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ORIGINAL

INJURY INCIDENCE RATE AMONG AMATEUR BASKETBALL PLAYERS

INCIDENCIA DE LESIONES DEPORTIVAS EN JUGADORES Y JUGADORAS DE BALONCESTO AMATEUR

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RESUMEN

El objetivo del presente estudio es conocer las tasas de incidencia lesional en entrenamiento y competición, tipos de lesión y tiempo de baja deportiva en jugadores/as de baloncesto *amateur* de las categorías comprendidas entre Benjamín y Senior. Se realizó un seguimiento de las lesiones sufridas en 25 equipos (289 jugadores/as de entre 8-34 años) adscritos a los juegos municipales y federados de la Comunidad de Madrid. Se contabilizaron 48 lesiones durante 10.961 Exposiciones de los jugadores/as a la actividad (AEs). Un 16,61% se lesionó durante este periodo. Las tasas de incidencia fueron 1,77-11,8/1.000 AEs para el sexo femenino y 3,63-9,3/1.000 AEs para el masculino en práctica y competición respectivamente. El esguince de ligamento fue el tipo de lesión más común (45,83%) y el esguince de tobillo el diagnóstico lesional más frecuente para la muestra total (20,83%). El mecanismo de lesión y tiempo de baja difirió entre sexos.

PALABRAS CLAVE: deporte, epidemiología, incidencia, lesiones, baloncesto, jugadores de baloncesto.

ABSTRACT

The purpose of the present study was to determine the injury rate both in practice and competition, injury diagnoses and time loss in amateur basketball players within Benjamin and Senior categories. Injuries suffered in 25 teams (289 basketball players aged 8-34) were followed up as long as they were affiliated with municipal and federation competitions in Madrid (Spain). 48 injuries were sustained during 10961 athletes' exposures (AEs). 16.61% of basketball players got injured during this time. Injury rate was 1.77-11.8 per 1000 AEs for girls and 3.63-9.3 per 1000 AEs for boys in practice and competition respectively. Ligament sprains became the most common injury diagnoses (45.83%) and ankle sprain the most common injury (20.83%). As for mechanisms that resulted in injury and time loss there were wide differences according to gender.

KEY WORDS: sport, epidemiology, incidence, injuries, basketball, basketball players.

INTRODUCTION

Nowadays, there is an increasing interest about sport practices in the United States (USA) and Europe, more precisely. This explains the increasing number of basketball players that has led basketball to be considered as a fundamental sport. This fact is inevitably linked to an increase in the number of injuries (1) and has raised a bigger interest within the scientific community, especially if we consider the last decade (1-4). In the USA, emergency room (ER) visits related to schooled children and young adults are the most frequent, accounting for 2.6-4.3 million per year (5,6). Considering these ages, basketball practice is the biggest sport cause of ER visits within men and the second one within women, both for soft-moderate injuries (6) and for severe injuries (7).

Epidemiology studies about basketball injuries represent an entity widely studied. While several studies are focused on one single gender elite players (8,9), others are focused on sex (1,10,11) or elite competition levels comparisons (8,9,12). Finally, some studies are focused on injuries epidemiology considering *amateur* basketball or school sports' practices that include basketball. In this variable group, we can find teenage groups (7,13-17), kids (6), adults (18) or different age ranges combination studies (2,3,19). Only a few of them relate sport injuries to training habits (16) or player's game positions (13,15,18).

The injury rate considering *amateur* basketball has been estimated between 1.83 and 7.9 for teenage players per 1000 athletes' exposures (AEs) (13). Most of the studies (7-10,12-14,17) confirm that injury rates decrease over a 50%,

considering both genders during practice sessions in comparison to competition moments. This applies to *amateur* basketball (7,13,14,17) as well as to elite and semiprofessional basketball (8-10,12).

There are few studies (2,3,5,19) whose samples include different age ranges. Consequently, most results are related to populations with very specific characteristics. On the other side, there are hardly any studies about the relation between specific game positions on the court and injury types risk considering *amateur* basketball players, due to the fact that they were developed in a hospital environment (2,6). Those that consider this factor do not come to conclusive results because of samples heterogeneity, including different age and game level ranges (13,16).

To this end, the purpose of the current study is to know injury incidence rate in practice and competition, taking gender and different game categories into consideration. Additionally, this study aims to describe high injury-prone injuries and game positions and which body segments are the most affected by them, as well as their consequences speaking on “out of sport practice” terms.

MATERIAL AND METHODS

Subjects

A descriptive/longitudinal prospective study was carried out from October to December 2013. Participant selection was done using a sequential non-probabilistic method. The result was a sample including two *amateur* basketball clubs, that is, a population of 25 basketball teams. The included ones were between 1st-2nd grade teams and senior teams. Those teams were affiliated to Madrid Basketball Association and they competed in local and association leagues. That was a mandatory criterion in order to be included in the study population (See Table 1). All of them were in the regular season phase and had a similar training and competition schedule.

