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ABSTRACT

The purpose of this study was to record injuries in amateur males and females basketball players. These players participated in a domestic championship in Athens, during the 2000-2001 basketball season. An injury is considered the problem in musculoskeletal system that did not allow the player to continue the game or the training and might be out of the field for at least one day. Every injury was recorded by the coach of the team. From the start of the period until the end of the year 110 injuries in males and 86 in females were recorded. The rate was 0.72 injuries per male athlete per year, while for females the corresponding rate was 0.56. Males had more overuse injuries than females ($p < 0.02$), while females had more injuries in the lumbar spine ($p < 0.001$). Males had more knee sprains in the medial collateral ligament of ($p < 0.05$), while females had more sprains in the anterior cruciate ligament ($p < 0.005$). Both sexes sustained injuries during the games and in the second part. It is concluded that injuries in Greek amateur basketball players did not differ considerably from published studies. Further studies are needed in order that such injuries should be prevented.

KEY WORDS: *injury, amateur, strains, sprains, overuse.*

INTRODUCTION

Basketball is a sport that takes place in a small court and very tall subjects are involved. This demands good physical fitness such as equilibrium, peripheral vision, strength, power, flexibility and reaction time (26). During the game the players are jump, pivot, run forwards and backwards and change directions many times (20). These activities with the stress to succeed more points and to accept as possible fewer, put excessive mechanical forces in musculoskeletal system which usually injured (3). Moreover the playground, plays a great role in the pattern of injury (4).

Many epidemiological studies in colleges and professional athletes, in both sexes reveal that ankle and knee are the anatomical sites that are commonly injured. Sprains, strains and fractures are the common types of injuries. But in many countries the differences in basketball level render the comparison between the results difficult (2, 17, 20).

In Greece after the European championship of 1987, there was a dramatic increase of the number of participants and according to the Hellenic Basketball Union they were 200.000 males and 100.000 females who participated in different activity levels. Epidemiological data about Basketball injuries lack in our country. Only the professional teams record injuries through the medical crew they have.

The purpose of this study was to record injuries in amateur male and female basketball players in a prospective clinical trial and to compare these injuries with published studies.

SUBJECTS - METHODS

The study was approved by the regional medical ethics committee of the University of Athens. All patients signed informed consent forms. According to the Hellenic Basketball Union during the period 2000-2001, 247 teams participated in the domestic Athens and Pireas championship. In order that our results to be representative and comparable, twenty male and female teams were randomly chosen. In every team ten players participated. The coaches of the teams were physical education teachers with basketball speciality, who record the injuries. Coaches and players, after the selection, were informed in details about the purpose of the study and the way data will be collected. The coaches were provided with a standard sheet from the Sports Medicine Lab, in which injuries would be recorded. Every week the collected injuries's data were subjected to the Sports Medicine Lab University of Athens. The data included in the sheet were: the anatomical region of injury, the period that the injury occurred (training or game), the diagnosis of the injury and the kind of the selected therapy. The collected data were from whole season, meaning from the

6th of August 2000 until 20 June 2001. In addition at the end of the season, new data were gathered with a second questionnaire. They concerning the number of games in which every player participated, the number of training per week, the duration of each training session, information about injuries that needed surgery or hospital care and number of players on the roster.

As injury was considered the one that occurred during training or the game and had as a result the player to lose at least one training session or one game and might have to visit a physician or physical therapist.

The number of players that included in the study were divided by number of the players injured in order to record the injury rate.

STATISTICAL ANALYSIS

The comparison of the type of injuries, anatomical location, rate, risk and the incidence of injuries between two sexes were done by a chi-square test with a 95% confidence interval. The level of significance was set at 0.05 level 28.

RESULTS

The study population of the present study were 153 male and 136 female amateur basketball players. Males participated in 26 games and the females in 19 games. In these games were included not only these for the championship, but also for the league. During the 2000-2001 period, 110 injuries were recorded for the males with a rate 0.72 injuries per player per season, while the female had 86 injuries and a rate 0.63. This difference was not statistical ($p = 0.07$).

