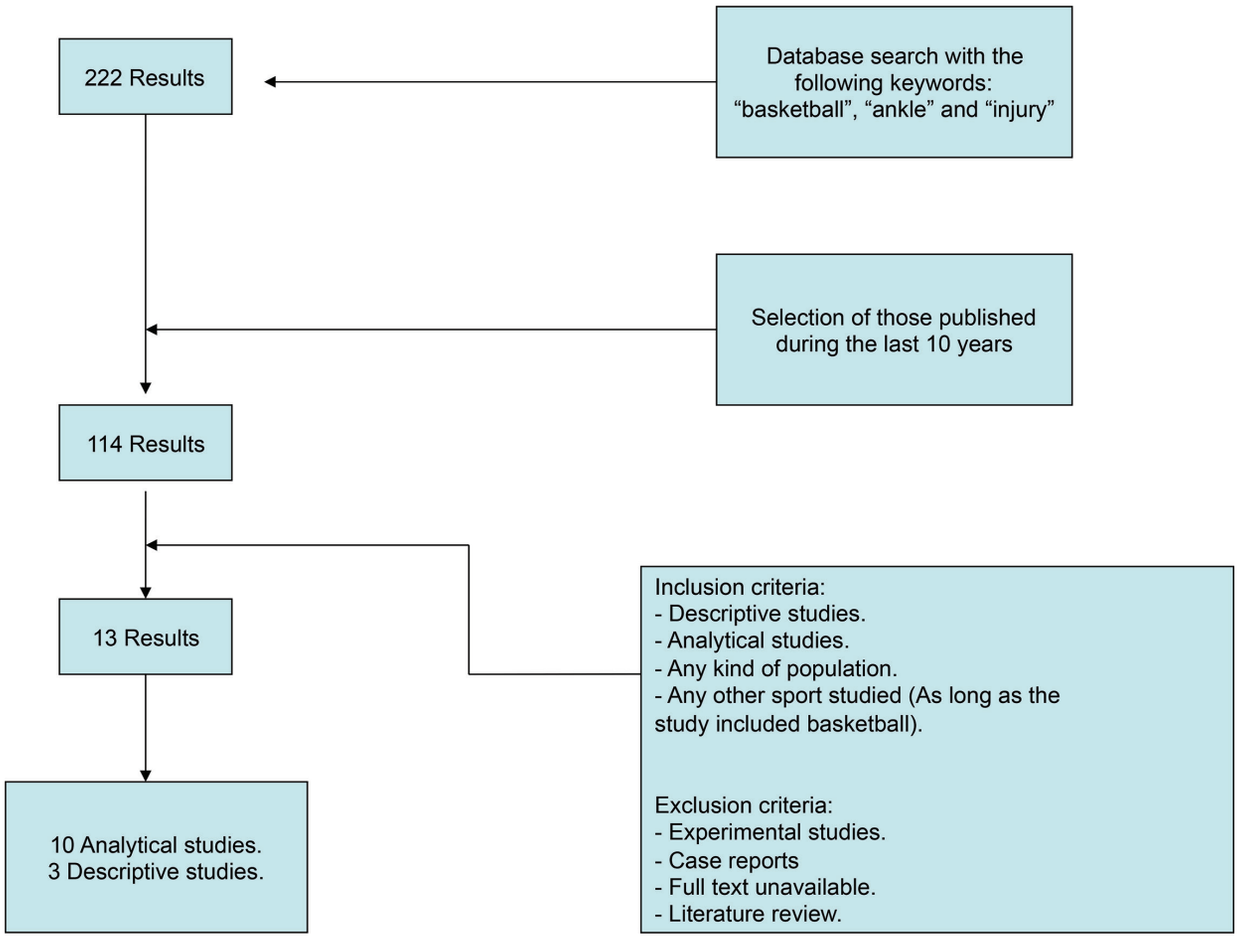


Figure 1. Chart which shows the selection process of the papers that were included in our study.

3. Results

After applying the inclusion and exclusion criteria, we were left with 13 articles, of which 3 were descriptive studies and 10 were analytical studies. All of them are listed in **Table 1**.

