ORIGINAL ARTICLE

INCIDENCE OF MUSCULOSKELETAL INJURIES IN ELITE FEMALE BASKETBALL ATHLETES

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SUMMARY

Basketball is a competitive sport, presenting a high incidence of contact and movement injuries. ***Objective:*** *to determine the incidence of musculoskeletal injuries in elite female basketball athletes.* ***Materials and Methods:*** *66 adult athletes, with ages ranging from 18 to 37 years (average: 23), from 5 teams playing A1-class São Paulo State Championship were prospectively assessed in the period of September 1999 – January 2000). Data concerning each individual athlete and the injuries occurred within that period were recorded by a physical therapist.* ***Results:*** *78 injuries were reported in 47 athletes (71.2%). The incidence of injuries was 2.6 injuries/athlete/ 1000 games/ training sections, with the highest incidence being noted during matches. Sprains were the most frequent diagnosis, accounting for 33%, particularly at the ankle region, followed by bruises (24%). The most frequently injured regions were knees, accounting for 21% of injuries, hands/ fingers (17%), leg/ thigh and ankle, accounting for 14% each. The physical contact with other athletes was the major mechanism of injury. We did not find a correlation between diagnosis, age, position and anatomical region injured, but younger athletes reported injuries less frequently. Most injuries were mild (88.5%), with the knee region showing the highest level of morbidity. The overload imposed by this kind of sport activity was more noticeable at lumbar and knee regions, requiring intensive prevention programs and follow-up of elite female basketball athletes.*

Keywords: *Athletic injuries; Epidemiology; Basketball; Women.*

Citation: *Silva AS, Abdalla RJ, Fisberg M. Incidence of musculoskeletal injuries in elite female basketball athletes. Acta Ortop Bras. [serial on the Internet]. 2007; 15(1):43-46. Available from URL: http://www.scielo.br/aob.*

INTRODUCTION

Although basketball is a relatively new sport within a historical context, existing for around 100 years, it is highly disseminated throughout the world, both as a male version and a female version.

Basketball presents all basic movements of the sports, such as jumps, landings, run, acceleration, deceleration, shifts and pivoting, which, alone, make it potentially hurtful. At total, female elite basketball is played in four quarters, of 10 minutes each, totaling 40 minutes a match, and, for being a collective sport, where ten players are in field playing the game, the exposure rate of these athletes to injuries becomes high.

Because basketball requires repeated jumps during games and drills as a result of the very requirements of this sportive activity, it causes various body overloads on many athletes, with lumbar region and lower limbs' joints being the most affected parts of the body (1).

With all these factors occurring in basketball, they make it one of the most hurtful of all kinds of sports (2).

Thus, the conduction of epidemiological studies has become critical for characterizing injuries in this sport and in the different variables surrounding it (age, gender, competition level, category) (3). However, less attention has been given to females, especially when it comes to high level athletes, despite of this increasingly engaging population in that sportive activity (4).

Thus, this study was aimed to document, as well as to correlate the causes of injuries within Brazilian elite female basketball players, in order to assess the overload degree in drills and the excessive number of matches in a championship against the number and kinds of reported injuries, and, subsequently, preventive programs can be designed by taking those data into account.

MATERIALS AND METHODS

Sixty six elite athletes were prospectively studied; all of them were females from five basketball teams in São Paulo state.

We assessed injuries occurred during the Paulista Female's A1 Division Championship, which started in 09/30/1999 and ended in 01/15/2000. This is regarded as the most important championship of the country at the time of study, thus counting on the best Brazilian athletes, who constitute the foundation of Brazilian national team.

All athletes belonged to the adult category and were registered at the Brazilian Basketball Confederation.

As a pre-requirement for the study, the club to be assessed should count on a physical therapist or a doctor available in all games and drills of their correspondent clubs during the whole championship for recording any resultant injuries.

During the Championship, teams played twice a week in average, and training sessions occurred five times a week in average, which resulted in 76 matches and 375 training sessions.

Previously to the Championship, all 66 athletes were assessed and questioned regarding their positions in court, how long they had been playing basketball, previous surgeries, and whether they wore any orthosis or not.

During the Championship, when an injury occurred, the physical therapist or doctor of each corresponding team filled an individual file for the athlete.

In this second moment, special attention was given to reports of the injuries occurred during the Championship in discussion, affected anatomical regions, mechanism of injury, treatment provided in each injury, injury severity, diagnostic methods employed, and physical therapeutic treatment time for each injury.