No differences were found between sexes in preconditioning injuries ($p = 0.267$), during training ($p = 0.283$) and during games ($p = 0.290$). Both males and females athletes suffered more injuries during games. The females had more injuries than males in the lumbar spine (14.0% V 5.5%, $p < 0.001$, *Table 1*). No differences were found between sexes in the ankle (31.8% V 24.5%, $p < 0.075$), knee ($p = 0.505$), fingers ($p = 0.583$), leg ($p = 0.565$), face ($p = 0.057$), head ($p = 0.565$), chest ($p = 0.572$), pelvis (0.555), wrist ($p = 0.581$), shoulder ($p = 0.573$) and thigh ($p = 0.365$). According to the injury type males had more overuse injuries than females (21.8% V 11.6%, $p < 0.02$). No differences were found in sprains ($p = 0.243$), fractures ($p = 0.165$), strains ($p = 0.175$), contusions ($p = 0.565$), dislocations ($p = 0.468$) and lacerations ($p = 0.643$). From the total of all injuries 62.6% occurred in upper extremities and 54.7% in the lower extremities. No differences were found between sexes in these injuries. The female athletes had more of knee sprains ($p < 0.03$), while males had more wrist sprains ($p < 0.04$).

Table 1. *Males/Females by percentage of injuries during the survey.*

	Males (N = 153)	Females (N = 136)
Injury type	Incidence (%)	Incidence (%)
Sprains	41.9	43.0
Overuse	21.8*	11.6
Strains	10.0	17.5
Fractures	10.9	12.8
Dislocation	6.4	3.6
Contusion	3.6	2.2
Lacerations	1.8	5.8
Concussion	3.6	3.5
Total	100.0	100.0

* = Males had a significant incidence of overuse injuries, compared with females ($p < 0.02$).

Table 2. *Males/Females by percentage of injuries during the survey.*

	Males (N = 153)	Females (N = 136)
Anatomical site	Incidence (%)	Incidence (%)
Ankle	31.8	24.5
Knee	13.7	15.1
Low back	5.5	14.0*
Fingers	7.3	7.0
Wrist	9.0	5.7
Face	5.5	5.8
Shoulder	6.3	6.6
Thigh	5.5	5.8
Leg	5.4	5.0
Head	3.7	3.5
Chest	3.6	4.7
Pelvis	2.7	2.3
Total	100.0	100.0

* = Females had a significant incidence of lowback injuries, compared with males ($p < 0.001$).

No differences were found in ankle, finger and shoulder sprains. Males had more knee sprains in the medial collateral ligament of ($p < 0.047$), while females had more sprains in the anterior cruciate ligament ($p < 0.005$). The mean absence of the athletes from the practice was 130.4 days for the males and 130.2 for the females. 62% of the males and 71% of the female athletes used physiotherapy for treating soft tissue injuries, while the rest used rest, ice, compression and elevation. No differences were found between two sexes in relation to playing surface.

DISCUSSION

The purpose of this study was to record injuries in a prospective clinical trial in a number of amateur males and females basketball players. In our country there are professional basketball players who participated in the professional National Basketball championship and amateur basketball players who participated in local championships in different Greek cities. We chose to study the amateur players, because professional teams had medical personnel who recorded every period injuries. There were no similar epidemiological data of injuries for amateur basketball players though. An other reason why we chose to study injuries in amateur basketball players was that the half of the total national teams are in Athens. Secondly, in most of the teams of Athens the coaches are physical education teachers with basketball speciality and great experience in sports injuries.

Basketball injuries have been investigated for many years. In current literature there are a lot of studies that have examined the severity and the rate of basketball injuries both in men and women (4, 8, 19, 25, 26, 32).

INJURY INCIDENCE

The incidence of injuries was 0.62 per male/per season and 0.73 per female per season. Our results are comparable with the results of the study of Messina et al (25). These researchers investigated the injury rate in colleges students who played basketball in a prospective manner. In one championship period a rate of 0.56 for the males and a 0.49 for the females was recorded ($p < 0.0015$). Although the injury rate of our study was slightly higher than the above study, there was no significant differences between sexes. The lower rate of the study of Messina et al (25), may be related with the basketball level, which in USA is higher than the subjects of our study. It may be related also with the age of the subjects, since the subjects studied were under eighteen year of age.