Before the clubs were included in the study, club managers were contacted. They authorized the study development and introduced the head researcher to the team’s coaches. The coaches were informed about the research development and the informed consent forms were given to each of them. Those teams out of the selection range (3rd-4th grade teams and senior teams) were excluded. Additionally, those teams not participating in local or association leagues were excluded because of their differences in playing style. Finally, those teams whose coaches or players did not agree with study terms about procedures in data collection explained by the head researcher were excluded as well.

Table 1. Ages per level (Up to date 12-31-2013)

Beginner (1st & 2nd Year)	8-9 years	3 teams	37 players
Primary (1st & 2nd Year)	10-11 years	5 teams	70 players
Middle (1st & 2nd Year)	12-13 years	6 teams	60 players
Cadet (1st & 2nd Year)	14-15 years	4 teams	46 players
Junior (1st & 2nd Year)	16-17 years	3 teams	32 players
Senior	>17 years	4 teams	44 players
	TOTAL:	25 teams	289 players

Teams that met inclusion and exclusion criteria and whose head coach delivered their informed consent were admitted as part of the sample. Final sample included 208 male players (72%) with an 8-34 years age range and 81 female players (28%) with an 8-23 years age range. Mean age and Standard Deviation (SD) was 13.71 (4.72) years for males; and 13.53 (3.2) years for females. Table 2 shows AEs, Time of Exposure (TE) per week among players' categories, as well as their total during the period the study was carried out.

Collecting Data

Data were collected in a prospective way. Weekly, the main researcher visited teams' facilities and talked to the head coaches or phoned them in order to register newly happened injuries. To avoid biases in the study results, injuries related to practice or competing activities were the only ones registered. An injury was considered if it was responsible for keeping a player apart of the activity for at least one day. If an injury was not diagnosed by a physician, a physical therapist or a health professional it could not be considered for this study.

Previously to start registering injuries, every club provided the head researcher with some information related to every player included in the sample: Weekly Exposition Time (hours) to activity (both in practice and competition) and Weekly AEs (both in practice and competition). Additionally, clubs provided their training schedule and the number of players belonging with the first or second year for every category.

Injury variables registered

Monthly, reports for every team regarding injuries were completed. These reports were designed considering the following variables:

1. Gender, Age, Competition level and Club.
2. Body area affected by injury: Head/Face/Neck Complex, Upper limb, Lower limb, Trunk, Other.
3. Body part affected by injury: head, cervical spine, shoulder, elbow, wrist, hand, finger, knee, ankle...

4. Type of injury: ligament sprains, dislocations/fractures, bruises-concussions, muscle-tendon injuries (tendinitis, fasciitis, fiber tears, muscle distensions), wounds-lacerations, hernias, other injuries.
5. Injury diagnosis: Medical diagnosis.
6. Injury mechanism: collision with another player, sports material contact, jumping-landing, falls into the ground, sprinting, direction changes-dribbling, and stress or overuse injuries.
7. Sport context: Practice, Competition.
8. Player position on the court: Point Guard, Shooting Guard, Shooting Forward, Power Forward, Center.
9. Out of the practice time: 1-7 days, 8-21 days, >21 days (Severe injuries).

Statistical Analysis

The statistical analyses were done using *Statistical Package for the Social Sciences software (SPSS®)* (version 22.0). After testing variables normal distribution, central tendency and dispersion indexes for the quantitative variables of the sample, as arithmetic mean and Standard Deviation, were computed. Referring to qualitative variables, absolute and relative frequencies were obtained for the sample description as well as for injuries description (considering all their dimensions). The injury incidence rate linked to every player was computed as injuries suffered per 1000 AEs and per 1000 hours of exposure (TE). Moreover, male to female Relative Risk (RR) for competition and training scenarios was calculated and a 95% Confident Interval (CI) value was used for that computing.

RESULTS

Injury Incidence Rate data

During the regular season, 48 injuries in 10961 AEs (7548 related to boys and 3413 related to girls) were registered. These AEs accounted for 13645.15 activity hours (both practice and competition time) and led to 4.37 injuries per 1000 AEs for the total sample. Additionally, 16.61% of the players got injured during the follow-up period.

Considering all injuries, 27 (56.2%) were sustained in practice and 21 (43.7%) were sustained in competition. That accounted for an injury rate of 3.03 and 10 per 1000 AEs for the whole sample in practice and competition respectively. On the other side, 9 over 48 injuries were severe and they accounted for 0.56 and 1.9 per 1000 AEs for practice and competition respectively.

Injury Incidence Rate data: differences by gender and age

12 injuries were sustained among female players, 7 during practice (58.3%) and 5 during competition (41.7%). Those resulted in an injury rate of 1.77 and 11.8 injuries per 1000 AEs, respectively for practice and competition (See Table 3) On the other side, male players accounted for 36 injuries, 22 (61.1%) related to practice and 14 (38.9%) related to competition. Those resulted in an injury incidence rate of 3.63 and 9.3 injuries per 1000 AEs, respectively for practice and competition.

