

HEALTH PROBLEMS OF BASKETBALL REFEREES: A PROSPECTIVE STUDY

PROBLEMAS DE SAÚDE EM OFICIAIS DE QUADRA DE BASQUETEBOL: ESTUDO PROSPECTIVO

PROBLEMAS DE SALUD EN ÁRBITROS DE BALONCESTO: ESTUDIO PROSPECTIVO

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ABSTRACT

Introduction: Basketball referees are the authorities responsible for ensuring that rules and regulations are followed and for making decisions. The ability of referees to respond to the physical and physiological demands imposed during the game is essential for good performance on the court. **Objective:** To understand the context in which health problems faced by basketball referees occur and to outline the epidemiological profile of musculoskeletal injuries. **Methods:** A prospective cohort study was conducted in which basketball referees were evaluated using a standardized form. The participants were monitored online weekly for 12 weeks using the Oslo Sports Trauma Research Center questionnaire to assess health problems, such as diseases (affecting the respiratory, cardiovascular, digestive or neurological systems) or musculoskeletal injuries (acute or from overuse). **Results:** The study sample consisted of 78 referees with a mean age of 36.5 (± 9.8) years. Most referees (97.4%) found it important to implement a preventive program. In relation to the health problems reported during follow-up, there was an incidence rate of 23.7 injuries per 1000 hours of play (95% CI 19.5 - 27.9) and the mean weekly prevalence of diseases was 3.2 (95% CI 0.4 - 6.0) and of injuries was 17.4 (95% CI 16.5 - 18.3). **Conclusion:** Through this study, it was possible to conclude that there was an incidence rate of 23.7 injuries per 1000 hours of play (95% CI 19.5 - 27.9) and a mean prevalence of diseases of 3.2 (95% CI 0.4 - 6.0) and musculoskeletal injuries of 17.4 (95% CI 16.5 - 18.3). The most common health problems that affected basketball referees were musculoskeletal overuse injuries of the lower limbs. **Level of evidence I; Prospective cohort study.**

Keywords: Athletic injuries; Disease; Epidemiology; Sports.

RESUMO

Introdução: Os oficiais de quadra de basquetebol são considerados autoridades oficiais responsáveis pelo cumprimento das regras e tomada de decisões. A capacidade de resposta dos oficiais às exigências físicas e fisiológicas impostas durante o jogo é fundamental para um bom desempenho em quadra. **Objetivo:** Compreender o contexto pelo qual ocorrem os problemas de saúde enfrentados por oficiais de quadra de basquetebol. E a partir disso, traçar o perfil epidemiológico de lesões musculoesqueléticas. **Métodos:** Estudo coorte prospectivo no qual foi realizado uma avaliação dos oficiais de quadra de basquetebol através de um instrumento de avaliação. Em seguida, foi realizado o acompanhamento semanal online por 12 semanas utilizando o questionário Oslo Sports Trauma Research Center para avaliar os problemas de saúde, sendo eles doenças (acometem sistema respiratório, cardiovascular, digestivo ou neurológico) e lesões musculoesqueléticas (agudas e sobrecarga). **Resultados:** A amostra foi composta de 78 oficiais de quadra com média de idade de 36,5 ($\pm 9,8$) anos. A maioria dos oficiais (97,4%) consideram importante a implementação de um programa preventivo. Em relação aos problemas de saúde durante o acompanhamento, houve uma taxa de incidência de 23,7 lesões a cada 1000 horas de jogo (IC 95% 19,5 - 27,9) e uma prevalência média semanal de doenças foi de 3,2 (IC 95% 0,4 - 6,0) e de lesões foi de 17,4 (IC 95% 16,5 - 18,3). **Conclusão:** Por meio deste estudo, foi possível concluir que houve uma taxa de incidência de 23,7 lesões a cada 1000 horas de jogo (IC 95% 19,5 - 27,9) e prevalência média de doenças de 3,2 (IC 95% 0,4 - 6,0) e de lesões musculoesqueléticas de 17,4 (IC 95% 16,5 - 18,3). Os problemas de saúde mais comuns que acometeram os oficiais de quadra de basquetebol foram as lesões musculoesqueléticas por sobrecarga em membros inferiores. **Nível de evidência I; Estudo de coorte prospectivo.**