Other investigators used recorded injuries according to playing hours. In a study Colliander et al (9) interviewed high class basketball players during

1981-82 period. 58% of the males and 62% of females reported injuries. The rate was 2.5 injuries/1000 playing hours in males, while in females the rate was 2.85 injuries/1000 playing hours. McKay et al (23) investigated prospectively 10.393 participations and concluded that the injury rate was 24.7/per 1000 playing hours. This variation in injury incidence, among published studies depends on the method used for the collection of data, since several authors used retrospective questionnaires and it is very difficult for any athlete to remember with details the injuries that suffered. An other point is the exact the condition, «injury». To avoid this problem in our study we recorded the injuries that were sustained by the same subjects in one playing season. Moreover, we recorded all injuries that could affect the participation of the athlete in at least one training or game session.

TYPES OF INJURIES

We found that sprains were the most common type of injuries with a rate 0.27 for males and 0.30 for females athletes per season. These results are in accordance with the results of the studies by Gomez et al (12), Hickey et al (16), Chandy & Grana (7), Garick (11), Moritz & Grana (27) and Shivele et al (31). A large number of injuries that were recorded in our study were overuse in nature. The reason why these injuries occurred, is that many athletes of our study were older athletes that were members of teams of higher categories. Several of the older aged players stopped to play professional basketball because of the overuse injuries and continued their career to the lower level championships, such is the domestic amateur level of our study. The variation of males age was 16-42 y and of the females 15-36 y. Low physical fitness, twich training per week and the participation with the advantage of the technical experience, possibly made the athletes more vulnerable to sustain overuse injuries.

INJURY LOCATION

This study is in line with other studies' findings which reveal that the majority of basketball injuries occur in the lower extremities. Ankle and knee were the most common injured anatomical sites in both sexes accounting for 45.5% V 39.6% of total injuries respectively. No differences were found among males and females in these injuries. Apple et al (1) in their study, found that a 20% of total injuries occurred in the ankle, and 18% in the knee. In an other study by Herny et all (15) the percentage of injuries for the ankle was 24% and for the knee 14%. In these studies injuries were recorded only in males. Data from National Athletic Training Association (29), showed that 43% and 34% of injuries occurred in the ankle, and 9% and 17% in the knee. Moritz & Grana (27) recorded 48% and 38% of all injuries in the ankle and

12% and 11% in the knee. Similarly Zeliko et al (33) found that 22% and 25% of injuries occurred in the ankle and 18% and 19% in the knee. Hickey et al (16), analysed injuries that occurred in a high class Australian males and females basketball players in a retrospective study from 1990-1995. In this study participated 49 females basketball players aged 17.6 years old. After results analysis 223 injuries were recorded. The anatomical sites that were injured were the knee and ankle. Brebble et al (6) investigated the rate and the nature of injuries in a rural area from 1988 to 1994 in 6000 patients. 66.4% of the injured subjects were males. The anatomical site of the ankle was commonly injured (33.15%). Beachy et al (5), found that knee injuries were more than the ankle injuries. These data also included minor injuries that they did not demand absent from training or games. These injuries were investigated from the point of lost time and the ankle was the anatomical site that was injured more often. In an other retrospective study of the National Collegiate Athletic Association injury data, Arendt and Dick (2), found a higher rate in knee injuries among females. In a retrospective study in high class basketball players from Ireland and Wall (18), a higher percentage of knee injuries in females was found. Leanderson et al (22) retrospective studied the rate of sprains in 102 basketball players who answered a questionnaire. 92% of them had ankle sprain while playing basketball and 83% reported concurrent injury. The rate was 5.5 injuries/1000 hours activity. MacKay et al (24), in their study found a rate 1.25/per 1000 participation with second injury region calf/anterior leg with 0.29/per 1000 participations. Chandy and Grana (7) interviewed athletes injuries by phone with the cooperation of coaches and concluded that the common anatomical injury site was the knee. Most of studies independently of the methodology used, concluded that the common anatomical sites in both sexes were the ankle and knee.

GENDER RELATED TO INJURIES

It is accepted in recent years, that female basketball players are vulnerable to more injuries. The greatest reason is the training/skill ability, since males participate in several sports and increase this in comparison with the females.

In our study, we found some differences in knee injuries: females had anterior cruciate ligament sprains, while males medial collateral ligament sprains. Many studies investigated these injuries from different views.

Haycock and Gillette (14), made a hypothesis that the increased incidence of injuries in males, may have a relationship with height, body mass and possibly with strength of males basketball players, that cause collisions that lead to injuries.