Relative Risk was significantly greater in competition than in practice; regarding female (RR, 6.67; 95% CI: 2.11-21.02) and male players (RR, 2.56; 95% IC: 1.31-5.00). Although injury rates data were greater considering male players, this difference was not statistically significant on sex RR (RR, 0.73; 95% IC: 0.38-1.42).

Table 2. Sample characteristics and Training exposition. Mean (SD).

	Beginner		Primary		Middle		Cadet		Junior		Senior	
	Male (n=33)	Female (n=4)	Male (n=48)	Female (n=22)	Male (n=39)	Female (n=21)	Male (n=30)	Female (n=16)	Male (n=23)	Female (n=9)	Varón (n=35)	Mujer (n=9)
Age, years	8.27 (0.45)	8.5 (0.50)	10.52 (0.50)	10.73 (0.45)	12.44 (0.50)	12.52 (0.50)	14.4 (0.49)	14.63 (0.48)	16.43 (0.50)	16.33 (0.47)	22.26 (3.04)	20.22 (1.69)
AEs Total/ Week	3 (0)	3 (0)	3 (0)	3 (0)	3.72 (0.45)	4 (0)	3.6 (0.49)	4 (0)	3.57 (0.50)	4 (0)	2.71 (0.45)	4 (0)
AEs Practice/Week	2 (0)	2 (0)	2 (0)	2 (0)	2.72 (0.45)	3 (0)	2.6 (0.49)	3 (0)	2.57 (0.50)	3 (0)	1.71 (0.45)	3 (0)
AEs Competition/ Week	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)
AEs Total up to 12/31/13	1056	128	1536	704	1651	945	1224	736	951	459	1130	441
TE/ Week, hours	3.36 (0.22)	3.37 (0.21)	3.24 (0.21)	3.39 (0.21)	4.22 (0.45)	5.02 (0.5)	4.37 (0.16)	5.14 (0.19)	4.28 (0.25)	4.5 (0)	3.69 (1.26)	6 (0)
TE Practice/ Week, hours	2.36 (0.22)	2.37 (0.21)	2.24 (0.21)	2.39 (0.21)	2.72 (0.45)	3.52 (0.5)	2.87 (0.16)	3.64 (0.19)	2.78 (0.25)	3 (0)	2.19 (1.26)	4.5 (0)
TE Competition/ Week, hours	1 (0)	1 (0)	1 (0)	1 (0)	1.5 (0)	1.5 (0)	1.5 (0)	1.5 (0)	1.5 (0)	1.5 (0)	1.5 (0)	1.5 (0)
TE Total up to 12/31/13	1212	147.5	2160.5	814.5	1787.5	1,151	1433	938.25	1186	435	1718.4	661.5

Table 3. Injury Incidence Rate among genders.

INJURIES		Injury Rate/1000 hours				
		Players AEs	Injury Rate/ 1000 AEs	Players TE (hours)	Injury Rate/1000 hours	
Total	n=48	10961	4.37	13645.15	3.52	
Practice	n=27	8866	3.03	10348.65	2.61	3.29 (1.86-3.96)
Competition	n=21	2095	10	3296.5	6.37	
Female						
Players	n=12	3413	3.5	4147.75	2.89	
Practice	n=5	2821	1.77	3337.75	1.5	6.67 (2.11-21.02)
Competition	n=7	592	11.8	810	8.64	
Male Players	n=36	7548	4.76	9497.4	3.79	
Practice	n=22	6045	3.63	7010.9	3.14	2.56 (1.31-5.00)
Competition	n=14	1503	9.3	2486.5	5.63	

Regarding age and injured players, the mean value was 15.12 years old and SD was 3.53 years. Gender differences were minimal: female values were 14.75 (2.92) years and male values were 15.25 (3.71) years. A greater injuries frequency was observed at 16 and 22 years and a lower incidence frequency at 10 and 18-21 years. These results were common for both genders. Table 4 presents injury incidence rates per 1000 AEs for the different categories referring to practice/competition circumstances.

Table 4. Injuries Incidence Rate per categories

Level	Injuries	Incidence Rate per 1,000 AEs	Level	Injuries	Incidence Rate per 1,000 AEs
Beginners	n=0	0	Cadet	n=12	6.12
Male	n=0	0	Male	n=7	5.72
Practice	n=0	0	Práctica	n=5	4.93
Competición	n=0	0	Competition	n=2	9.52
Female	n=0	0	Female	n=5	6.79
Practice	n=0	0	Practice	n=2	3.21
Competition	n=0	0	Competition	n=3	26.79
Primary	n=7	3.125	Junior	n=13	9.22
Male	n=4	2.6	Male	n=10	10.52
Practice	n=3	2.4	Practice	n=6	7.82
Competition	n=1	3.47	Competition	n=4	21.74
Female	n=3	4.26	Female	n=3	6.54
Practice	n=0	0	Practice	n=3	8.55
Competition	n=3	22.72	Competition	n=0	0
Middle	n=9	3.47	Senior	n=7	4.46
Male	n=9	5.45	Male	n=6	5.31
Practice	n=6	4.35	Práctica	n=4	5.13
Competition	n=3	10.99	Competition	n=2	5.71
Female	n=0	0	Female	n=1	2.27
Practice	n=0	0	Practice	n=1	2.85
Competition	n=0	0	Competition	n=0	0

Regarding gender differences and severe injuries, if we consider female players, it is remarkable that those injuries only occurred during a competition context and their injury incidence rate was 3.36 per 1000 AEs. Mean Age related to those injuries was 13 (2) years. However, male results showed an injury rate of 0.82 and 1.33 per 1000 AEs (results for practice and competition, respectively) and the mean age related to those injuries was 16.57 (3.54) years.