Descritores: Traumatismos em atletas; Doença; Epidemiologia; Esportes

RESUMEN

Introducción: Los árbitros de baloncesto son las autoridades responsables por garantizar que las reglas y los reglamentos sean cumplidos y por la toma de decisiones. La capacidad de respuesta de los árbitros a las demandas físicas y fisiológicas impuestas durante el juego es fundamental para un buen desempeño en campo. **Objetivo:** Comprender el contexto en el que ocurren los problemas de salud de los árbitros de baloncesto y trazar el perfil epidemiológico de las lesiones musculoesqueléticas. **Métodos:** Fue realizado un estudio de cohorte prospectivo en el que los árbitros de baloncesto fueron evaluados por medio de un formulario estandarizado. Los participantes fueron monitorizados semanalmente en línea durante 12 semanas, usándose el cuestionario de Oslo Sports Trauma Research Center para evaluar los problemas de salud, como enfermedades (que afectan a los sistemas respiratorio, cardiovascular, digestivo



o neurológico) o lesiones musculoesqueléticas (agudas o por sobrecarga). Resultados: La muestra del estudio fue compuesta por 78 árbitros con promedio de edad de 36,5 (\pm 9,8) años. La mayoría de los árbitros (97,4%) consideró importante implementar un programa preventivo. Con relación a los problemas de salud durante el acompañamiento, hubo incidencia de 23,7 lesiones a cada 1000 horas de juego (IC 95%: 19,5 - 27,9) y la prevalencia promedio semanal de enfermedades fue de 3,2 (IC 95% 0,4 - 6,0) y de lesiones, 17,4 (IC 95% 16,5 - 18,3). Conclusión: Por medio de este estudio, fue posible concluir que hubo una tasa de incidencia de 23,7 lesiones a cada 1000 horas de juego (IC 95%: 19,5 - 27,9), y prevalencia promedio de enfermedades de 3,2 (IC 95% 0,4 - 6,0) y de lesiones musculoesqueléticas de 17,4 (IC 95% 16,5 - 18,3). Los problemas de salud más comunes que acometieron a los árbitros de baloncesto fueron las lesiones musculoesqueléticas de los miembros inferiores. **Nivel de evidencia I, Estudio de cohorte prospectivo.**

Descriptores: Traumatismos en atletas; Enfermedad; Epidemiología; Deportes.

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INTRODUCTION

Basketball is considered one of the most popular sports in the world.¹ The basketball game is conducted by court referees, table referees and a commissioner.² Basketball referees include a lead referee and one or two umpires, who are the considered responsible for ensuring that rules and regulations, making decisions about rule violations committed, and maintaining the spirit of the game.²⁻⁴

Their duties during a basketball game require them to move in different speeds and directions in order to position themselves properly on the court.^{3,4} Their ability to respond to the physical and physiological demands imposed by a game is essential for good performance on the court.⁴ A group of basketball referees' heart rates was measured during a championship and found to be an >150 beats per minute.⁵

Referees are also faced with high psychological demands, with acute stress during the games, due mainly to situations they report as stressful, such as "making an error", "aggressive coach or player reactions", and "the presence of important people".⁶ This means that it is quite possible to declare that the stress levels can be related to the risk of musculoskeletal injuries in sport.⁷

Despite the benefits derived from sports, practitioners are subject to musculoskeletal injuries.^{8,9} As there is a scarcity in the literature of studies carried out in basketball referees, we can observe the main musculoskeletal injuries that affect basketball players are injured in the lower limbs (63.7%),⁸ with mean costs of up to \$ 7,011 for the treatment.¹⁰

Recent studies address the importance to understand the context of sports injuries (personal, sociocultural and environmental).^{11,12} Although a sports injury in the biomedical perspective it is the same type of injury, with similar tissue damage and clinical prognosis, when considering the context in which each individual fits, the same injury can have different implications.¹¹ Given the complex nature of sports injuries, a more elucidated understanding of the problem is needed, which can be measured using qualitative research methods.^{11,12}

Objective

To understand the context in which health problems faced by basketball referees occur, such as diseases or musculoskeletal injuries and their respective complaints. And from the results obtained, outline the epidemiological profile of musculoskeletal injuries in this population.

METHODS

Study design

This prospective study was previously approved by the Ethics and Research Committee of the *Universidade Federal de São Paulo* (CAAE: 91116818.3.0000.5505). All participants signed voluntary informed consent form.

