

**WORK PROPOSALS FOR INJURIES REDUCTION IN LOWER LIMBS IN BASKETBALL.
SYSTEMATIC REVIEW**

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ABSTRACT

Due to the importance of the injuries in basketball, the aim of this systematic review was to find out work proposals that can reduce lower limbs injuries rate in basketball. For that, articles from Pubmed and Google Scholar databases were reviewed. The results showed that different training proposals can reduce the injury index in the knee (patellar tendon and ACL) and the ankle, being these protocols effective in different basketball categories. In addition, the effectiveness of warm-up programs designed for other sports (FIFA 11+) in this modality was shown. However, there was no evidence on which of the different proposals was more effective in preventing lower body injuries. Therefore, it would be interesting for future studies to compare different protocols under the same circumstances, in order to find which is the most appropriate.



KEY WORDS

team sports, ankle, knee, patellar tendon, acl, categories.



INTRODUCTION

The sport of basketball has grown exponentially in recent years and today, it is one of the most played sports in the world, with approximately 450 million players (1). Team sport is characterised by the fact that it is an activity in which there is constant contact between players (2). As a result, many different and varied situations occur, such as accelerations and decelerations, jumps, lateral displacements or changes of direction (2).

The predominant body characteristics of basketball players are large statures and heavy bodies. For this reason, basketball is a physical activity in which a large number of injuries occur, both acute and repetitive (2). Most of the injuries in this sport occur in the lower extremities (63.7%), with 21.9% being ankle injuries and 17.8% knee injuries (2). In the study by González et al. (3), it is clearly shown that the lower limb is the most frequently injured (56.25%). Of the ligament sprains occurring in their study, it is observed that the external ankle ligament sprain is the most frequent (45.45%). On the other hand, McKay et al. (4), add to this information that the most common cause of ankle sprains is due to landings, which corresponds to the time in which the player is in the air after a game action and then contact with the ground occurs. In addition, it appears that players who have had previous ankle injuries have a higher rate of re-injury, as do players who wear inner tubes in their shoes (4).

On the other hand, Sánchez and Gómez (5) carried out an interesting literature review in which they compared the results of 28 studies on injuries in this modality. The conclusions reinforce the data presented above, as they show that ankle sprains are the most common injury, with knee sprains in second place. The "Pivots", due to their body weight and large size, are the players who are most injured and normally, these injuries occur more in competition than in training. Finally, the same study (5) highlights that girls are more frequently injured than boys. However, some controversy has been demonstrated with regard to the latter. Specifically, studies such as that of Zuckerman et al. (6) show opposite results, since in the American university leagues (NCAA), 2308 men and 1631 women are injured in the same period of time, two seasons.

In addition to these factors, Khan et al. (7) show in their work that another of the most common injuries in this modality are those known as stress or overload injuries. They analysed 75 NBA players over 10 years, suffering 76 bone stress injuries and missing a total of 1769 games. Most of them are in the foot (55.5%) and ankle (21.1%) and occur mostly during the regular season (82.9%). This type of injury also occurs in training categories, as in the study by Leppänen et al. (8), 207 Finnish youth players were analysed, suffering 97 stress injuries.

Finally, it has been observed that the implementation of an appropriate training plan can reduce the number of injuries occurring in basketball players (9,10). Prophylactic programmes significantly reduce the incidence of general lower extremity injuries and ankle sprains (9). On the other hand, Herman et al. (10) show in their work that neuromuscular warm-up reduces the incidence of lower extremity injuries. Therefore, it can be seen that different training plans can reduce the incidence of injury.

Therefore, the aim of this study is to find out about work proposals that can reduce the rate of lower limb injuries in basketball practice.



MATERIALS Y METHODS

Systematic review of work proposals to reduce lower body injuries in basketball.

Selection of studies and search strategy

The articles in this systematic review were identified through an automated database search of the Pubmed and Google Scholar systems. The articles were reviewed during the first two weeks of March 2021.

As for the descriptors or search keywords that were used were the following: "basketball and injuries", which were also used in English: "basketball and injuries".

The following methods were used for the literature search:

- Analysis of the different documents, which made it possible to obtain the most important information from them and to understand their different constituent elements.
- Synthesis of the information, which allowed a more orderly work and the subsequent comparison of the data presented.