When we analyse the whole set of studies, the first thing that stands out is the fact that the population groups are very different from each other, both regarding their ages and gender, also their occupation and level of play. Moreover, the studies' designs also varied greatly comparing one to the other. As a whole, these studies tend to conclude that ankle sprains are one of the most frequent injuries during any kind of basketball practice, if not the most.

Cumps et al. [1] studied senior players (mean age 23.7 years ±7) of different levels of play during a whole competitive season. During this study, 164 total players were recruited, and the goal was to assess the overall incidence of acute and overuse basketball injuries. After observing prospectively the population, which consisted of 81 male and 83 female players, the researchers concluded that the incidence of ankle sprains as a direct consequence of practicing basketball was 6/1000 play hours, which made them the most frequent acute injury. As a matter of fact, the study also states that the main trigger for an ankle sprain would have been the act of landing on an opponent's foot after a jump, and so, jumping tasks would be the ones which is the reason for higher risks of ankle sprains (52.9% of total) in contrast to such others as cutting (11.8%), running to score (11.8%) or passing and receiving (5.9%).

This last conclusion would match with the one made in Nelson et al. [3] work, which stood that rebounding would be the activity associated with the greatest proportion of ankle injuries, and that among the different positions, basketball centres would be at higher risk. Similar to Fernandez et al. [4] and Borowski et al. [5], Nelson's group gathered a study population consisting in 100 random US high schools. The goal of the three articles was to observe these populations for 1 [3, 4] or 2 school years [5] for sports-related injuries. While in the first case [3], basketball was the top sport in ankle sprains incidence rates, in Fernandez et al. [4] experience, basketball was moved to the third position in that aspect, after football and soccer. In addition, what stands out from these two studies is the difference in injury rates per athlete exposure. Nelson et al. [3] calculated an ankle injury rate of 5.23 per 10,000 athlete exposures, Fernandez et al. [4] observed a 1.31/1000 rate for boys and 1.36/1000 for girls. Both studies would conclude in fact that basketball is one of the top sports accountable for ankle injuries during high school practice.

A similar conclusion and a similar design could be found in Borowski et al. [5] conclusions. This descriptive study also gathered a population of 100 random US high schools, but unlike Nelson et al. [3] and Fernandez et al. [4], they focused only on basketball-related injuries. Their goal was to prove that basketball injury rates differed by gender and type of exposure. After a 2-year-follow-up, their conclusions were that they in fact did. Injury rates per 1000 exposures were far higher during competition (3.27) than during practice (1.40), with a 95% confidence interval, 2.10–2.57. Significant differences were also observed in gender, as girls held a 2.08 injury rate in contrast to the 1.83 that boys did (95% confidence interval, 1.03–1.26). In both groups, the ankle and foot were the most injured parts of the body (39.7%), and sprains the most frequent kind of injury (44.0%). These sex differences