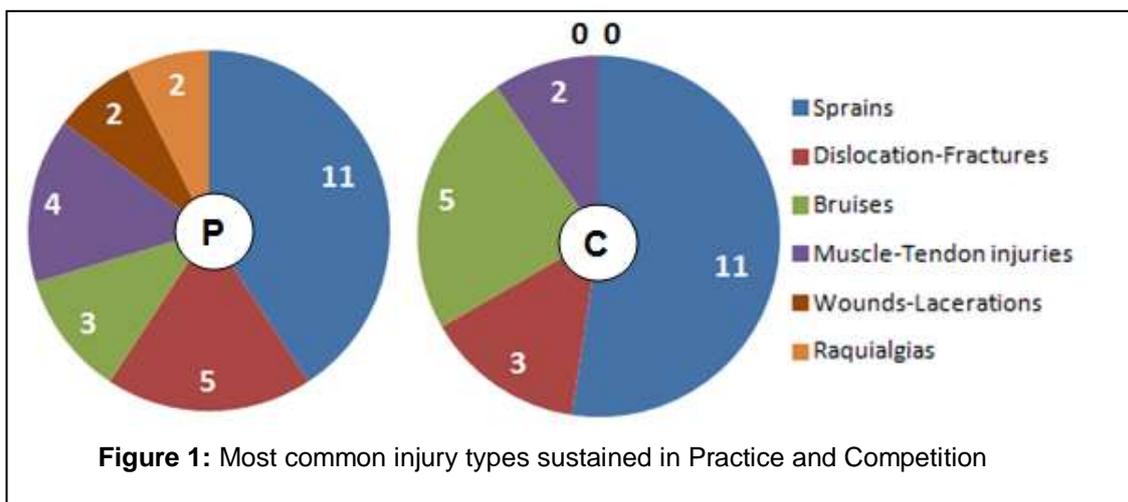
Injuries events

Considering the whole sample, 48 injuries were registered: The most frequently injured body area was lower limb (56.25%), followed by upper limb (29.17%) and head/face/neck/trunk complex (14.58%). More precisely, the most frequently injured body part was the knee (22.92%), followed by the foot/ankle (22.92) and the fingers (16.67%). After those, legs (10.92%), head-cervical spine-orofacial complex (8.33%), forearm-

wrist (8.33%), thoracic-lumbar spines (6.25%) and shoulder (4.17) occupied the last positions.

The most common injury types were ligament sprains (45.83%), bruises (16.67%), dislocations/fractures (16.67%), muscle-tendon injuries (12.5%), rachialgiae (4.17%) and wounds-lacerations (4.17%). Figure 1 displays the most common injuries suffered and the differences between practice and competition moments.

Considering ligament sprain injuries, the most frequent one was sustained by external lateral ligament of the ankle (45.45%), becoming the most frequent injury for the whole sample as well (20.83%). This injury incidence rate was 0.56 per 1000 AEs in practice scenarios and 2.39 per 1000 AEs in competition scenarios.



All the injuries registered during the research period totaled 115.43 weeks of sport practice absence: 43.75% affected players during 8 to 21 days interval, 35.41% affected players during 1-7 days interval and 20.83% affected players during 21 or more days, and these ones were considered as severe injuries.

Most common injury mechanisms are presented in Figure 2. They are showed separately by practice or competition periods. Players falling into the ground represented a 22.92% of the total injuries (particularly during competition). It was followed closely by players' contacts or collisions (16.67%) and contacts with sports elements (14.58%).

Relating the most common injuries and the most common injury mechanisms, it was observed that 27.27% of the ligament sprains were caused by landing on the field or over another player's foot after jumping actions and those were related to ankle's ligaments complex. 22.72% of the injuries were caused by sports material contact -more specifically the ball contact- affecting fingers essentially. Finally, 18.18% of the injuries

were caused by direction changes/dribbling and they were related to knee joint injuries.

