Injury occurrence and related performance factors in ACB players

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Abstract

The aim of this study is to analyse whether there are significant relationships between the occurrence of injuries and official ACB statistical variables related to performance, anthropometry and position. Statistical variables of 554 professional basketball players (age: 26.97±4.86 years, height: 199.23±8.80 cm, minutes per season: 441.18±315 min) in ACB competition were analysed for two seasons (2012-13 and 2013-14). In addition, injury reports were registered and injuries were categorized taking into account OSICS-10 classification. Anthropometric variables (weight, height, BMI) and age were also analysed. Ankle (77 players; 23.7% of total injured players) and knee (52 players; 16.0% of total injured players) were the most reported injuries. There were no relationships between weight or BMI and the occurrence of injuries (P>0.05). Shooting-guards, power-forwards and centers suffered more injuries in average than point-guards and small-forwards (P<0.05). Players who reported any anatomical injury played more minutes during the regular season (527±260 vs. 380±315 min; P=0.000). Significant differences (P<0.05) were also found in statistics per minute of points (0.382±0.114 vs. 0.352±0.284), performance rating (0.391±0.172 vs. 0.290±0.469), rebounds (0.167±0.092 vs. 0.151±0.110), assists (0.066±0.045 vs. 0.062±0.065), goals made (0.138±0.047 vs. 0.125±0.083), blocks made (0.015±0.019 vs. 0.013±0.019), dunks (0.013±0.022 vs. 0.009±0.017), steals (0.034±0.015 vs. 0.032±0.024), received fouls (0.105±0.040 vs. 0.096±0.093), free throws attempted (0.093±0.044 vs. 0.091±0.166) and +/- statistic (-0.013±0.241 vs. -0.124±0.640). Players who were injured during the season did more actions per minute in average for every variable, excepting the blocks against. Statistical performance variables influence the occurrence of injuries, especially those variables that measure positive actions imply a higher risk of injury. Higher performance in basketball involves a higher risk of injury.

Keywords: Basketball. Injuries. Performance. Anthropometry. Game position.

Resumen

El objetivo de este estudio es analizar la relación entre la ocurrencia de lesiones y los valores de rendimiento recogidos en las estadísticas oficiales de la liga ACB, variables antropométricas y de posición. Se ha analizado la información estadística de 554 jugadores de baloncesto profesional (edad: 26.97±4.86 años, estatura: 199.23±8.80 cm, minutos por temporada: 441.18±315 min) en la liga regular ACB durante dos temporadas (2012-13 y 2013-14). Además, se han recogido los partidos médicos de cada jornada y categorizado las lesiones según el sistema OSICS-10. También se han incluido variables de tipo antropométrico (peso, estatura y IMC) y la edad. Las lesiones con mayor incidencia fueron las de tobillo (77 jugadores; 23,7% del total de lesionados) y rodilla (52 jugadores; 16,0% del total de lesionados). No se encontraron relaciones entre el peso o el IMC y la ocurrencia de lesiones (P>0,05). Los escoltas, ala-pívots y pívots padecieron más lesiones de media que los bases y los aleros (P<0,05). Los jugadores que padecieron alguna lesión disputaron más minutos durante la temporada regular (527±260 vs. 380±315 min; P=0,000). Además, se observaron diferencias significativas (P<0,05) en las estadísticas por minuto de la liga ACB en puntos (0,382±0,114 vs. 0,352±0,284), valoración (0,391±0,172 vs. 0,290±0,469), rebotes (0,167±0,092 vs. 0,151±0,110), asistencias (0,066±0,045 vs. 0,062±0,065), tiros convertidos (0,138±0,047 vs. 0,125±0,083), tiros libres intentados (0,093±0,044 vs. 0,091±0,166), estadística +/- (-0,013±0,241 vs. -0,124±0,640). Los jugadores que presentaron alguna lesión anatómica realizaron más acciones de media por minuto en todos los aspectos, excepto en los tapones en contra. Las variables de rendimiento estadístico de la liga ACB influyen en la ocurrencia de lesiones y las variables que indican acciones positivas implican un mayor riesgo de padecer lesiones.