We classify musculoskeletal injuries in basketball as the ones affecting these athletes' locomotive apparatus, leading them to partially or totally shutdown their sportive activities (5).

Study conducted at the Rehabilitation Department, UNIFESP – EPM.

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Received in: 03/15/06; approved in: 07/29/06

Regarding injury severity, this was classified according to the shutdown period, from the moment the injury occurred to athlete release for drills and/or games, being classified as mild (less than 7 days), moderate (8 – 30 days) and severe (more than 30 days) [6].
The present study was approved by the Committee on Ethics in Research of the Federal University of São Paulo, according to protocol nr. 990/01.
The following statistical tests were performed:
1. The Mann-Whitney's test: used for comparing two independent samples.
2. Kruskal-Wallis' post hoc variance analysis: used for comparing three or more independent samples.
3. Spearman's correlation coefficient: non-parametric correlation coefficient, where the only requirement is to contain ordinal values. It ranges from 0 to 1, the closer to 1, the higher the correlation.
4. Pearson's chi-square test: for checking the dependence correlation between two dichotomic variables, following the principle of comparison between frequencies found in a sample and the expected frequencies, should an independence correlation existed between both variables. The Fisher's exact test was used when n was lower than 30, or when at least one <5 expected frequency existed.
For all statistical tests, the adopted significance level was alpha<0.05 or 5%.

RESULTS

A total of 78 injuries were recorded along the study period, occurring in 47 (71.21%) of the 66 athletes.
Injuries incidence during the study period was 2.6 injuries for each athlete by 1000 games/drills, being 1.8 injuries/ athlete by 1000 drills and 6.6 injuries/ athlete by 1000 games; thus, a higher injury incidence is found during games when compared to drills ($p< 0.001$).
Regarding the anatomical region of injuries, these predominantly occurred on lower limbs, accounting for 54% of the injuries, followed by upper limbs and head/trunk, both accounting for 23% of the injuries.
Regarding injuries according to the specific anatomical region, the knee was most mentioned, accounting for 21% of injuries (Figure 1).
Regarding injury diagnostic, we found that sprains, accounting for 33% of the injuries, was the most common and representative on ankle region, followed by contusion (24%), with both kinds of injuries totaling a number higher than all other injuries combined (Figure 2).
Regarding the correlation between injury diagnostic and injured anatomical region, we found that, in the ankle, all injuries were classified as sprains, with 11 cases of this kind of injury, all of them occurring in inversion.
On other anatomical regions, the distribution of injuries frequencies was variable. At head and neck region, fractures/ dislocations were prevalent, with 33% of the cases, being represented by two nose fractures and laceration/ abrasion, also accounting for 33% of the cases.
Concerning the knee, the vast majority (44% of the cases) was classified as sprains, in 7 cases resulting in meniscal injury, 4 partial injuries of tibial collateral ligament, and 2 partial injuries of fibular collateral ligament, followed by others, accounting for 25% of the cases, being represented by a synovial plica associated to patellar osteoarthritis, a synovial plica, a chondromalacia associated to patellar osteoarthritis, and a chondromalacia, followed by contusion in 19% of the cases, those characterized by 3 episodes, and, finally, laceration/ abrasion and tendonitis/ fasciitis, each in 6% of the cases, both kinds of injury represented by one episode each, and, specifically at a secondary diagnosis, a patellar tendonitis.
On hands/ fingers, over half of the injuries were classified as sprains, in 62% of the cases, these occurring in 8 cases all on fingers; contusion, accounting for 23% of the occurrences of which 3 cases and fracture/ dislocation accounting for 15% of the cases, being a fracture of fifth metacarpal and a metacarpophalangeal joint dislocation on the fifth finger.
On leg/ thigh region, only two kinds of injuries were reported: contusion in 64% of the cases, six being on thigh region and one on leg, and muscular injury, in 36% of the cases, being two on femoral biceps, one on semimembranous muscle, and one on femoral rectus muscle.
Regarding the lumbar region of vertebral spine and pelvic waist, half of the injuries were classified as lumbalgia/ dorsalgia in 50% of the cases, represented by four lumbalgia cases and one lumbosciatalgia case.
There was a statistically significant difference in the association of injury diagnosis and affected anatomical region ($p < 0.001$).
Regarding athletes' position in court, our study counted with 31.8% of them acting as pivots, 27.3% in more than one position, 24.2% as side players, and 16.7% as point guards. In literature, there are no studies addressing data about athletes not playing in a single position. We addressed such fact, since in all clubs the so-called "jokers" existed, who acted in court according to couch's needs.
In the correlation between injury diagnosis associated to athletes' positions in court there was no statistically significant difference, the same happening between injured anatomical region and athlete's position.
Another item studied here was to check if a difference existed between the number of injuries associated to athletes' ages. For this, we divided our study group into four age groups: below 20 years old, 20-25 years old, 26-30 years old, and above 30 years old.
At the conclusion, we noticed that athletes belonging to the youngest age group (below 20 years old) were those presenting the lowest number of injuries.
We also assessed the number of injuries suffered by a same player during the championship, in which we concluded that older athletes were more likely to suffer consecutive injuries than the younger ones during study time. Such comparison was statistically significant ($p = 0.010$).
Regarding injury diagnosis associated to athletes' ages, no statistically significant difference was found ($p = 0.295$), but injuries diagnosed as sprains and fractures/dislocations tended to present higher medians than other kinds of injuries, which characterized that older athletes were more frequently affected by both kinds of injuries than younger athletes, while tendonitis/ fasciitis and lumbalgia/ dorsalgia tended to be more frequent in younger athletes.
Regarding injured anatomi-