Shively et al (31), investigated 79 high schools in Oklachoma by phone and concluded that females had more knee injuries, while the overall injury

rate was the same. In an other study by Zeliko et al (33), reviewed all injuries that occurred in high class basketball players for two seasons and found that females had high overall injury rate and high rate knee injuries. Gray et al (13), studied retrospective injuries in basketball players that asked medical advice in a sport medicine clinic during a two year period and concluded a higher injury rate in women. Lanese et al (21), reported that overall injury rate was the same between males and females that participated in same sports, but males had a higher injury rate in upper extremities, while females had more knee injuries. In a recent study by MacKay et al (23), investigated the basketball injuries in comparison with gender and standard of competition and they found that there was no difference.

TIME OF INJURIES

We found that a large percentage of injuries (68% V 73%) occurred during the second half of the games. The insufficient quantity of cardiovascular/muscular fitness and the progression of injury inductive fatigue are the main factors that can cause injuries in amateur basketball players. Another view is that the increased intensity in the second half of games is responsible for injuries in both sexes (3, 20, 26).

Males and females suffered injuries that occurred during the games. Although the time spent for training was longer than the spending time for games, the exposure time per participation hour in a game was double than in training. Other studies confirmed that the athletes were more vulnerable to injuries during games than in the training sessions (2, 8, 17, 18, 22, 30), while other have reported a higher injury percentage during the training, but these numbers must be compared with relative and not absolute participation time. Ferreti et al (10), concluded that the increased injury rate during the games depends on athletes overtrying and subject in to higher injury rate. More over the high competitive level during the games can make athletes more vulnerable to injuries.

VALIDITY AND RELIABILITY

We believe that physical education teachers with basketball specialty are the most appropriate authorities for the accurate collection of data. Coaches spend every day with athletes for the entire season and they know them very well. We try in our study to include teams that have trainers with basketball specialization, who could do the first diagnosis of sports injuries and collect the data. The collection of injury incidences in a week basis decrease the possibility to oversee some of them. More coaches at the end of playing season

can give more information about the participating athletes and give details about injuries that needed surgery. It must be supported that the injury data collection during different seasons could bias the results. The responsibility of the trainers who studied only one team for one season can increase the reliability and validity of an injury report. All coaches of our study manifest very good responsibility and a high sense of duty.

CONCLUSION

Our prospective study in male and female amateur basketball players participating in a local championship in Athens, revealed that both sexes suffered injuries that occurred during the games and not in the practice. Males had more overuse injuries while females more low back injuries. Ankle and knee were the anatomical sites that injured more commonly in both sexes. These injuries do not differ considerably from the published studies. Further studies are needed to find possible contributing factors to preventing injuries in amateur Greek population.

REFERENCES

1. Apple JD. Basketball injuries. An overview. *Phys SportsMed* 16(12): 64-74, 1988.
2. Arendt E, Dick R. Knee injury patterns among men and women in collegiate basketball and soccer. *Am J Sports Med*, 23: 694-701, 1995.
3. Basset FH. Basketball. In Schneider RC, Kennedy JC, Plant ML eds. *Sports Injuries Mechanisms, Prevention and Treatment*, Baltimore, Williams & Wilkins 1985, pp 79-90.
4. Bassett FH. Basketball. In, Fu FH and Stone DA eds. *Sports injuries: Mechanisms, Prevention and Treatment*, Baltimore, Williams & Wilkins, 1994 pp 209-222.
5. Beachy G, Akau CK, Mantinson M. High schools sport injuries. A longitudinal study at Panahu school: 1988-1996. *Am J Sports Med* 25: 675-681, 1997.
6. Brebble TB, Chyou PH, Wittman L, McCormick J, Collins K, Zoch T. Basketball injuries in a rural area. *WMJ* 98(7): 22-44, 1999.
7. Candy TA, Grana WA. Secondary school athletic injuries in boys and girls. A three year comparison. *Phys Sports Med* 13(3): 106-111, 1985.
8. Cohen AR, Metz J. Sports-specific concerns in the young athlete: basketball. *Pediatr Emerg Care* 16(6): 462-8, 2000.
9. Colliander E, Eriksson E, Herkel M, Skold P. Injuries in Swedish Elite Basketball. *Orthopaedics*, 9(2): 225-7, 1986.