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Introduction

Sports activities increase the risk of injury which, in some cases, could cause permanent disability or joint degeneration in the long term. Different types of sports are associated with certain injury patterns and types, while age, gender and type of activity (for example: recreational or competitive) are influential factors in the risk of sustaining injury. This risk has increased in the case of practising basketball: the sport has progressed towards an increasingly more physical game in which contact is accepted and expected. Present-day basketball emphasises the speed and power of its players, as well as the strength and rapidity required to control the opponent’s position, get a rebound or shoot a basket. A greater incidence has been observed (number of injuries per player, each year) the higher the level of competition, with particular mention of professional levels.

Longitudinal studies on professional, university and lower category basketball players have served to describe the characteristics of the injuries occurring in this sport. In general, injuries are significantly more common during a match than during training and are more frequent when there is contact between players. Although improvements have been made in the safety of playing basketball, injuries are still influential on insurance costs, lost working days and the use of medical resources.

In scientific literature, the epidemiology of injuries in basketball has been described, based on a number of factors. The most prominent include the total incidence of injuries on the number of injuries per hours of exposure at matches and/or training sessions, the difference in the incidence of injuries at different competition levels, the incidence of injuries with regard to the body site or type of injury (bruise, muscle injury, ligament strain, etc.), the incidence of the injuries based on the cause of the injury (with contact, without contact, jumping, sprinting, etc.) and the incidence of injuries based on anthropometric variables (age, weight BMI, height, sex, etc.).

However, few investigations have studied the relationship existing between the occurrence of injury and the performance of players during the matches. The studies existing have mainly been conducted in the United States (NBA), studying differences in performance after sustaining long term injuries or injuries requiring surgery. A study of the relationships between performance and incident occurrence could offer information of interest to trainers and fitness coaches and promote specific preventive type work with the profiles of players that are most likely to sustain injury. Moreover, this information could be of assistance in decision making with regard to any changes in the rules of this sport, directed at reducing injuries.

With this aim in mind, this study is directed at analysing the occurrence of injuries and the relationship with sporting performance for basketball players in the ACB professional league, as well as the effect of the match position and anthropometric variables.

Material and method

Design

In order to analyse basketball player injuries in the ACB league, a cross-sectional, descriptive, retrospective methodology was used to study the injuries and performance of players based on the information provided by the official website of the ACB league for each of the injury reports prior to each regular league match for the seasons 2012-13 and 2013-14.

Participants

The study population comprised all the players (554) forming part of the ACB league for seasons 2012-13 and 2013-14. The following requirements were established for inclusion in the study: i) to have played at least one match in the ACB league and ii) not to have played in another team in the same competition during the season. A sample of 554 ACB league players during seasons 2012-13 and 2013-14 met both requirements and, therefore, were included in this study.

Procedure

We examined the information on "Novedades y Parte Médico" (news and medical report) on the official ACB basketball league website, corresponding to the Regular League for seasons 2012-13 and 2013-14, with a total of 68 matches recorded. All the injury reports were obtained for all the matches played. Based on this information, we identified which league players had been injured, the type of injury sustained, recording the body site of the same. The OSICS classification was used to classify the injuries.

Subsequently, the total individual statistics were obtained for each player for each of the two seasons. The statistics showed the performance of the players for each variable, in absolute values (total for the season) and for each match played. As the risk of sustaining injuries increased with the match exposure time in minutes, the original data were used to calculate the individual statistics per minute for each player. In this way, the time effect was eliminated in the correlation between actions and playing time (the greater the playing time, the more actions made). Data not related to performance were also collected, such as: height, weight, date of birth and playing position. Age was calculated by deducting the player’s date of birth from the year corresponding to the last regular league match played in the season studied.

Statistical analysis

Absolute frequencies and percentages were used to analyse the qualitative variables. Contingency tables with Pearson’s χ² statistic were used to analyse the relationship between qualitative variables.