Author/year	Participants	Results	Comments
1. Cumps et al. [1]	164 senior (23.7 ± 7.0 years) basketball players of all levels of play	Ankle sprains and overuse knee injuries were the most frequent. Ankle sprains were re-injuries in 52.9% of cases.	The mean absence from basketball activity after an acute injury was 2 w 5 d (± 5 w 1 d).
2. Ito et al. [7]	1219 basketball players (professional and amateur) attending a Sports Medicine Clinic. 1991–2011. Mean age was 19.4 years (8–39).	1414 injuries listed. Foot and ankle: 24.8% male, 23.8% female. Most frequent kind of lesion: sprain.	Knee most frequent (41.7% male, 50.4% female). Most did not seek medical attention.
3. Kim et al. 2014.	268 female athletes (162 basketball). Public school during 3 sports seasons.	84 basketball – related injuries. Most common part of the body injured was the knee (67.9%), followed by ankle (21.4%).	46.4% injuries during competition. 53.3% injuries during practice.
4. Pappas et al. [2]	Patients aged 7–17 consulting to ERs for basketball-related injuries Jan 2001 to Dec 2006. (NEISS data).	9790 annual injuries for an estimated 325,465 US-wide. 21% ankle sprains (most common diagnosis).	7–11 year group accounted for 18.9% of all injuries. 12–17 year group accounted for 81.1%. Higher rate of ankle sprains among boys and finger sprains among girls.
5. Waterman et al. [12, 13].	100 random hospitals. All ankle sprain injuries presented. (NEISS data).	82,971 annual ankle sprains. 20.3% of total were basketball related. 41.1% sustained during sports were basketball related.	Estimated 3,140,132 US-wide ankle sprains. An age of 10 to 19 years old is associated with higher rates of ankle sprain.
6. Deitch et al. [9]	NBA database (702 players) and WNBA database (443 players). 6 full seasons.	Ankle sprain accounted for 21% injuries (most frequent injury) during game competition and/or practice.	WNBA players had higher injury rates than NBA players.
7. Drakos et al. [10]	NBA database from season 1988–1989 to 2004–2004. 1643 players with 12,594 injuries.	Ankle was first joint in injury frequency (14.7%). Ankle sprains were the most common injury (13.2%)	Ankle sprains were responsible for 8.8% games missed due to injury. 49.9% injuries took part during game play.
8. Waterman et al. [12, 13]	USMA cadets from 2005 to 2007.	614 ankle sprains during 10,511 person-years.	Basketball's incidence rate was 1.67 for men (highest among all sports) and 1.14 for women.
9. Borowski et al. [5]	100 US high schools during 2005–2006 and 2006–2007 academic years. 780,651 AEs.	1518 basketball related injuries. Injury Rate: 1.94/1000 AEs. (2.08 girls and 1.83 boys).	Girls' rate was significantly higher ($P < 0.01$). Time loss: less than a week: 51.3%. 1 to 3 weeks (30.0%). More than 3 weeks (8.1%)

Author/year	Participants	Results	Comments
10. Fong et al. [6]	1715 sports related injuries attending an ER department during 2005.	32.9% derived from basketball (most). 81.3% were ligament sprains. Mean age was 24.6 years.	—
11. Hammig et al. [11]	Data from the 1997–2004 National Ambulatory Medical Care Survey. 507,000 adults aged 20–59 with basketball related lesions.	Ankles sustained 18.3% injuries. Sprains were the most common injury (31.3%).	93% ankle sprains received radiological procedures. Females (0.8/1000) had a much lower rate of visits than males (5.7/1000).
12. Fernandez et al. [4]	100 US high schools in 2005. 2289/4350 lesions were low extremity.	Basketball was 3rd in injury rate (1.31 per 1000 athletic exposures).	Estimated 807,222 low extremity lesions per year nationally. Fractures were most common in ankles (41.8%). 8% boys and 7% girls needed surgery.
13. Nelson et al. [3]	100 US schools during the 2005–2006 academic year.	Basketball accounted for 23.8% of all ankle injuries (boys 12.2%, girls 11.6%).	Rebounding was the activity associated with a greatest number of ankle injuries.

AE: Athlete exposure: 1 athlete participating in 1 basketball competition or practice.

Table 1. A summary of the papers that was revised in this study.

are not universal, however. For example in Fong et al. [6] work, which studied 1715 sports injuries attending an emergency department during the year 2005, it is stated that 80.4% of those patients seeking healthcare after a sports-related injury were male. Furthermore, Ito et al. [7] group did not find significant differences in gender upon analysing foot and ankle injuries in male (24.8% of all basketball-related injuries sustained by 1219 players attending one sports medicine clinic between 1991 and 2011) and female population (23.8%).

Another interesting statement held by Ito et al. [7], and confirmed by Kin et al. [8] was that the ankle did not necessarily have to be the most frequently injured body site. Although the studies listed above did sustain that the ankle was the most injured site deriving from basketball practice, both these authors sustained that it was the knee followed by the ankle (in these studies, sprains were still the most frequent injury however). In addition, in Ito et al. (7) conclusions, female athletes were at a higher risk of suffering a knee injury (50.4% of all female injuries) than male athletes (41.7% of all male injuries). This fact is also sustained by Kin et al. [8], who observed 84 basketball-related injuries in 162 female athletes during three sports seasons and found out that 67.9% of the sustained injuries affected the knee.