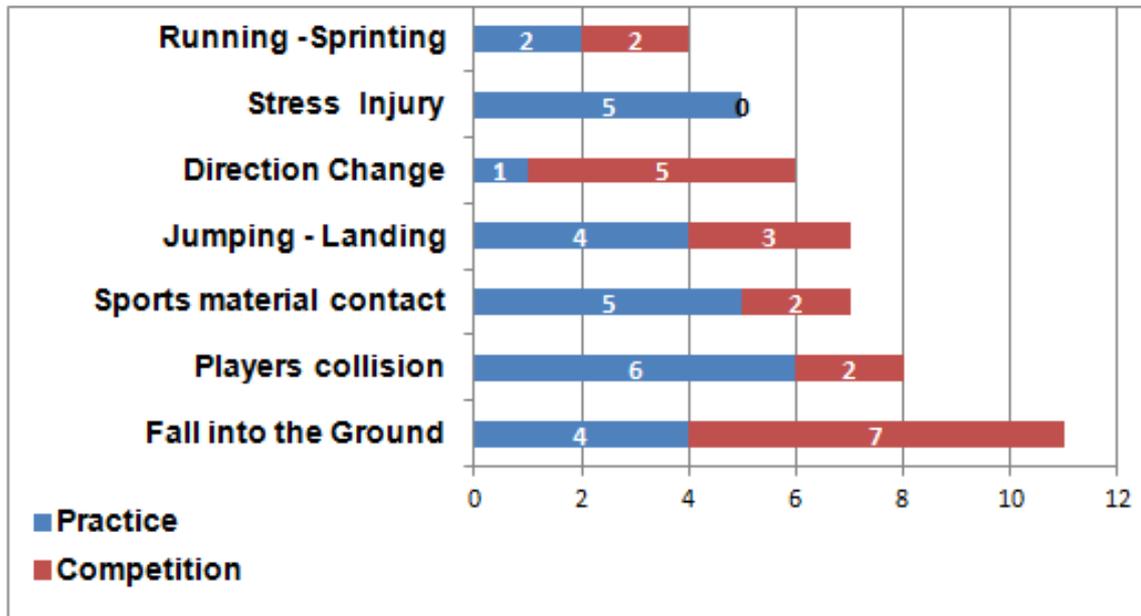


Figure 2: Most common injury mechanisms sustained in Practice or Competition (Whole Sample).

Regarding players positions, the most injury-prone positions were those of Shooting Forwards and Centers (27.08% for each position). After those, Shooting Guards (25%) and Power Forwards-Point Guards (10.41% each) registered the lowest injury rates.

Crossing positions with injuries and injury mechanisms, it was observed that the most frequent injury related to Shooting Guards and Shooting Forwards were ligament sprain injuries (32%), affecting both fingers and ankles, and bruises-concussions (24%). The most common injury mechanisms for those players were falls into the ground (32%) and ball contacts (20%). On the other side, ligament sprain injuries were also the most frequent injuries for Power Forwards and Centers (61.11%). However, regarding these positions, knees became the most damaged body area (54% of the total ligament sprains affected this body part). The most common causes of this particular injury were other players contacts-collisions, direction changes-dribbling and jumping-landing (22.22% for each of them).

Finally, ligament sprain injuries were also the most common injuries for Point Guards (60%). Two thirds of them were ankle's ligaments related injuries and they were caused after jumping-landing events.

Gender differences (See Figure 3): Regarding females, the body area registering the majority of injuries was the knee (41.67%). Considering those, 50% were related to sudden movements or abrupt direction changes. Those injuries totaled 0.35 injuries per 1000 AEs of practice and

6.76 injuries per 1000 AEs of competition. These results reflect that knee joint related injuries were, approximately, 20 times more likely to happen during competition than during practice moments in female *amateur* basketball players.

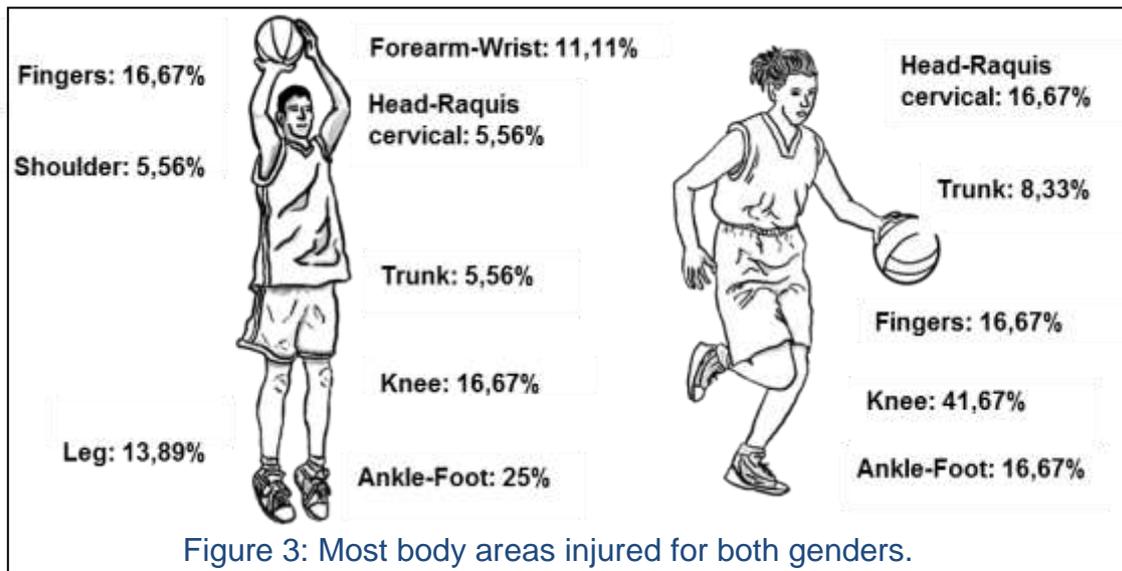


Figure 3: Most body areas injured for both genders.