Participants

Among the eligibility criteria, basketball referees registered in *Federação Paulista de Basketball* present at the physical and theoretical annual test, both sexes, over the age of 18 and with a minimum practice time of one year as referees were included. Referees who refused to participate in the study were not included, and those who refused to remain in the study during the follow-up period were excluded.

Evaluation

Data collection was carried out in February 2019, and the referees were contextualized using standardized evaluation form structured by the authors based in the literature.^{9,13} The evaluation was self-administered performed using a standardized form, addressing: (i) personal data and history of refereeing, (ii) history of diseases and musculoskeletal injuries in the last 12 weeks, (iii) prevention of injuries, and (iv) characteristics of a preventive program.

After the initial evaluation, a weekly follow-up was then conducted online for a period of 12 weeks to assess the basketball referees' health issues. The health problems were reported with the Oslo Sports Trauma Research Center (OSTRC) assessment tool, which records health problems using four questions addressing: (i) sports participation, (ii) training volume, (iii) sports performance, and (iv) injury or diseases symptoms.^{14,15} The instrument has a severity score, that can be used as an objective measure of the consequences of injuries and to monitor injury evolution, ranging from 0 (absence of problems) to 100 (maximum severity level) points.^{14,15}

If the OSTRC resulted in a score greater than zero, the participants self-reported if the health problem to which they referred was a disease or injury.^{14,15} The participants defined the area of the body, the type, and the moment of injury, or then, the symptoms disease. For both health problems, respondents specified the number of days missed, the intensity of the symptoms,¹⁶ whether the health problem had been previously recorded, and necessity to seek health care, and their respective costs.¹⁵

The health problems were classified as disease if they involved other body systems (respiratory, cardiovascular, digestive or neurological system) and the injuries were subcategorized into acute (onset can be linked to a specific and identifiable injury event) and overuse (do not have a clearly identifiable injury event) injuries.¹⁵

Study size

Due to the scarcity of studies that evaluated musculoskeletal injuries in basketball referees, it was not possible to perform the sample calculation and, therefore, a sample was collected for convenience. However, considering the mean prevalence of health problems of basketball referees obtained during the follow up in the order of 20.6 (95% CI 18.6 - 21.2), we highlight a sample error of 1.3%.

Data analysis

All data analysis were performed on SPSS 20.0 software. Participant characteristics were first explored through descriptive analysis, and a histogram inspection was performed to check assumptions of data normality. Continuous variables with a normal distribution were summarized with means and standard deviations and categorical variables were presented in percentages and frequencies.

The incidence rate and their respective 95% confidence interval (CI) was calculated for the analysis of new musculoskeletal injuries, which consists of the number of new injuries by the person-time exposure measurement until the injury was identified (for not injured participants, the time of exposure was 12 weeks of follow-up).

The mean prevalence was calculated for health problems reported during the follow-up weeks. For this calculation, the number of referees reporting any health problem was divided by the number of referees responding to the instrument in the respective week, thereby normalized by the time of exposure.⁹

The mean prevalence of substantial health problems was also calculated. Substantial health problems were defined as problems leading to a moderate reduction, severe reduction, or complete incapacity to participate in typical training volume and performance (score of 2, 3, or 4 on questions 2 and 3).¹⁵ The severity score and the mean prevalence of health problems were presented in means, together with their associated 95% CI.

For cost analysis, the costs related to medical consultations, physiotherapy and massage sessions, medications and medical devices were considered as direct costs, which are presented in mean (*Reais*) and standard deviation or minimum and maximum value. And the indirect costs related to absenteeism at work or physical preparation were reported only the mean and standard deviation of the days missed.

RESULTS

In Table 1, we can observe personal data and history of refereeing of 78 referees included in this study.

Among the participants, 21 (26.9%) reported having suffered some kind of musculoskeletal injury in the last 12 weeks; five of these referees reported two injuries in that same time period, leading to a total of 26 injuries. In Table 2, we can observe injury prevalence and their costs in the 12 weeks prior to the initial evaluation.

All participants were asked about their understanding and what they do to prevent injuries, whether they consider themselves important and whether they already have a preventive program for referees, as can be seen in Table 3.

In Table 4, the referees reported which characteristics they considered ideal for the implementation of a preventive program.

Among the referees, two participants did not answer a single instrument during the follow-up, which resulted in a dropout rate of 2.5%, however they were not excluded from the analysis. The response rate had a mean of 72.9%, which means that each participant returned about 9 out of 12 weekly questionnaires.