Evangelos Pappas et al. [2] stated that not only gender, but also age was an independent risk factor for basketball injuries. In their study, Pappas et al. [2] analysed 325,465 annual visits from paediatric patients (aged 7–17) to US emergency departments (ED) from 2000 to 2006. They separated the patients into two groups of age (7–11-year-old and 12–17-year-old). Their results were overwhelming. The 7–11-year-old group accounted for 18.9% of all basketball-related injuries, and the 12–17-year-old group, for 81.1%. The two most frequent diagnoses were ankle

sprains and finger sprains. Once again, males held a higher proportion of the ankle sprains, with an incidence rate of 3.4 per 100,000 exposures (3.2 in girls) in the 7–11-year-old group, and an incidence rate of 26.5 per 100,000 exposures (23.2 in girls) in the 12–17-year-old group.

Deich et al. [9] and Drakos et al. [10] observed the incidence of lower extremity lesions in professional basketball (NBA and WNBA). Deich et al. [9] stated that gender-based differences in injury rates have in fact been reported in scholastic and collegiate basketball, and that the purpose of their study is to confirm whether these differences exist in professional basketball. After observing 702 male professional players and 443 female professional players for 6 competitive seasons (gathering a total of 70,420 male exposures and 22,980 female exposures), they concluded that WNBA (female) athletes had a significant higher incidence of lower extremity injuries (14.6 per 1000 exposures) when compared to NBA (male) athletes (11.6 per 1000 exposures, 95% confidence interval, 13.1–16.2). In both leagues, ankle sprain was the most common diagnosis when the injury took part during a game, but the knee was the most overall injured site. Upon reviewing Drakos et al. [10] results, however, we found again that the injured body site was influenced by the gender. In this study, only NBA players were observed, and ankle sprains were the most common injuries both during practice and game play. As we saw before in non-professional athletes, knee injuries increased alongside the number of female athletes in the study group, and male groups tend to suffer more ankle sprains both in professional and amateur basketball [10, 11]. Another conclusion in Drakos et al. [10] work that could be also seen in Kin et al. [8] is that there were no significant differences in overall injury rates when comparing injuries occurring during game play (49.9%) to those occurring out of it (50.1%).

4. Discussion

There is solid evidence in the literature to state that basketball is a sport that is strongly linked to ankle injuries, and above all, ankle sprains. The literature has pondered and stated so when observing population groups which differed among themselves in many aspects such as gender, age, occupation, level of play, moment of play (practice vs. competition). All of them have concluded in one way or another that the practice of basketball is a factor that is more closely linked to the risk of developing a sport-related ankle sprain, regardless of the population group they studied. The finding shows that ankle sprains are the most common injury is not surprising in light of the frequency of jumping and landing in a crowd of players.

As it has been sated, the different studies that we assessed focused on very different population groups each. We found this an advantage, since it allowed us to gain an overall vision of both professional athletes and general population, and so we were able to obtain different and interesting data.

In the majority of the previously listed studies, we could observe that the individuals belonged to similar age groups (school or high schools, professional athletes, USMA cadets, etc.). It is for this that it was difficult to state the role of age in the onset of ankle sprains or any injuries. There are however exceptions. In Pappas et al. [2] results, we could see that in paediatric basketball, there was a direct correlation between age and the risk of suffering an injury such as an ankle sprain. In addition, Brian et al. [12] found also a correlation between age and the incidence of ankle lesions, since in their experience, the risk increased considerably as age did.

Another determining aspect about the demographics of the population was gender. In overall terms, there could seem that there is a higher incidence of all kinds of injuries among the female gender [9, 13]. This fact would be altered whenever the joint in which the injury took place was being considered. Deich et al. [9] stated gender-based differences when they concluded that in professional basketball, the likelihood of suffering from an injury was higher in the female population in comparison with male athletes (14.6 per 1000 exposures vs. 11.6 per 1000 exposures).