For the quantitative variables, the Kolmogorov-Smirnov test was used to check the normality of the variables for a sample. The data are presented as mean ± standard deviation. To determine whether or not there are any significant differences between players sustaining a type of injury during the season, the different match performance variables were taken and a means comparison was made, using the t-test for variables with a normal distribution and the Mann-Whitney U statistic for those nonparametric variables. The significance level was set at P<0.05 for all cases.
The PASW Statistics 18 software program was used for the statistical analysis.

Results

Table 1 shows the results for the incidence of injuries. From this, it can be seen that the most common body injuries are to the knee (25.85%), ankle (19.17%), leg (between the ankle and knee) (12.18%) and foot (9.43%). The lower extremities account for approximately 80% of the total number of injury reports. Injuries to the ankle (23.69%), knee (16.00%), leg (between ankle and knee) (10.46%), wrist and hand (8.92%) are the most common injuries sustained by players during a season. Injuries to the knee (4.69±6.27), foot (4.68±4.93) and hip and groin (4.07±5.48) account for the greatest number of convalescence days during the season. The most common injury sustained by players (ankle) accounted for an average of 2.5±2.56 convalescence days per player. In general, each injured player lost an average of 4.21±4.54 days, slightly less (4.04±4.59) in the case of body injuries.

With regard to the percentage of players presenting a certain type of injury during the season, the most common injuries were to the ankle (13.90%), knee (9.39%) and medical illnesses or infections (9.21%).

Table 2 shows the statistical performance variables with regard to the occurrence of body injuries. During the regular season, players with some body injury played more minutes on average (527±260 vs. 380±315 min; \( P = 0.000 \)) in all game statistics, both for throw statistics (attempted and made), rebounds (total, offensive and defensive), blocks (for and against), dunks, fouls received, as well as the +/- statistic (partial marker in the game while a certain player is on court), and the rating (all the variables calculated per minute played). Those players sustaining some type of body injury, performed an average of more actions per minute in all aspects commented except in the case of blocks against, where they received less actions of this type.

With regard to anthropometric variables, no significant differences were found between players with an body injury, based on height, weight and BMI (\( P > 0.05 \)). However, statistically significant differences were observed when taking the age of the players into account (\( P = 0.000 \)). Players with some body injury during the regular season were older than the group of players with no injuries (28.06 vs. 26.19 years; \( P = 0.000 \)). Finally, the analysis of injuries based on the game positions of the players gave statistically significant differences (\( P < 0.05 \)) in the case of the shooting guards (1.87±2.88 injuries), power forwards (1.81±3.76 injuries) and centres (2.07±4.54 injuries), who sustained more injuries on average than the point guards (1.23±3.18 injuries) and the small forwards (1.49±3.06 injuries).

Table 1. Incidence of injuries by reports, players and convalescence days.