During the follow-up, we can observe an incidence rate of 23.7 injuries per 1000 hours of play (95% CI 19.5 - 27.9). In relation the mean weekly prevalence, the musculoskeletal injuries was higher than diseases. (Table 5)

During the follow-up period, the referees had an exposure time of 2,312 hours of games, with a mean of 3.5 (± 1.2) matches per week. Among the reported injuries, 71 (58.7%) injuries occurring during the matches, 38 injuries (31.4%) during physical preparation, 8 (6.6%) during activities of daily living, and 4 (3.3%) while practicing another sport for recreation. Among the reported injuries, 68 (56.2%) of the participants

Table 1. Sample characterization (N=78).

Variables	N (%)
Sex	
Male	66 (84.6%)
Female	12 (15.4%)
Age (years)*	36.5 (± 9.8)
Body mass index*	25.5 (± 3.2)
Dominance	
Right	72 (92.3%)
Left	6 (7.7%)
Profession (except referee)	
Physical education professional	19 (24.4%)
Teacher	12 (15.4%)
Autonomous	6 (7.7%)
Others	41 (52.5%)
Work time per week (hours)*	33.5 (± 12.4)
Practice time as referees (years)*	11.8 (± 9.6)
Basketball matches per month*	17.4 (± 13.7)
Physical preparation (N=64)	64 (82.1%)
Bodybuilding	40 (51.3%)
Running	21 (26.9%)
Others	3 (3.9%)
Practice time per week (hours)*	6.3 (± 3.0)
Sport (N=42)	42 (53.8%)
Basketball	33 (42.3%)
Cycling	2 (2.6%)
Others	5 (11.9%)
Practice time per week (hours)*	4.9 (± 2.8)
Associated diseases (N=6)	6 (7.7%)
Systemic arterial hypertension	5 (83.3%)
Diabetes Mellitus	1 (16.7%)
Health insurance	37 (47.4%)
Health assistance by basketball organization	0 (0%)

*Mean (standard deviation).

Table 2. Injury prevalence in the last 12 weeks (N=78).

Variables	N (%)
Injury prevalence (last 12 weeks)	21 (26.9%)
Injury area (N=26)	
Knee	7 (26.9%)
Triceps surae	6 (23.1%)
Ankle	3 (11.5%)
Others	10 (38.5%)
Injury type (N=26)	
Tendinopathy	8 (30.8%)
Anterior knee pain	5 (19.2%)
Muscle injury	5 (19.2%)
Sprain	3 (11.6%)
Others	5 (19.2%)
Moment of injury (N=26)	
Physical preparation	17 (65.4%)
Arbitrament	9 (34.6%)
Complaints (N=17)	17 (21.8%)
Pain	12 (70.6%)
Edema	2 (11.8%)
Instability	2 (11.8%)
Others	1 (5.8%)
Training volume reduction	16 (76.2%)
Absence from arbitrament/ physical preparation	5 (23.8%)
Time (days)*	53 (± 74.8)
Absence from work	2 (9.52%)
Time (days)*	10.5 (± 13.4)
Treatment (N=14)	14 (66.7%)
Medical	4 (28.6%)
Physiotherapy	4 (28.6%)
Medical and physiotherapy	6 (42.8%)
Cost (R\$)†	964.63 (35.00 - 4,000.00)

*Mean (standard deviation); †Mean (minimum and maximum values).

Table 3. Knowledge and health support (N=78).

Variables	N (%)
Modifications to improve health condition	
Physical preparation	30 (38.4%)
Monitoring with specialized professionals	13 (16.7%)
Nutrition	11 (14.1%)
Others	6 (7.7%)
Nothing to modify	18 (23.1%)
Enough knowledge on preventing injuries	29 (37.2%)
Behavior to preventing injuries	
Physical preparation	43 (55.2%)
Heating and stretching	20 (25.6%)
Nutrition	4 (5.1%)
Others	2 (2.6%)
Nothing to prevent injuries	9 (11.5%)
Basketball organization has a preventive program	0 (0%)
Implementation of a preventive program	76 (97.4%)

Table 4. Injury prevention program characteristics (N=76).