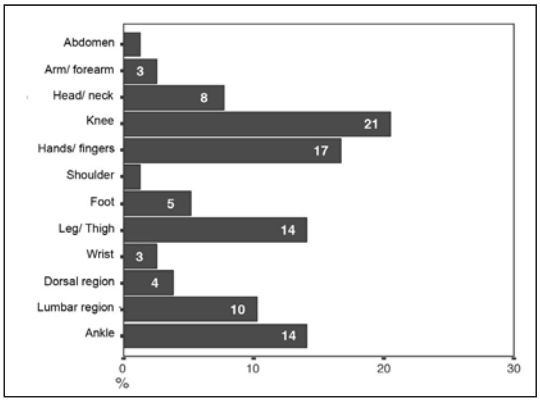

Figure 1 – *Distribution of injury frequency according to specific anatomical regions.*

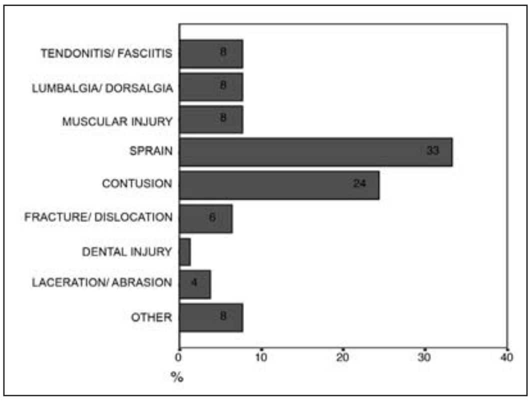

Figure 2 – *Distribution of injury frequency according to diagnosis.*

cal region compared to athletes' ages, the results were at the threshold (p = 0.088), where knee, hands/fingers, wrist and ankle regions tended to present higher medians than other injuries, which characterizes that those regions were more injured in older athletes, while regions such as arm/ forearm and leg/thigh were more frequent in younger athletes.

Concerning the mechanism of injury, contact with other athletes was the most common, accounting for 37 cases (47.3%), followed by non-contact, accounting for 35 cases (46.2%), and contact with ball, which accounted for 6 mentions (6.5%).

Regarding injury severity, the great majority were classified as mild (88.5%), followed by moderate injuries (9%), with only 2.5% being regarded as severe.

As for physiotherapeutic approach, in injuries occurring during the period of the study, and we found that this ranged from 0 to 120 physical therapy days.

In the correlation between physical therapy time and injury diagnosis, we noticed that injuries with chronic characteristics, such as tendonitis/ fasciitiis and those classified as 'others' required a longer physical therapy time compared to other kinds of injuries, and such correlation presented a statistically significant difference (p = 0.001) (Figure 3).

Regarding the correlation of physical therapy time and injured anatomical region, we noticed that knee and foot regions required a longer physical therapy time, but no statistically significant difference was found compared to other anatomical regions (p = 0.117) (Figure 4).

In what concerns to surgical approaches, these were more frequent on knee region, being also the region presenting the highest level of morbidity.