10. Ferreti A, Puddu G, Marriani PP. Jumper's knee: An epidemiological study of volleyball players. *The Phys and Sports Medic* 12(10): 97-106, 1984.
11. Garick JG, Requa RK. Girl's sports injuries in high school athletics. *JAMA* 239: 2245-2248, 1978.
12. Gomez E, DeLee JC, Farney WC. Incidence of injury in Texas girls' high school basketball. *Am J Sports Med* 24 (5): 684-687, 1996.
13. Gray J, Taunton JE, MacKenzie DC. A survey of injuries to the anterior cruciate ligament of the knee in female basketball players. *Int J Sports Med* 6: 314-316, 1985.
14. Haycock CE, Gillete JV. Susceptibility of women athletes to injury. Myth V reality. *JAMA* 236: 163-165, 1976.
15. Henry JH, Laucear B, Neigut D. The injury rate in professional basketball. *Am J Sports Med* 10-16, 1982.
16. Hickey GJ, Fricker PA, McDonald WA. Injuries of young elite female basketball players over a six-year period. *Clinics J Sports Med* 7(4): 252-256, 1997.
17. Hippe M, Flint A, Lee RK. University basketball injuries: a five-year study of women's and men's varsity teams. *Scand J Med Scie in Sports(Copenhagen)* 3(2): 117-121, 1993.
18. Ireland ML, Wall C. Epidemiology and comparison of knee injuries in elite female and male United States basketball athletes. *Med Sci Sports Exerc* 22: s82, 1990.
19. Jackson MD, Moeller JL, Hough DO. Basketball injuries. In Sallis RE and Massamino F ed. *Essentials of sport medicine*, St. Louis, Mo., Mosby-Year Book 1996 pp 109-234.
20. Jackson MD, Moeller JL, Hough DO. Basketball injuries. In Sallis RE and Massamino F eds. *Essentials of sport medicine*, St Louis Mo, Mosby-Year Book 1996 pp 558-570.
21. Lanesse RR, Strauss RH, Leizmann, DJ. Injury and disability matched men's and women's intercollegiate sports. *Am J Public Health* 80: 1459-1462, 1990.
22. Leaderson J, Memeth G, Eriksson E. Ankle injuries in basketball players. *Knee Surg Sports Traum Arthr* 1(3-4): 200-2, 1993.
23. McKay GD, Goldie PA, Payne WR, Oakes BW, Watson LF. A prospective study of injuries in basketball: a total profile and comparison by gender and standard of competition. *J Sci Med Sport* 4(2): 196-211, 2001.
24. McKay GD, Goldie PA, Payne WR, Oakes BW. Ankle injuries in basketball: injury rate and risk factors. *Br J Sports Med* 35(2): 103-8, 2001.
25. Mesina DF, Farney WC, Delee JC. The incidence of Injury in Texas school basketball. A prospective study among male and female athletes. *Am J Sports Med* 27(3): 294-299, 1999.

26. Minkoff J, Simonson BG, Sherman OH, Cavaliere G. Basketball Injuries. In Renstrom, PAFH ed. Clinical practice of sports injury prevention and care, Oxford, Blackwell Scientific Publications 1994 pp 303-353.
27. Moritz A, Grana WA. High school basketball injuries. *Phys SportsMed* 6(10): 92-95, 1978.
28. Norusis MJ. SPSS 8.0 guide to Data Analysis. BK & Disk eds. 1998.
29. Powell J. Presentation of high basketball injuries in National Athletic Trainer Association Meeting (NATA), Baltimore, 1988.
30. Sickles RT, Lombardo JA. The adolescent basketball player. *Clinics in sports Medic* 12(2): 207-219, 1993.
31. Shively RA, Grana WA, Ellis D. High school sports injuries. *Phys SportsMed* 9(8): 46-50, 1981.
32. Sonzogni JJ, Gross ML. Assessment and treatment of basketball injuries. *Clinics in sports medic* 12(2): 221-237, 1993.
33. Zelisko JA, Noble HB, Porter M. A comparison of men's and women's professional basketball injuries. *Am J Sports Med* 10: 297-299, 1982.
34. Zvifac J, Thompson W. Basketball. In Caine DJ (ed.) et al, *Epidemiology of sports injuries*, Champaign, Ill., Human Kinetics Publishers, 1996 pp 86-97.

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