Variables	N (%)
Moment	
Before physical preparation/ game	68 (89.5%)
After physical preparation/ game	8 (10.5%)
Frequency	
Once a week	7 (9.2%)
Twice a week	35 (46%)
Three times a week	34 (44.8%)
Time	
10 minutes	5 (6.6%)
15 minutes	17 (22.4%)
20 minutes	35 (46%)
30 minutes	19 (25%)
Professional to design the program	
Physiotherapist	52 (68.4%)
Physical education professional	19 (25%)
Alone	5 (6.6%)
Access to program	
Smartphone app	51 (67.1%)
Online/website	24 (31.6%)
Flyer/poster	1 (1.3%)

Table 5. Mean weekly prevalence of health problems.

Health problems	Mean (CI 95%)
Health problems	19,4 (18,6 - 20,2)
Disease	3,2 (0,4 - 6,0)
Injury	17,4 (16,5 - 18,3)
Acute	5,3 (4,3 - 6,2)
Overuse	12,1 (11,1 - 13,1)
Substantial health problems	4,8 (3,8 - 5,9)
Disease	0,9 (-0,1 - 1,8)
Injury	3,9 (2,8 - 4,9)
Acute	1,3 (0,8 - 1,8)
Overuse	2,6 (1,26 - 3,9)

did not seek professional medical care, 35 (28.9%) referees sought a doctor, and 18 (14.9%) referees sought a physiotherapist. The mean cost of participants with health problems was R\$ 30.30 (± 11.2), and 40 (33.1%) participants used medication.

Throughout the 12 weeks of follow-up, the mean weekly prevalence of injuries [17.4 (95% CI 16.5 – 18.3)] was higher than the mean weekly prevalence of diseases [3.2 (95% CI 0.4 – 6.0)]. (Figure 1) Overuse injuries [12.1 (11.1 – 13.1)] were more prevalent than acute injuries [5.3 (95% CI 4.3 – 6.2)] in most weeks, as can be seen in Figure 2.

In relation to substantial health problems, the mean weekly prevalence of injuries [3.9 (95% CI 2.8 - 4.9)] was higher than diseases [0.9 (95% CI -0.1 - 1.8)] in most weeks. (Figure 3) Despite the variation in the type of injuries, overuse injuries [2.6 (95% CI 1.26 - 3.9)] were more prevalent than acute injuries [1.3 (95% CI 0.8 - 1.8)], as seen in Figure 4.

The health problems had a mean of 30.5 (95% CI 29.3 - 31.6) on the severity score, while the substantial health problems had a mean of 29.3 (95% CI 28.1 - 30.5), as can be observed in more detail in Figure 5.

Injury duration mapping is also a way to measure the severity of musculoskeletal injuries. Table 6 shows how the majority of both acute and overuse injuries were defined as mild, with only one to three days of missed training/work.

DISCUSSION

To the best of our knowledge of the current literature, this is the first prospective study to measure the prevalence of basketball referees' health issues. The present study initially evaluated 78 basketball referees, with mean weekly prevalence of diseases was 3.2 (95% CI 0.4 - 6.0), and the mean weekly prevalence of musculoskeletal injuries was 17.4 (95% CI

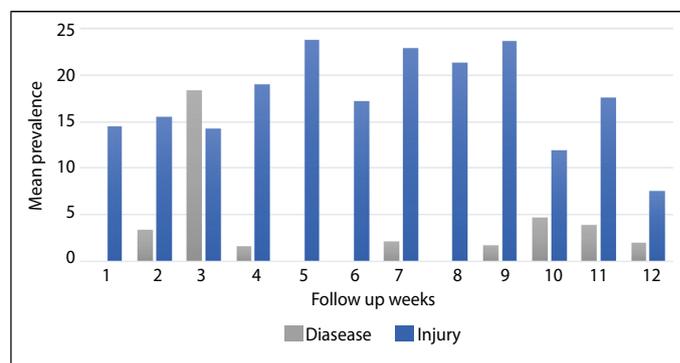


Figure 1. Mean weekly prevalence of health problems during the follow up measured using the OSTRC instrument.

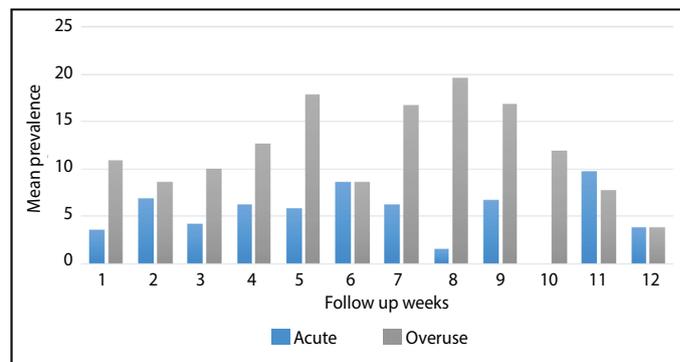


Figure 2. Mean weekly prevalence of injuries type during the follow up measured using the OSTRC instrument.