Inclusion and exclusion criteria

Initially, the search was carried out in both Spanish and English. We should bear in mind that the "Google Scholar" search engine allows the search to be carried out in Spanish, so initially it was carried out as follows: "Baloncesto and Lesiones". Subsequently, the same procedure was carried out, but in English, i.e. "Basketball and injuries". As for the "Pubmed" search engine, the search must be carried out in English, so "Basketball and injuries" was used.

As general criteria for both search engines, a search for articles between the years 2000 and 2021 was determined, mainly in order to eliminate articles that were outside this criterion and therefore, to make a more specific and updated search. The following restrictions were taken into account when searching for articles (Table 1):

Table 1. Selection criteria: inclusion and exclusion.

INCLUSION CRITERIA	EXCLUSION CRITERIA
Articles published between 2000- 2021	Articles published outside the established dates
Articles written in Spanish and English	Non-scientific articles
Articles whose title corresponds to the subject matter commented on	Articles whose subject and abstract do not correspond to the commented theme

RESULTS

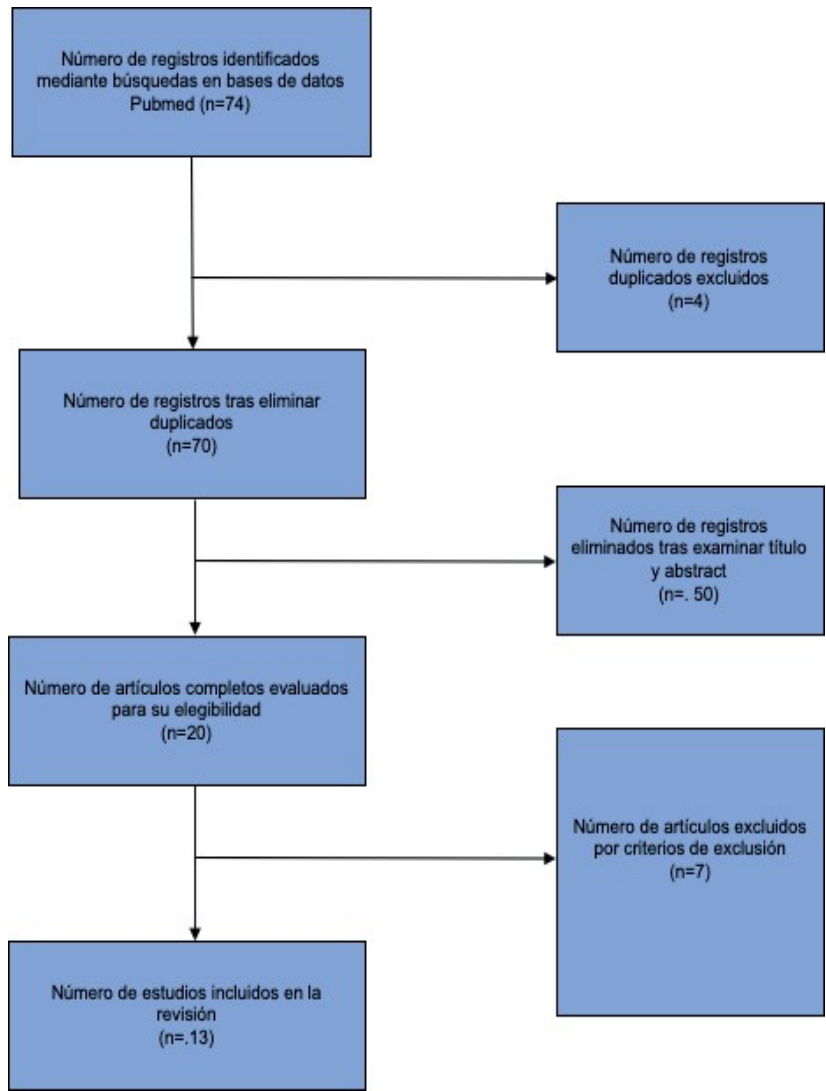


Figure 1 shows the flow chart followed to obtain the results of the studies.

Figure 1. Flow chart of the item selection process.

Source: Own elaboration

Table 2 shows the studies that make up the results of this systematic review. Specifically, the study authors, participants, injured area worked on in the study, study design and the results obtained are shown.

Table 2. Studies found that deal with injury reduction methods.