<table>
<thead>
<tr>
<th>OSICS</th>
<th>LA</th>
<th>Reports(n)</th>
<th>% PLA</th>
<th>JL (n)</th>
<th>% JLA</th>
<th>% J</th>
<th>JDC (weeks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Ankle</td>
<td>181</td>
<td>19.17</td>
<td>77</td>
<td>23.69</td>
<td>13.90</td>
<td>2.35±2.56</td>
</tr>
<tr>
<td>B</td>
<td>Pelvis and buttocks</td>
<td>4</td>
<td>0.42</td>
<td>3</td>
<td>0.92</td>
<td>0.54</td>
<td>1.33±0.57</td>
</tr>
<tr>
<td>C</td>
<td>Thorax</td>
<td>2</td>
<td>0.21</td>
<td>2</td>
<td>0.62</td>
<td>0.36</td>
<td>1.00±0.00</td>
</tr>
<tr>
<td>D</td>
<td>Thoracic spine</td>
<td>20</td>
<td>2.12</td>
<td>12</td>
<td>3.70</td>
<td>2.17</td>
<td>1.67±0.47</td>
</tr>
<tr>
<td>E</td>
<td>Elbow</td>
<td>8</td>
<td>0.84</td>
<td>5</td>
<td>1.54</td>
<td>0.90</td>
<td>1.60±0.55</td>
</tr>
<tr>
<td>F</td>
<td>Foot</td>
<td>89</td>
<td>9.43</td>
<td>19</td>
<td>5.85</td>
<td>3.43</td>
<td>4.68±4.93</td>
</tr>
<tr>
<td>G</td>
<td>Hip and groin</td>
<td>57</td>
<td>6.04</td>
<td>14</td>
<td>4.31</td>
<td>2.53</td>
<td>4.07±5.48</td>
</tr>
<tr>
<td>H</td>
<td>Head</td>
<td>17</td>
<td>1.80</td>
<td>11</td>
<td>3.38</td>
<td>1.99</td>
<td>1.55±1.21</td>
</tr>
<tr>
<td>K</td>
<td>Knee</td>
<td>244</td>
<td>25.85</td>
<td>52</td>
<td>16.00</td>
<td>9.39</td>
<td>4.69±6.27</td>
</tr>
<tr>
<td>L</td>
<td>Lumbar spine</td>
<td>35</td>
<td>3.70</td>
<td>19</td>
<td>5.85</td>
<td>3.43</td>
<td>1.84±2.12</td>
</tr>
<tr>
<td>M</td>
<td>Infection</td>
<td>63</td>
<td>N/A</td>
<td>51</td>
<td>N/A</td>
<td>9.21</td>
<td>1.24±0.68</td>
</tr>
<tr>
<td>N</td>
<td>Neck</td>
<td>14</td>
<td>1.48</td>
<td>11</td>
<td>3.38</td>
<td>1.99</td>
<td>1.27±0.93</td>
</tr>
<tr>
<td>O</td>
<td>Abdomen</td>
<td>15</td>
<td>1.59</td>
<td>3</td>
<td>0.92</td>
<td>0.54</td>
<td>2.00±1.73</td>
</tr>
<tr>
<td>Q</td>
<td>Leg</td>
<td>115</td>
<td>12.18</td>
<td>34</td>
<td>10.46</td>
<td>6.14</td>
<td>3.38±3.67</td>
</tr>
<tr>
<td>R</td>
<td>Forearm</td>
<td>7</td>
<td>0.74</td>
<td>2</td>
<td>0.62</td>
<td>0.36</td>
<td>3.50±3.54</td>
</tr>
<tr>
<td>S</td>
<td>Shoulder</td>
<td>26</td>
<td>2.75</td>
<td>9</td>
<td>2.77</td>
<td>1.62</td>
<td>2.89±2.20</td>
</tr>
<tr>
<td>T</td>
<td>Thigh</td>
<td>43</td>
<td>4.56</td>
<td>23</td>
<td>7.08</td>
<td>4.15</td>
<td>1.87±1.18</td>
</tr>
<tr>
<td>U</td>
<td>Arm</td>
<td>0</td>
<td>0.00</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00±0.00</td>
</tr>
<tr>
<td>W</td>
<td>Wrist and hand</td>
<td>67</td>
<td>7.10</td>
<td>29</td>
<td>8.92</td>
<td>5.23</td>
<td>2.31±1.98</td>
</tr>
<tr>
<td>X</td>
<td>Not specified</td>
<td>247</td>
<td>-</td>
<td>108</td>
<td>-</td>
<td>19.49</td>
<td>2.29±2.23</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>1254</td>
<td>100.00</td>
<td>484</td>
<td>100.00</td>
<td>100.00</td>
<td>4.21±4.54</td>
</tr>
</tbody>
</table>

OSICS: injury code. LA: Body Site. %PLA: percentage of Reports in relation to total number of Body Injuries. JL: Injured Players. %JLA: percentage of Players in relation to the total number of Body Injuries. %J: percentage of Players in relation to the total number of Body Injuries. JDC: Convalescence Days.
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Discussion

The aim of this investigation was to study the occurrence of injuries and the relationship with performance factors for professional ACB basketball players. The results obtained show how ankle and knee injuries prevail over other injuries, both for the number of days in which the player is convalescing and in the total number of players injured. These results are consistent with those of other studies, which indicate that the most common injuries in basketball are those to the upper extremities and knee injuries being less common.