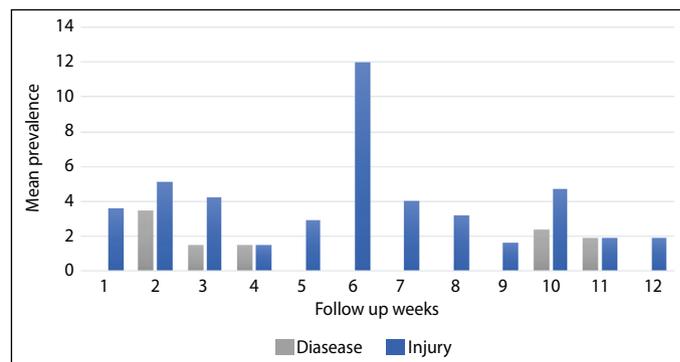


Figure 3. Mean weekly prevalence of substantial health problems during the follow up measured using the OSTRC instrument.

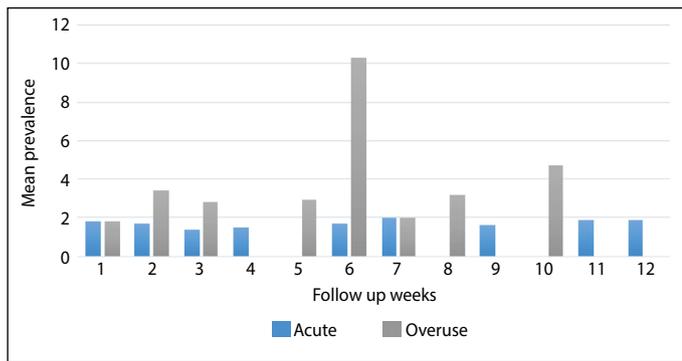


Figure 4. Mean weekly prevalence of injuries type (substantial health problems) during the follow up measured using the OSTRC instrument.

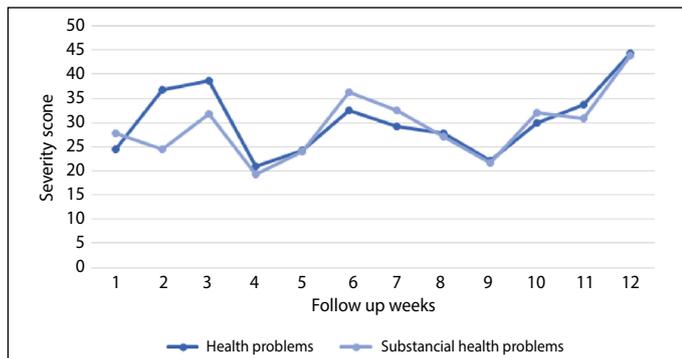


Figure 5. Severity score (0 to 100 points) during the follow up measured using the OSTRC instrument.

Table 6. Location and time lost due to severity of injuries.

Injury area	Minimum (1-3 days)	Mild (4-7 days)	Moderate (8-28 days)	Severe (>28 days)	Total
Acute injuries					
Thigh	2	0	0	0	2
Knee	2	0	0	0	2
Ankle	6	2	0	0	8
Low back	5	1	0	0	6
Calf	1	0	1	0	2
Overuse injuries					
Shoulder	2	0	0	0	2
Forearm	2	0	0	0	2
Hip/ groin	5	0	1	0	6
Thigh	1	0	0	0	1
Knee	9	2	0	0	11
Ankle	1	0	0	0	1
Foot	2	0	1	0	3
Low back	1	0	0	0	1
Achilles tendon	9	0	0	0	9
Total	48	5	3	0	56

16.5 - 18.3), with acute injuries primarily affecting the ankle and overuse injuries primarily affecting the knee.

The results of a study conducted with soccer referees from São Paulo showed that referees have a longer recovery time from muscle injury than athletes, inferring that athletes receive better attention and health care.¹⁷ This goes against the results obtained in our study that show that—in our country—basketball organizations do not provide professionals with health insurance plans. Referees were also unanimous in reporting a complete lack of formal guidance or education in ways for them to prevent musculoskeletal injuries.