AUTHOR/S (YEAR)	PARTICIPANTS	INJURED AREA	INTERVENTION	RESULTS
Eils et al., (2010)	N= 198 Age:14-43 years Professional players in German basketball leagues.	Ankle	Intervention group (N=96) performed 6 exercises. Control group (N=102) who performed normal training routines.	There were 21 ankle sprains in the control group and 7 in the intervention group. The risk of an ankle sprain was reduced by 35.5% With proprioceptive training. Significant improvements in joint position and single limb posture were achieved in the intervention group.
Gual et al., (2016)	N= 26 Age:18-35 years First National of Catalonia	Patellar tendon	Intervention group (N=13) performed 4 sets of squats of 8 repetitions once a week, using inertial resistance (Yo-Yo test). Control group (N=13) performed normal	The results in both Squat tests were better in the intervention group. There was an improvement in muscle power of the lower limbs. No discomfort was caused in the patellar tendon with this approach.
Longo et al., (2012)	N= 121 Age:12-19 years Elite players	Knee and Ankle	The intervention group (N= 80) undertook the programme Fifa 11. Control group (N=41) performed pre-established warm-ups by the team	The study showed that the Fifa 11+ programme prevents lower body injuries. However, no significant differences were found between knee and ankle injuries.
McGuine y Keene (2006)	N= 765 Age:15-18 years Players in secondary education	Ankle	Intervention group (N=373) undertook balance training Control group (N=392) performed standard exercises.	There were 23 ankle sprains in the intervention group and 39 in the control group. Balance training reduced ankle sprains by 38%. The balance training allowed players to miss fewer days of competition than those who did not.
Moiler et al., (2006)	N= 125 Age:13-23 years Basketball players amateur	Ankle	Intervention group (N=64) used repositioning bandaging (FRT). Control group (N=61) could choose any other type of protection than FRT.	There were 2 ankle injuries in the intervention group, while there were 9 in the control group. All players who sustained these injuries had previously sustained other ankle injuries. FRT taping reduced the likelihood of an ankle sprain.

Myer et al., (2009)	N=1 Teenage girl	Anterior cruciate ligament	One player, who tore her ACL at the age of 14, was observed and the effects of the lack of injury prevention work were noted.	His quadriceps strength and hip abduction were reduced. He re-ruptured his ACL.
Otsuki et al., (2014)	N= 71 Girls in secondary education	Anterior cruciate ligament	The experimental group performed a programme of squats, agility and jumps. The control group continued with their training.	Peak strength increased in the control group. Knee flexion range was reduced in the control group (from 59.52 to 53.15).
Owoeve et al., (2018)	N= 920 Age:11-18 years School basketball in Alberta, Canada	Ankle	494 players undertook the neuromuscular warm-up, which consisted of aerobic, strength, agility and balance exercises. 426 players performed warm-up warm-up.	The chance of suffering an ankle sprain was reduced by 32%. Neuromuscular training protected ankle sprains. ankle sprain.
Pearson et al., (2020)	N = 16 Men	Patellar tendon	Intervention group (N=8) performed short duration knee isometrics (24 sets of 10 seconds). Control group performed long duration isometric loading (6 sets of 40 seconds).	Patellar tendon pain was reduced in both groups. Improved quadriceps function. Both methods of contraction were found to be equally effective.
Rio et al., (2017)	N = 20 Age: older than 16 years	Patellar tendon	One group performed isometric quadriceps extension, while the other group performed isotonic leg extension.	Isometric contractions provided greater benefits. P-Visa values improved at the end of 4 weeks.
Riva et al., (2016)	N= 55 Age:18-45 years First Italian National Basketball League.	Ankle	The following exercises were carried out over three biennia Classic proprioceptive exercises with rocking chairs and unstable surfaces.	Proprioceptive control was improved by 72.2% from the first to the third biennium. The number of ankle sprains in matches was reduced by 76.8% and 81% in training. The third biennium corresponded to the most efficient preventive strategy.
Slauterbeck et al., (2019)	N= 802 Age:Adolescents Categories "Freshman, Junior varsity and Varsity".	Knee and Ankle	The intervention group (N= 415) performed the Fifa 11+ programme. The control group (N=387) carried out the warm-ups they had done previously	The injury rate was 1.35 in the intervention group and 1.27 in the control group. The control group had higher proportion of knee and ankle injuries, although the results were similar. Overall, this study did not demonstrate that Fifa 11+ reduced lower body injuries.