Finally, we questioned the athletes during championship if they presented any episode of sporadic pain not requiring them to be away from drills and games. We had 28 athletes (42%) who answered affirmatively to that question, with the lumbar region of spine being accountable for 14 mentions (40% of the cases), followed by knee with 10 mentions (29% of the cases), as the most frequently mentioned regions.

DISCUSSION

Backx et al.[1] report as sports with high injury risk those involving physical contact and jumps.

Basketball requires all basic movements of high-risk sports, such as jumps, landings, acceleration, deceleration, shifts and pivoting, which, alone, lend a potentially hurtful nature to it.

From the total number of athletes studied here, 47 (71.21%) suffered at least one injury during the period of study, which characterizes a high injury rate for a short-term study. Other authors found similar results [7,8].

We questioned if the sportive experience would reduce the number of injuries in older athletes, a fact that was not found here, because the ones presenting the lowest number of injures were the athletes belonging to the youngest age group as categorized in our study (lower than 20 years old). Oppositely, the highest the age group, the highest the number of consecutive injuries on a same athlete, which potentially characterizes stronger efforts required by each match on those players, who most of cases are the most challenged ones in court because of their experience, and those playing the highest number of matches. So, these are the athletes who most frequently suffer the consequences of previous injuries as a result of the longer times they have been playing basketball and of the stronger physical fatigue during games when compared to the younger athletes, thus increasing their risk of injuries.

Regarding the correlation between age and kind of injury, and age and injured anatomical region, no statistically significant correlation was found, but older athletes presented with a higher number of sprains and fracture/ dislocations than the younger ones, which perhaps, especially in cases of fractures/ dislocations due to their traumatic nature, is justified, since older athletes are usually the team's "stars", and consequently, the most "targeted" ones.

A fact that called our attention was a higher number of tendonitis/ fasciitis and lumbalgia/ dorsalgia in younger athletes, because such diagnostics with overload characteristics are thought to be more common in older athletes, but this has not happened.

Regarding the kind of injury, in our study, sprains were the most frequent kind, accounting for 33% of the cases, being more representative at ankle region, which is according to expectations, because the vast majority of studies in literature report the same for basketball athletes of both genders [2,9-11]. Then, we reported contusion in 24% of the total number of injuries, with both injury diagnostics combined representing over half of the number of injuries in this study. Contusions are reported by some authors as the major kind of injury in basketball players [7,12,13] which is acceptable, because of the continuous physical contact resultant from modern basketball.

Concerning grouped body region (trunk, head and limbs), a large portion of literature addressing basketball report lower limbs as the region with the highest incidence of injuries [2,10,11]. In our study, this was confirmed, where lower limbs accounted for 54% of all injuries.

In terms of the most commonly injured anatomical region in basketball, there are some controversies in literature, but most authors report the ankle region as being the most common one [8,9-11,13]. In our study, this anatomical region occupies the third position, mentioned in 14% of the cases.

Other authors report knee as the most commonly affected region[3,14,15]. In our study, the knee was the most affected region, accounting for 21% of total injuries.

Another increasingly important anatomical region according to studies addressing injuries incidence is the hand/ fingers region. In our study, this was the second most affected area, in 17% of the cases. There are authors who report this region as the most likely to be injured[2,16].

The majority of authors describe these three anatomical regions (ankle, knee, and hands/ fingers) as the most affected by injuries in basketball.

Regarding the correlation between athlete's position in court and the kind of injury, there was no statistically significant difference, the same happening regarding athlete's position in court and injured anatomical region, results similar to Gantus' [7]. But, Henry et al.[8] found differences for this correlation.

Concerning the questioning about a highest incidence of injuries in drills or games, literature shows some divergences: Gantus[7] report a higher number of injuries in drills than in games, but Henry et al.[8] and Gutgesel[12] say the opposite. In our study, we also found a higher number of injuries during drills, but the number of training sessions during a season

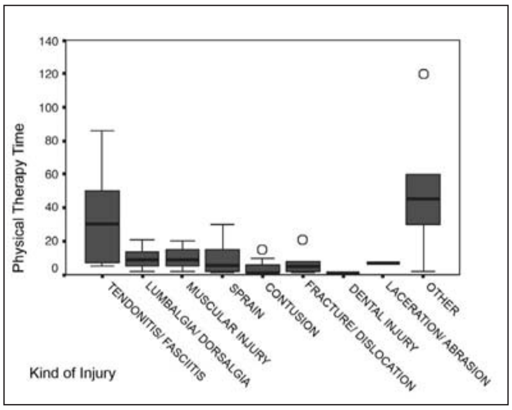

***Figure 3** – Distribution of frequency according to the correlation between physical therapy time and kind of injury.*