Also, as stated earlier, female athletes tended to suffer a greater proportion of knee injuries in comparison with male athletes [11], who more frequently presented with ankle injuries. All in all, when reviewing the recent literature on basketball-related injuries, one can observe that the tendency to report a knee injury grows as the number of female athletes increased in the studied population. In the same manner, the proportion of ankle injuries seems to increase whenever the target population contains more male individuals [3].

The incidence rates of ankle injuries can vary greatly when considering one or other population groups. We observed that the level of play (professional or amateur) had a direct impact, and it could be found as high as 3.2 per 1000 athlete exposures [10] in professional NBA players, while in amateur practice the incidence rates were significantly lower. Moreover, the moment of play in which the injury took part also seemed to be crucial, since ankle sprains would be more likely to take place during a game, but knee injuries would seem more likely to occur during practice in Deitch et al. [9] opinion. This fact was however not common to other authors' experience, which pointed out that ankle sprains would be the prevalent injury, no matter the moment of play [10]. The difference between these two authors' findings could reside that in the group where ankle sprains were always the most common injury only male athletes were being studied, and as we have pointed out before, gender was found to be determining when it came to the body site the injury would affect [11].

Cumps et al. [1] studied senior players of different levels of play during a whole competitive season. One of the aspects he focused on was the moment inside the play in which an injury was most likely to occur. Since perhaps the main trigger for an ankle sprain would have been the act of landing on an opponent's foot after a jump, any tasks which involved jumping would conduct to a higher risk of injury (52.9% of total) in contrast to such others as cutting (11.8%), running to score (11.8%) or passing and receiving (5.9%). For the same reason, rebounding would be the task with a higher risk of landing wrong-footed and thus creating an injury.

Yet another interesting thing was to determine whether the onset of basketball-related injuries of any kind was more prompt to take place during practice or during competition. Even though one could be led to think that the higher intensity of play that athletes experienced during competition would lead to a higher risk of injuries of any kind, we found no solid evidence of this aspect. Even though in Borowski et al. [5] experience injury rates per 1000 exposures were far higher during competition (3.27) than during practice (1.40), it stood up to us that in the majority of the other papers, there was an approximated 50–50% distribution of injuries during these two periods [8–10]. That stood up to us, since one would think that the higher level of intensity during a match would make it easier to suffer an injury. One of the possible explanations for this aspect would be that athletes tend to dedicate more time to practice than to competition.

When it comes to the medical management of basketball-related ankle sprains, the first thing that stood up to us was that not many authors had considered this aspect. For those who had,

it is frequent to notice that those individuals who suffered from ankle sprains or any other injuries did not seek medical care [7]. In Hammig et al. [11] experience however, the majority of those individuals who did consult to a health centre received X-rays. Regarding the outcome of the athlete after suffering an injury, the vast majority of authors agree that the recovery on long term is complete and the need for surgery was reasonably low [4]. There seems to be a higher variety of opinion concerning the mean absence of play after the injury took part, but the general tendency seems to be less than 3 weeks [3, 5].

We found a great variability concerning the likelihood of suffering from an injury in a single exposure. For example, Nelson et al. [3] stated that the risk of suffering an injury in a single exposure (risk of 5.23 per 10,000 exposures) was remarkably lower than in Fernandez et al. [4] experience (1.31/1000 rate for the male group and 1.36/1000 for the female group), even though both studies focused on similar groups of population.

5. Conclusions

To sum up with, many authors have dissected in the last 10 years the subject of ankle injuries onset during basketball practice. From their acknowledgements, one can observe that ankle injuries have a high tendency to take place during the practice of basketball, and sprains are the most common. There is some variability in the way and frequency that these injuries take place depending on the gender, age and level of play, however.

When performing a review of the recent literature, one must be careful at the time to interpret the results and conclusions, as the designs and variables of every study are very different from one another. It is easy to be led to misunderstanding, since every article states its own hypothesis and targets. Our goal as stated before was to review the current literature about the occurrence of ankle sprains during basketball practice, and to analyse the latest additions that have been made to the subject.

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