As previously seen in athletes,¹⁸ the implementation of an injury prevention program for referees helps to minimize the incidence of musculoskeletal injuries.^{19,20} The identification and early intervention of musculoskeletal injuries can prevent an injury from getting worse,

generating worse consequences social, economic, health and sports participation and professional,⁹ but despite being elucidated in the literature, basketball referees from the state of São Paulo carry out injury prevention on a voluntary and independent way

Currently, injuries are commonly operationalized in the literature as the need to seek medical attention or time missed from sports activities.⁹ However, this is a reality that does not match the referee population, since, unlike athletes, referees do not have a medical team at their disposal. Moreover, when considering the time away from sports, referees do not play daily. In addition, probably due to financial need milder injuries do not lead to time loss, since Brazilian referees are paid according to the number of games played, which can contribute to an underestimated number of injuries.

The severity score provides an overview of the injury's evolution over time and also differentiates the periods of higher and lower severity.^{9,14} On a range from 0 to 100 points,¹⁴ health problems in our study had a mean of 30.5 (29.3 - 31.6). Therefore, we can conclude that most basketball referees have weightless injuries and few missed days (most of them ranging between 1 to 3 missed days). However, according to the literature, weightless injuries in sports are reported to be more frequent and can, therefore, be a more widespread problem.⁹ Indeed, we found that health problems had a mean weekly prevalence of 20.6 (95% CI 18.6 - 21.2), while substantial health problems that led to a reduction in training volume and performance had a lower mean weekly prevalence of 4.8 (95% CI 3.8 - 5.9).

To date, few studies in the literature have evaluated health problems in basketball referees. Our results are similar to studies with soccer referees, with musculoskeletal injuries being more prevalent in lower limbs.²⁰⁻²³ A prospective study with Premier Football League referees found an incidence rate of 5.75 injuries per 1000 hours,²³ while a prospective study with 2006 FIFA World Cup referees, showed an incidence of 20.8 injuries per 1000 hours,²¹ that are similar to our study with incidence rate of 23.7 injuries per 1000 hours of play (95% CI 19.5 - 27.9). When comparing the moment of injury, the injuries with Premier Football League referees occurred more frequently during football matches,²³ while FIFA World Cup referees showed a greater number of injuries in physical preparation,²¹ however, in our study there was a divergence at the moment of injury, in the initial evaluation there was greater report of injuries during physical preparation, and in the follow-up there was greater report of injuries during the match.

The principal strength of this article is that it is the first published article in the literature describing a prospective study on the health problems of basketball referees. The principal limitation of the study is that it was accomplished in the state of São Paulo, therefore must be taken when extrapolating the data to basketball referees residing in other regions or countries, and there was also a period of seasonality, as the initial assessment of the participants was carried out at the beginning of the basketball season. For future studies, it is suggested that basketball referees from different states and countries.

CONCLUSION

Through this study, it was possible to conclude that the basketball referees do not have health policies developed for this population. Regarding health problems, there was an incidence rate of 23.7 injuries per 1000 hours of play (95% CI 19.5 - 27.9) and a mean prevalence of disease of 3.2 (95% CI 0.4 - 6.0) and musculoskeletal injuries of 17.4 (95% CI 16.5 - 18.3), being that overuse injuries were more prevalent [12.1 (95% CI 11.1 - 13.1)] than acute injuries [5.3 (95% CI 4.3 - 6.2)]. Therefore, the most common health problems that affected basketball referees were musculoskeletal overuse injuries in the lower limbs.