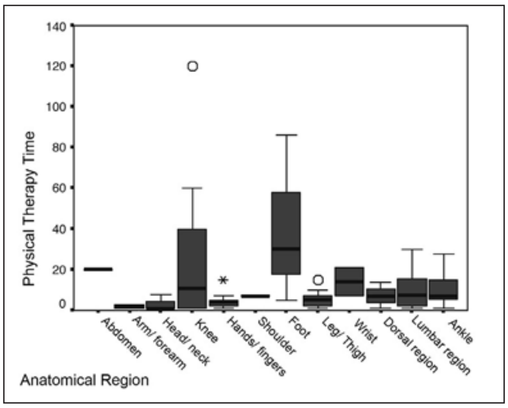

***Figure 4** – Distribution of frequency according to the correlation between physical therapy time and injured anatomical region.*

reaches 3 times the number of matches; thus, when we assess the incidence of injuries in drills and games, we conclude that, in fact, the incidence was higher in games (6.6 injuries/ athlete by 1000 matches) than in training sessions (1.8 injuries/ athlete by 1000 training sessions), the same being reported by Gomes et al.[17].

Regarding the mechanism of injury in our study, contact with other athlete was slightly superior, with 37 mentions (47.3%), followed by non-contact with 35 mentions (46.2%), and contact with ball with 6 reports (6.5%). Literature describes similar data for this item [18,19].

Regarding injury severity, most of literature studies addressing basketball report that mild injuries are prevalent [10,11]. In our study, these data were corroborated.

In our study, the athletes practiced five days a week in average, and played twice a week in average, meaning that basketball was played on a daily basis. This demonstrates that, especially for high level athletes, countless repeated movements are performed, such as jumps, landings, throws, pivoting, sudden shifts, which, alone, do increase the potential for acute injuries as a result of a higher number of exposures, as well as 'overuse' injuries by combining overloads occurred as a result of such mentioned movements. Thinking about this fact, we questioned the athletes regarding sporadic painful episodes occurring during the championship but not precluding them to play/ practice. We found 28 athletes (42%) who answered affirmatively to the question, with lumbar region with 40% of the total reports, and knee (29%) being the most affected portions, which corroborated the initial hypothesis of weekly overloads required to these athletes, and, even in a short-term study such as this (only one season), those overloads are noticeable.

Epidemiological studies in all categories and levels of the basketball are required for us to know the real circumstances of overload and even of traumatic injuries in those athletes.

This is easily accessible in global literature, but in a lower number for female elite athletes.

Similarly, many authors propose preventive measures for different injuries in basketball, but many of those measures are not seen in this sport.

Despite of these facts, we believe that when we work in interdisciplinary teams, where a common interest exists in reducing injuries in this sport activity, results can be achieved, with a shorter temporary leave from courts and a better performance. Furthermore, athletes' awareness regarding existent materials and techniques for injuries prevention is essential for their own protection, and for making the jobs of sports-related professionals easier. Providing current data concerned to musculoskeletal injuries epidemiology in elite female basketball athletes may be important for better understanding the overloads imposed on these athletes during a championship season. These analyses may be the groundings for preparing preventive measures in this sportive modality, targeting better performance, lower morbidity, better results and longer sportive life in elite athletes.

CONCLUSION

- A total of 47 athletes (71.2%) were affected by some kind of injury during the study.
- The incidence of injury was higher in games than in training sessions.
- The knee was the anatomical region most affected by injuries.
- Regarding diagnosis, sprain was the most common kind of injury, especially on ankle.
- Younger athletes (lower than 20 years old) presented with the lowest number of injuries.
- Contact with other athletes was the key mechanism of injury.
- Most injuries were regarded as mild.
- The knee region presented the highest level of morbidity.
- The knee region and the lumbar region of spine received the highest number of mentions when assessing sporadic pain.

ACKNOWLEDGMENTS

We would like to thank the physical therapists Ana Daumeister, Andréia Formigone, Fabian Perez, Fábio Rodrigues José, Milena Gomes Perroni, Milton Gameiro, Pedro Henrique Regasso and all the athletes who agreed to take part on the study. Without those people, this study would be nothing more than an idea.

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