Regarding males, the body area which accounted for the highest injury rate was the foot-ankle (25%) followed by the knee (16.67%) and the fingers (16.67%). Moreover, it was noticed that fingers injuries rate was constant both in practice and competition contexts. However, knee injury rates and ankle injury rates were doubled and even tripled comparing practice and competition moments, respectively.

Ligament sprains represented the highest injury rate considering female and male players (58.33% and 41.67%, respectively). Regarding female players, dislocation/fracture injuries occupied the second position (16.67%). As for male players, bruise injuries were more frequent than dislocations/fractures (22.22% and 16.67% respectively) and they were in second and third place respectively.

For the whole sample, the highest injury incidence rate registered was the lateral ankle ligament sprain, with an injury incidence rate of 0.35 and 1.69 per 1000 AEs in females and 0.83 and 2.66 per 1000 AEs in males (regarding practice and competition, respectively).

Most frequent cause of injuries in female players differed from that of the whole sample. It was observed a high tendency to players' contacts or collisions (25%) and overuse injuries (16.67%) during practice whereas direction changes (25%) and sport elements contact injuries (16.67%) were more common during competition. Regarding male players, falls into the ground became the most common injuries' cause (30.56%), especially in competition, followed by players contact and sports elements contact (13.89% in both circumstances).

Out of practice time results equaled 189 days (27 weeks) in female players and 619 days (88.42 weeks) in male players. Regarding female players, 50% of injuries resulted in a 1-7 days out of practice time, 33.33% of injuries resulted in a 8-21 days out of practice time, and 16.67% of injuries resulted in a >21 days out of practice time. Regarding male players, 30.56% of the injuries resulted in a 1-7 days out of practice time, 50% of injuries resulted in a 8-21 days out of practice time and 19.44% of the injuries resulted in a >21 days out of practice time.

DISCUSION

As to authors' knowledge, this is the first study related to injury rates that includes epidemiological data considering all Spanish *amateur* development basketball leagues (Beginners-Seniors). It computes RR (CI 95%) for every gender taking into account practice and competition moments in a prospective follow-up. Moreover, other non-previously contemplated variables have been analyzed such as severe injuries, out of practice time, age average or players positions.

Injury rates from gender and age

In contrast to previous studies, it has been registered a lower injury incidence value than expected: 16.61% against 78.72% observed in other studies such as the one of Sánchez Jover & Gómez Conesa (16). This difference can be attributed to procedural variations, since this study included a smaller sample size (47 basketball players from Murcia basketball team) and its follow-up period extended during three seasons. That time gave more opportunities to register a greater number of injured players.

Coincidentally with previous injury incidence studies (7,13,14) based on *amateur* basketball players it has been obtained a higher risk of injuries during practices than during competitions in both genders. This fact is, very likely, associated to the variety of unpredictable circumstances during competition development. The differences between both situations were statistically significant and the female players group had RR values higher than male players. Other studies (7,13,14) including teenagers as sample and collecting their sample considering 100 nationally representative high-schools from the USA did not obtain such RR values for female players though. Although it is suggested that those lower values obtained were due to differences between samples they used and ours, none of them described age, competition level, or training and competition AEs per week. Given those facts, the comparability between those studies and ours is unknown.

Some prospective longitudinal studies like Borowski's *et al* (13) obtained an injury incidence rate of 1.43 and 3.66 for *amateur* female basketball players and 1.38 and 2.93 for *amateur* male basketball players per 1000 AEs in practice and competition, respectively. In the current research it

has been shown higher injury incidence rates. However, Borowski et al. followed a stricter criterion for injury inclusion in their study and this fact might have been responsible for significantly reduced injury incidence rates.

On the other side, our study showed that male players sustained more injuries than female players as it was anticipated by other previous studies (1), and only injury rates were higher in female players during competition. This great difference between practice and competition for female players could be showing a higher injury risk regarding female players or a lower training intensity than male players; since those got more injured in this context.

Given that they included a very specific age range, there are quite a few studies that included variables such as age mean related to injuries presentation or age ranges more prone to injuries. Pappas *et al.* (6), in their epidemiological study about Pediatric injuries related to basketball, included a sample formed by kids and teenagers (Range 7-17 years old) that went to ER departments after suffering an injury while they were playing basketball. This study reported a higher injuries incidence in the 7-11 age range. Additionally, Randazzo *et al.* (2) carried out a similar epidemiological study, but they included a sample formed by different age ranges to the previous one (Range 5-19 years old). This study found the highest injury incidence rates in the 15-19 years range. In our study, it has been found that the age mean associated to injuries was 15.12 years (3.53). There were not significant differences between genders on this value, and they highest injury incidence rates were found in 16 and 22 years old players. These results are close to those obtained by Randazzo *et al.* This could be due to the fact of having a similar age range sample in both studies.