Sugimoto et al., (2017)	N= 241 Age: Secondary school students	Anterior cruciate ligament	<p>Experimental group (N=125) underwent neuromuscular training to reduce traumatic knee injuries through trunk stabilisation and knee strengthening.</p> <p>Control group (N=116) who performed a work programme with elastic bands.</p>	<p>Athletes complied correctly with the protocol, while coaches did not.</p> <p>Correct compliance in other studies has led to a 73% lower incidence of ACL injury than non-compliance.</p> <p>In this study, the pre-established requirements were not met (average rate of 1.3 +- 1.1 per week in pre-season and 1.2+- 0.5 times in season).</p>
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DISCUSSION

It has been observed that the performance of different training plans has effects on the prevention of knee injuries in basketball players (11,12,13). Specifically, Rio et al. (11) show that training composed of isometric contractions of the quadriceps provides greater benefits than isotonic contractions in relieving pain in the patellar tendon of adolescent basketball players. Pearson et al. (13) report that isometric knee work, both short and long duration, produces beneficial effects on quadriceps function and also reduces patellar tendon pain. However, other authors state that concentric and eccentric squat work improves lower body muscle power and does not produce muscle power of the lower body and does not cause discomfort to the patellar tendon itself (12).

With regard to ACL injury, numerous authors have investigated different protocols that can reduce the injury rate (14,15,16). Work consisting of squats, agility and jumps increases quadriceps strength values and improves the flexion range of the knee itself in adolescent girls (16). For their part, Sugimoto et al. (14) state that neuromuscular training comprising trunk stabilisation and knee strengthening exercises are more effective than work with elastic bands. On the other hand, in the same study they comment that one of the fundamental aspects to reduce the probability of ACL injury is that the proposed training protocols are followed (14). On the other hand, Myer et al. (15) state that not performing strengthening and rehabilitation exercises after an ACL tear significantly reduces strength in the quadriceps and hip abduction, thus increasing the possibility of suffering another ACL tear.

With respect to the ankle, it has been noted that there are numerous training plans at the secondary school level that aid in the prevention of ankle injuries, especially ankle sprains (17,18). Neuromuscular warm-up consisting of aerobic, strength, agility and balance exercises reduce the likelihood of ankle sprains and have been shown to be effective (17). McGuine and Keene (18) add that balance work reduces the number of ankle sprains in adolescents and also reduces the severity of the injury if it occurs, allowing players to reduce the time it takes to return to competition.

Research has also been conducted regarding training methods that reduce ankle injuries at the professional level (19,20,21). In the comparison of different types of training, it has been shown that repetition work on electronic platforms, dynamic tasks and visualisation of the player's own results are effective strategies in the prevention of ankle sprains, improving proprioceptive control and reducing the number of sprains produced, both in training and in matches (19). On the other hand, the use of proprioceptive training based on monopodal exercises and foot rotation exercises with rubber bands decreases the risk of suffering an ankle sprain (20). Finally, Moiler et al. (21) show that the use of FRT repositioning taping reduces the likelihood of a player suffering an ankle sprain (20). of a player suffering an ankle sprain, although players who have suffered an ankle injury before are more likely to re-injure their ankle.

Finally, different studies show the applicability of programmes that have been used in other sports, with reference to the Fifa 11+ programme used in football (22,23). The use of the Fifa 11+ warm-up programme reduces the risk of injury in the lower body of professional basketball players, although without notable differences with respect to the ankle and knee compared to pre-established warm-ups (22). In contrast, Slauterbeck et al. (23) show that Fifa 11+ does not decrease the number of knee and ankle injuries compared to other preset warm-ups.

In conclusion, it seems that different work programmes aimed at reducing the number of lower body injuries in basketball sport are very useful for achieving this objective, provided they are carried out correctly, thus avoiding harm to the athlete. However, there is no evidence as to which protocols are most effective in avoiding any of the injuries mentioned above. Therefore, further research is needed on this subject, so an interesting line of study would be to compare specific training programmes, for a given time between them and with samples of equivalent subjects, in order to see which is more effective under the same circumstances.

 **LIMITATIONS**

With regard to the limitations of this work, it should be noted that basketball is one of the most popular sports in the world and, unfortunately, one in which numerous injuries occur at all levels. If we reflect on the results obtained in this review, we realise that there is no clear pattern in terms of the protocols that are most effective in preventing any of the aforementioned injuries. We see that the population groups or the duration of the studies are different from each other, so it is difficult to compare which method is more effective.

On the other hand, many of the studies have been carried out for several sports, so that sometimes some data that could be interesting were not present or were difficult to find.

Last but not least, some of the studies did not have a large sample size, even down to one subject.

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