Taking into account the combined frequency of ankle and foot injuries (33.89% of injury days), this gives a similar percentage to that obtained by other studies conducted for basketball, pointing to this body site as the most susceptible to injury with regard to the upper extremities.

A foot injury incident was recorded (5.9%) in the range defined by other studies conducted at the NBA: 7.9%20, 7.6%6 and 4.2%8 in relation to the total number of injuries. This situation is repeated for hip injuries: 4.3% in relation to a 7.5%20; a 6.2%6, and a 2.4%; and in head or skull injuries (3.4%) in relation to the 1.9%6, 5.3%20 and 5.7%6 recorded in other studies of the NBA. The low incidence of injuries to the thoracic column, neck, shoulder, elbow, thorax, pelvis, abdomen and forearm concurs with studies of the NBA6,20. This similarity between studies and competitions is probably due to the similar energy and muscle demands of basketball at a professional level10.

With regard to performance factors, it is extremely interesting that those players sustaining some type of injury obtained better averages in all positive aspects of the match statistics. Moreover, the difference in averages for negative factors is not significant, except for the blocks against, in which lower averages were obtained (implying better action).

It appears that the best players are more exposed to injuries, given the fact that those players sustaining some type of injury obtained better statistical performance per minute than those players that were not injured. As indicated by some studies, the evolution of basketball towards a sport where contact is permitted10,12, may have something to do with this fact. Numerous studies indicate that the most common cause of injury is landing from a jump15,15,15. With actions of this type, there is more risk of injury than changes of pace dribble15, so that it is not surprising that injured players have obtained better averages in rebounds and dunks. Likewise, all the actions implicitly involve a jump during normal performance (except for free throws). The 2 and 3-point throws, blocks and rebounds are generally performed with a jump, where the risk of injury is increased.

Offensive actions have traditionally been identified as significantly more likely to produce injuries15. The importance of points, field goals made and rating, give grounds to expect that those players with great offensive skills are more likely to be injured. This may be due to their capacity to score points, which would increase the level of contact with the defence. The fact that injured players have averaged more steals may be due to the predominance of contact in this type of action, although it should be borne in mind that this does not always happen in this way.

The players with the greatest rating in the ACB final statistics are more likely to sustain injuries. The rating is a statistical value that depends

Table 2. Relevant performance variables with regard to the occurrence of body injuries.

<table>
<thead>
<tr>
<th>Study variable (per minute of play)</th>
<th>Not injured</th>
<th>Injured</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Minutes</td>
<td>380±135</td>
<td>527±260</td>
<td>0.000*</td>
</tr>
<tr>
<td>Points</td>
<td>0.35±0.284</td>
<td>0.38±0.114</td>
<td>0.000*</td>
</tr>
<tr>
<td>3-point field goals made</td>
<td>0.03±0.040</td>
<td>0.03±0.027</td>
<td>0.011*</td>
</tr>
<tr>
<td>2-point field goals made</td>
<td>0.09±0.082</td>
<td>0.10±0.054</td>
<td>0.003*</td>
</tr>
<tr>
<td>Field goals made</td>
<td>0.12±0.083</td>
<td>0.13±0.047</td>
<td>0.000*</td>
</tr>
<tr>
<td>Free throws made</td>
<td>0.06±0.161</td>
<td>0.07±0.034</td>
<td>0.000*</td>
</tr>
<tr>
<td>Free throws attempted</td>
<td>0.09±0.166</td>
<td>0.09±0.044</td>
<td>0.000*</td>
</tr>
<tr>
<td>Offensive rebounds</td>
<td>0.04±0.042</td>
<td>0.04±0.035</td>
<td>0.025*</td>
</tr>
<tr>
<td>Defensive rebounds</td>
<td>0.10±0.094</td>
<td>0.11±0.075</td>
<td>0.002*</td>
</tr>
<tr>
<td>Total rebounds</td>
<td>0.15±0.110</td>
<td>0.16±0.092</td>
<td>0.016*</td>
</tr>
<tr>
<td>Assists</td>
<td>0.06±0.065</td>
<td>0.06±0.045</td>
<td>0.001*</td>
</tr>
<tr>
<td>Steals</td>
<td>0.03±0.024</td>
<td>0.03±0.015</td>
<td>0.016*</td>
</tr>
<tr>
<td>Blocks for</td>
<td>0.01±0.019</td>
<td>0.01±0.019</td>
<td>0.000*</td>
</tr>
<tr>
<td>Blocks against</td>
<td>0.01±0.038</td>
<td>0.01±0.008</td>
<td>0.003*</td>
</tr>
<tr>
<td>Dunks</td>
<td>0.00±0.017</td>
<td>0.01±0.022</td>
<td>0.001*</td>
</tr>
<tr>
<td>Fouls received</td>
<td>0.09±0.093</td>
<td>0.10±0.040</td>
<td>0.000*</td>
</tr>
<tr>
<td>+/- Statistic</td>
<td>-0.12±0.640</td>
<td>-0.01±0.241</td>
<td>0.006*</td>
</tr>
<tr>
<td>Rating</td>
<td>0.29±0.469</td>
<td>0.39±0.172</td>
<td>0.000*</td>
</tr>
</tbody>
</table>