All authors declare no potential conflict of interest related to this article

REFERENCES

1. Moura D, Fonseca F. Biomecânica e Traumatologia no Basquetebol. *Revista Medicina Desportiva informa*. 2016;7(5):24-7.
2. **Federação Internacional de Basketball (FIBA). Regras Oficiais de Basquetebol 2018 [Accessed in: 28 may 2020]. Available in: <http://www.cbb.com.br/comum/code/MostrarArquivo.php?C=NDMxMA%2C%2C>.**
3. Guillén F, Feltz DL. A conceptual model of referee efficacy. *Front Psychol*. 2011;2:25.
4. Borin JP, Daniel JF, Bonganha V, Moraes AM, Cavaglieri CR, Mercadante LA, et al. The distances covered by basketball referees in a match increase throughout the competition phases, with no change in physiological demand. *Open Access J Sports Med*. 2013;4:193-8.
5. Vaquera A, Mielgo-Ayuso J, Calleja-González J, Leicht AS. Sex differences in cardiovascular demands of refereeing during international basketball competition. *Phys Sportsmed*. 2016;44(2):164-9.
6. Kaisidis-rodafinos A, Anshel MH, Porter A. Personal and situational factors that predict coping strategies for acute stress among basketball referees. *J Sports Sci*. 1997;15(4):427-36.
7. Laux P, Krumm B, Diers M, Flor H. Recovery–stress balance and injury risk in professional football players: a prospective study. *J Sports Sci*. 2015;33(20):2140-48.
8. **Andreoli CV, Chiaramonti BC, Buriel E, Pochini AC, Ejinisman B, Cohen M. Epidemiology of sports injuries in basketball: integrative systematic review. *BMJ Open Sport Exerc Med*. 2018;4(1):e000468.**
9. Hespagnol Junior LC, Barboza SD, Van Mechelen M, Verhagen E. Measuring sports injuries on the pitch: a guide to use in practice. *Braz J Phys Ther*. 2015;19(5):369-80.
10. Knowles SB, Marshall SW, Miller T, Spicer R, Bowling JM, Loomis D, et al. Cost of injuries from a prospective cohort study of North Carolina high school athletes. *Inj Prev*. 2007;13(6):416-21.
11. **Bolling C, van Mechelen W, Pasman HR, Verhagen E. Context Matters: Revisiting the First Step of the ‘Sequence of Prevention’ of Sports Injuries. *Sports Med*. 2018;48(10):2227-34.**
12. Finch C. A new framework for research leading to sports injury prevention. *J Sci Med Sport*. 2006;9(1-2):3-9; discussion 10.
13. **Goutteborge V, van Sluis M, Verhagen E, Zwerver J. The prevention of musculoskeletal injuries in volleyball: the systematic development of an intervention and its feasibility. *Inj Epidemiol*. 2017;4(1):25.**
14. Clarsen B, Myklebust G, Bahr R. Development and validation of a new method for the registration of overuse injuries in sports injury epidemiology: the Oslo Sports Trauma Research Centre (OSTRC) overuse injury questionnaire. *Br J Sports Med*. 2013;47(8):495-502.
15. Clarsen B, Ronsen O, Myklebust G, Florenes TW, Bahr R. The Oslo Sports Trauma Research Center questionnaire on health problems: a new approach to prospective monitoring of illness and injury in elite athletes. *Br J Sports Med*. 2014;48(9):754-60.
16. **Karcioglu O, Topacoglu H, Dikme O. A systematic review of the pain scales in adults: Which to use? *Am J Emerg Med*. 2018;36(4):707-14.**
17. de Oliveira MC, da Silva AI, Paes MR. Incidência de lesão musculoesquelética em árbitros de futebol de São Paulo. *Rev Carioca Educ Fis*. 2015;10:115-22.
18. **Kilic Ö, Van Os V, Kemler E, Barendrecht M, Goutteborge V. The ‘Sequence of Prevention’ for musculoskeletal injuries among recreational basketballers: a systematic review of the scientific literature. *Phys Sportsmed*. 2018;46(2):197-212.**
19. Weston M, Castagna C, Impellizzeri FM, Bizzini M, Williams AM, Gregson W. Science and medicine applied to soccer refereeing: an update. *Sports Med*. 2012;42(7):615-31.
20. Bizzini M, Dvorak J. FIFA 11+: an effective programme to prevent football injuries in various player groups worldwide—a narrative review. *Br J Sports Med*. 2015;49(9):577-9.
21. Bizzini M, Junge A, Bahr R, Helsen W, Dvorak J. Injuries and musculoskeletal complaints in referees and assistant referees selected for the 2006 FIFA World Cup: retrospective and prospective survey. *Br J Sports Med*. 2009;43(7):490-97.
22. Bizzini M, Junge A, Bahr R, Dvorak J. Injuries and musculoskeletal complaints in referees—a complete survey in the top divisions of the Swiss football league. *Clin J Sport Med*. 2009;19(2):95-100.
23. Kordi R, Chitsaz A, Rostami M, Mostafavi R, Ghadimi M. Incidence, nature, and pattern of injuries to referees in a premier football (soccer) league: a prospective study. *Sports Health*. 2013;5(5):438-41.