Finally, Pascual *et al.* (19) carried out a systematic review of epidemiological studies to describe injury rates in several sports (including basketball) and used an 8 to 70 years old sample. They found two injury frequency peaks, one related to 15 year old players and another peak, although less pronounced, related to 22 year old players. These findings are very along the same lines to the results found in our study.

Highest incident injury types for the whole sample

Considering basketball characteristics, that involve very frequent jumping and direction changing, is not surprising that most of the 48 registered injuries were sustained by lower limbs. This result support other studies reports: 42.0% (6), 66.2 – 66.9% (14), 65.4-67.7% (13). Additionally, the most common injury type was ligament sprains (45.83%). This percentage is similar to those obtained in other researches (1,2,6,12-14,16,18).

Ligament sprains frequency was followed by bruises-concussions, dislocations/fractures and muscle/tendon injuries. These four injury types

are situated on top of the most frequent injuries list, considering all the studies. However, the specific list order is very dependent to the injuries classification chosen by the authors, as well as to the sample included in the study. On this point, Borowski *et al.* (13) and Kostopoulos & Dimitrios (18) placed muscle-tendon injuries in the second position (17.7% and 27%, respectively). This type of injury was followed by bruises-concussions and dislocations/fractures. They included USA and Greek teenage samples, respectively. Other studies as Randazzo's *et al.* (2) merged ligament sprains and muscle-tendon injuries and this type of injury category became the most frequent one (44.8%) followed by dislocations/fractures (22%) and bruises. Their sample was formed by USA kids and teenagers.

- Gender differences

For male players, the ankle-foot was the most injured area and for female the knee was. This difference could be attributed to anatomical differences (joint alignment and elasticity, mainly) and to developmental differences in adolescence stages. As male's development involves a neuromuscular development that protects the knee from hits and rotations, these developments are not so clear for females (6). Most frequent injury mechanisms (landing on the playground or adversary foot and sudden direction changes) are directly linked to technical gestures and to physical requirements demanded by basketball players. However, Meewisse *et al.* (20), in a prospective study including 318 different college basketball players, showed that the most frequent injury cause was crashing into a rival. The use of a higher game level sample might explain this greater tendency to contact between the 10 players, as they are competing simultaneously for a very limited space amount.

The most common injury diagnoses for the whole sample was the ankle sprain. Its incidence rate, considering both genders, was similar to those of Sánchez Jover & Gómez Conesa (16) who obtained 1.5 injuries per 1000 AEs. However they did not compared neither gender nor sport context.

Considering "out of practice time" results in our sample, female players showed a shorter recovery time. 50% female player registered injuries that caused a 1-7 out of practice time whereas this percentage was lower for male players (33.56%). Results achieved by Borowski *et al.* (13) are opposed to some point to ours: a 47.7% of injuries involved a 1-7 days out of practice time for female players and a 55.3% of injuries involved a 1-7 days out of practice time for male players.

Incidence between players' positions

As it was shown by Vanderlei *et al.* (15), game actions that required speed, promptness and direction changes -especially developed by point-guards and shooting guards- caused a highest ankle sprain injury rate in

comparison to the inside the paint players'. Additionally, this type of injury was related to jumping-landing events for point-guards and falls into the ground for forwards.

Given the fact that inside the paint players are exposed to greater contact movements in order to gain space and these players are taller and heavier than the outside the paint players, traumatic injuries were the most common within this group. In this case, knee sprains obtained the highest injury incidence rate and this was probably due to the fact that this joint had to assume bigger impacts in comparison to other players' positions.

Study Limitations

It would be required a longer follow-up time in order to obtain more consistent results in all levels of basketball practice. On the other side, we just have considered injuries that were diagnosed by health professionals and, however, there were some injuries out of this criterion and, obviously, their inclusion would have changed injury incidence rates obtained. Finally, the entire sample was collected in just one geographic area and this fact could compromise extrapolating our results to the whole Spanish *amateur* basketball population.

Given those circumstances, more prospective studies that include a longer follow-up period and a better sample definition (considering characteristics and players' level) are needed in order to corroborate and extrapolate the results achieved in this pilot study.

CONCLUSIONS

Injury rates were very variable considering gender and age categories and there was a higher injury incidence rates values related to competition than to practice. Those results were common both genders, and specifically for 16 and 22 years old basketball players. On the other side, although a higher injury rate was registered for female players during competition moments male basketball players sustained the highest injury incidence rates during the follow-up period.