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on offensive and defensive actions alike, but can be considered as a mixed variable in which offensive actions have a greater contribution. The case of the fouls received deserves particular attention. Contact between players has been considered to be a variable that is particularly likely to cause injuries, and injured players suffer more fouls per minute played. The study conducted by Hootman et al.11 on university competition in the USA - National Collegiate Athletic Association (NCAA) identified that 58% of competition injuries were due to physical contact.

Attempted and made free throws were indicated as decisive factors in the occurrence of injuries: injured players attempted and made more free throws per minute of play. This fact may appear surprising, given the fact that a free throw is an action in which no jumping or contact is involved. However, it should be borne in mind that a free throw is the result of a foul (implying contact) and, on many occasions, the throw simultaneously involves taking a shot at the basket (implying a jump). Although studies have been made that indicate a greater predisposition to injury with regard to contact or a jump8,13, it is necessary to explore the relationship existing between free throws and injuries in order to clarify this possible explanation.

Assists have been identified as a determining factor in the occurrence of injuries, although passing and receiving the ball is not considered to be so decisive as jumping, in order to produce an injury of this type.15 However, account should be taken of the fact that many assists are made with a jump in order to dish the ball when getting a defensive assist. This aspect should be studied more deeply, as the passing and jumping actions take place simultaneously on many occasions.

On the other hand, it was to be expected that injured players should have had significantly more minutes of game exposure time, given the fact that other studies indicate the logical importance of the relationship between a greater exposure time and a higher risk of injury.12 Finally, it is interesting to emphasise that neither weight, height nor BMI were significant variables with regard to injury occurrence. This fact suggests that these variables are not as determinant in injury exposure as the technical level and level of involvement in the game, in addition to other variables that are outside the scope of this study, such as physical preparation and prior history of injuries sustained by these athletes.11,12

As limitations to this study, we would highlight, on the one hand, the fact that there is no indication of the reasons for the injuries (contact, non-contact, jumping, sprinting, etc.) or the types of injuries (muscle, bone, tendon, ligament, etc.), which would enable a deeper analysis of the injuries sustained in the ACB league. On the other hand, it should be pointed out that we did not have access to the minutes of training exposure for each player. Therefore, we have only taken account of the exposure to injuries during matches. Due to the design of this investigation, it was not possible to resolve these two constraints. However, we consider that the information provided may be of interest in order to progress in the understanding of professional basketball injuries in Spain, by compiling the injuries occurring in all top professional teams during two complete seasons, providing a new way of studying injuries and relating them to statistical performance. It would be advisable to conduct prospective studies, although it would be complicated to do so with reliable data from all the teams involved.

**Conclusion**

There are differences between the match statistics for injured and uninjured players during the professional basketball season in Spain. The weight and height of players are not determining variables in the occurrence of injuries. The most common injuries are to the ankle and knee, and there are differences in injury occurrence between the different game positions.

**Conflict of interests**

The authors have no conflict of interest whatsoever.

**Bibliography**

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