The most common injured area for male players was the ankle-foot area whereas for female players it was the knee area. The most common injury mechanisms for male players were landing-stepping over the playground or a rival's foot and quick direction changes for female players. The most common injuries were ligament sprains, including both genders, followed by dislocations/fractures, bruises and muscle-tendon injuries. The most repeated injury diagnosis was the ankle sprain (20.83%)

REFERENCES

(1) Sánchez Jover F, Gómez Conesa A. Epidemiología de las lesiones deportivas en baloncesto. *Rev Int Med Cienc Act Fís Deporte*. 2008;8(32):270-281.

- (2) Randazzo C, Nelson NG, McKenzie LB. Basketball-related injuries in school-aged children and adolescents in 1997–2007. *Pediatrics* 2010;126(4):727-733. <https://doi.org/10.1542/peds.2009-2497>
- (3) Harmer PA. Basketball injuries. *Med Sport Sci.* 2005;49:31-61. <https://doi.org/10.1159/000085341>
- (4) Cumps E, Verhagen E, Meeusen R. Prospective Epidemiological Study of Basketball Injuries During One Competitive Season: Ankle Sprains and Overuse of Knee Injuries. *J Sports Sci Med.* 2007;6:204-211.
- (5) Adirim TA. Overview of Injuries in the Young Athlete. *Sports Med.* 2003;33(1):75-81. <https://doi.org/10.2165/00007256-200333010-00006>
- (6) Pappas E, Zazulak BT, Yard EE, Hewett TE. The Epidemiology of Pediatric Basketball Injuries Presenting to US Emergency Departments: 2000-2006. *Sports Health.* 2011;3(4):331-335. <https://doi.org/10.1177/1941738111409861>
- (7) Darrow CJ, Collins CL, Yard EE, Comstock RD. Epidemiology of severe injuries among United States high school athletes: 2005-2007. *Am J Sports Med.* 2009;37(9):1798-1805. <https://doi.org/10.1177/0363546509333015>
- (8) Agel J, Olson DE, Dick R, Arendt EA, Marshall SW, Sikka RS. Descriptive Epidemiology of Collegiate Women's Basketball Injuries: National Collegiate Athletic Association Injury Surveillance System, 1988-1989 Through 2003-2004. *J Athl Train.* 2007;42(2):202-210.
- (9) Dick R. Descriptive epidemiology of collegiate men's basketball injuries: National Collegiate Athletic Association Injury Surveillance System, 1988–1989 through 2003–2004. *J Athl Train.* 2007;42(2):194-201.
- (10) Deitch JR, Starkey C, Walters SL, Moseley JB. Injury Risk in Professional Basketball Players A Comparison of Women's National Basketball Association and National Basketball Association Athletes. *Am J Sports Med.* 2006;34(7):1077-1083. <https://doi.org/10.1177/0363546505285383>
- (11) McKay GD, Goldie PA, Payne WR, Oakes BW. Ankle injuries in basketball: injury rate and risk factors. *Br J Sports Med.* 2001;35(2):103-108. <https://doi.org/10.1136/bjism.35.2.103>
- (12) McKay G, Goldie P, Payne W, Oakes B, Watson L. A prospective study of injuries in basketball: a total profile and comparison by gender and standard of competition. *J Sci Med Sport.* 2001;4(2):196-211. [https://doi.org/10.1016/S1440-2440\(01\)80030-X](https://doi.org/10.1016/S1440-2440(01)80030-X)
- (13) Borowski LA, Yard EE, Fields SK, Comstock RD. The epidemiology of US high school basketball injuries, 2005-2007. *Am J Sports Med.* 2008;36(12):2328-2335. <https://doi.org/10.1177/0363546508322893>
- (14) Rechel JA. An Epidemiologic Comparison of High School Sports Injuries Sustained in Practice and Competition. *J Athl Train.* 2008;43(2):197-204. <https://doi.org/10.4085/1062-6050-43.2.197>
- (15) Vanderlei FM, Bastos FN, de Lemes IR, Vanderlei LC, Junior JN, Pastre CM. Sports injuries among adolescent basketball players according to position on the court. *Int Arch Med.* 2013;6(1):7682-7686. <https://doi.org/10.1186/1755-7682-6-5>

- (16) Sánchez Jover F, Gómez Conesa A. Hábitos de entrenamiento y lesiones deportivas en la selección murciana de baloncesto 2007. *Rev Int Med Cienc Act Fís Deporte*. 2008;8(30):146-160.
- (17) Messina DF, Farney WC, DeLee JC. The incidence of injury in Texas high school basketball. A prospective study among male and female athletes. *Am J Sports Med*. 1999;27(3):294-299.
- (18) Kostopoulos N. Injuries in Basketball. *Biology of exercise*.2010;6(1):47-55. <https://doi.org/10.4127/jbe.2010.0035>
- (19) Pascual CM, Pérez VR, Calvo JS. Epidemiología de las lesiones deportivas. *Fisioter*. 2008;30(1):40-48. [https://doi.org/10.1016/S0211-5638\(08\)72954-7](https://doi.org/10.1016/S0211-5638(08)72954-7)
- (20) Meeuwisse WH, Sellmer R, Hagel BE. Rates and risks of injury during intercollegiate basketball. *Am J Sports Med*. 2003;31(3):379-385.

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