

# INCREASED RISK OF SPORTS INJURIES AMONG MEDICAL STUDENTS: CROSS-SECTIONAL STUDY

## ELEVADO RISCO DE LESÕES ESPORTIVAS EM ALUNOS DE MEDICINA: ESTUDO TRANSVERSAL

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### ABSTRACT

**Objective:** To evaluate the nature and rate of sports injuries in medical students, as well as the risk factors at these events. **Methods:** All student-athletes (218) from a Medical School, integrated in at least one of the six team sport modalities (soccer, rugby, indoor soccer, handball, basketball, and volleyball) in 2017, were included. Injuries affecting their performance, regardless of time loss, were included. Athlete-exposure (A-E) was defined as one student-athlete participating in one practice or game. **Results:** Injury rates were significantly higher in junior medical students (1<sup>st</sup> – 3<sup>rd</sup> year) (7.58 per 1000 A-E, 95%CI = 6.11-9.06) than in senior medical students (4<sup>th</sup> – 6<sup>th</sup> year) (4.49 per 1000 A-E, 95%CI = 3.26-5.73) ( $p < 0.001$ ). Multi-sports athletes had higher injury rates (10.69 per 1000 A-E, 95%CI = 8.22-13.17) than single-sport athletes (4.49 per 1000 A-E, 95%CI = 3.51-5.47) ( $p = 0.002$ ). More than 60% of reported injuries occurred in the lower limbs and the mechanism that accounted for most injuries in games was player contact (51%); whereas in practice, it was non-contact (53%). **Conclusion:** Junior medical students present a higher injury rate than seniors. Medical students practicing more than one modality had a higher injury rate than those involved in just one sport modality. **Level of Evidence IV, Cross-Sectional Study.**

**Keywords:** Athletic Injuries. Students, Medical. Epidemiology.

### RESUMO

**Objetivo:** Avaliar a incidência e as características das lesões esportivas em alunos de medicina, assim como os fatores de risco envolvidos. **Métodos:** Todos os alunos (218) da Faculdade de Medicina da Universidade de São Paulo que integravam seis modalidades esportivas (futebol, rugby, futsal, handebol, basquete e vôlei) em 2017 foram incluídos. Foram incluídas as lesões que afetaram a performance, independente do tempo de afastamento. Uma exposição-atleta (E-A) foi definida como a participação de um aluno em um jogo ou treino. **Resultados:** A taxa de lesão foi maior em alunos do 1<sup>o</sup> ao 3<sup>o</sup> ano (7,58 por 1000 E-As 95% IC = 6,11-9,06) do que em alunos do 4<sup>o</sup> ao 6<sup>o</sup> ano (4,49 por 1000 E-As 95% IC = 3,26-5,73) ( $p < 0.001$ ). Alunos praticantes de mais de uma modalidade apresentaram maior taxa de lesão (10,69 por 1000 E-As, 95% IC 8,22-13,17) do que alunos praticantes de apenas uma modalidade (4,49 por 1000 E-As, 95% IC 3,51-5,47) ( $p = 0.002$ ). Mais de 60% das lesões ocorreram nos membros inferiores e o principal mecanismo em jogos foi contato com outro jogador (51%), e em treinos foi lesão sem contato (53%). **Conclusão:** Alunos do 1<sup>o</sup> ao 3<sup>o</sup> ano apresentaram maior taxa de lesão do que alunos do 4<sup>o</sup> ao 6<sup>o</sup> ano. Alunos praticantes de mais de uma modalidade apresentaram maior taxa de lesão do que alunos praticantes de apenas uma modalidade. **Nível de Evidência IV, Estudo Transversal.**

**Descritores:** Traumatismos em Atletas. Estudantes de Medicina. Epidemiologia.

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### INTRODUCTION

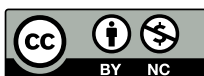
Medical School is a highly demanding course with potential drawbacks for students. Rates of depression and anxiety disorders are higher amongst medical students than among their nonmedical counterparts, and problems such as burnout and substance abuse are more frequent.<sup>1</sup> Growing evidence that physical exercise could be an option in facing these problems exist.<sup>2</sup> Participating regularly in a group fitness classes, in opposition to exercising alone or not

at all, can lead medical students to decrease their perceived stress and increase their the physical, mental, and emotional quality of life.<sup>3</sup> In Brazil, medical schools have a strong tradition in competitive sports tournaments. In addition to full-term classes and academic activities, medical students also participate in weekly practices and games in several sports modalities. Despite bringing several benefits to their quality of life, physical activity is a risk factor for musculoskeletal injuries.<sup>4</sup>

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

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The knowledge and surveillance of sports injuries are key components for preventing these events. According to van Mechelen, Hlobil, and Kemper,<sup>5</sup> to prevent sports injuries, a four-step procedure should be followed: 1) identify the problem; 2) establish cause and mechanism; 3) develop, evaluate, and implement interventions; and 4) reevaluate these strategies through continuous surveillance. The purpose of this study was to evaluate the injury rate and the nature of sports injuries in medical students, as well as the risk factors involved.

## METHODS

All student-athletes from the University of São Paulo Medical School (a 6-year course), Brazil, integrated in at least one of the six team sport modalities (soccer, rugby, indoor soccer, handball, basketball, and volleyball) in 2017 were included, totalizing 218 participants. An appropriate institutional review board approved the project (CAPPesq 3.044.669 – 28/11/2018) and each participant provided written informed consent before participation. The study is in accordance with the Helsinki Declaration of 1975, which was revised in 1983.

Data from exposures and injuries for the 2017 season were collected separately. Regarding exposures, a form summarizing the number of practices and games and the average number of participants for each activity were submitted weekly by each team through Google forms based on the National Collegiate Athletic Association (NCAA) exposure report (Appendix 1).<sup>6</sup> The authors collected data regarding injuries retrospectively, after the last practice or game of the 2017 season, based on the NCAA questionnaire (Appendix 2).<sup>6</sup> Demographic data on age, gender distribution, year of Medical School, and number of sports practiced were also collected at the end of the season.

A reportable injury had to meet the following criteria: 1) injury occurred as a result of participation in a university practice or game, and 2) injury resulted in restriction of the student-athletes participation or performance, regardless of time loss. Exposure was defined as one athlete participating in one practice or one game (athlete-exposure, A-E).<sup>6</sup>

Data on injury mechanisms (non-contact, other contact, player contact, and unknown), site of injury by body part (head and neck, upper limbs, torso and back, lower limbs, and other system), and severity of injury were analyzed as percentages. Injuries that resulted in at least 21 days away from sports activities were classified as severe.

A cross-sectional analysis was performed after injury and exposure data compilation. The analysis includes a comparison of injury rates in three categories: sports event (game vs. practice), year of medical school (junior athletes 1<sup>st</sup>- 3<sup>rd</sup> year vs. senior 4<sup>th</sup>-6<sup>th</sup> year) and the number of sports practiced (single-sport athletes vs. multi-sports athletes). Multi-sports athletes were those integrated in at least two sports modalities. Injury rates were expressed as the number of injuries per 1000 A-E,<sup>6</sup> with a confidence interval of 95%. For comparison between injury rates, the chi-squared test was used, with p-value < 0.05

## RESULTS

### Sample characteristics

In total, 218 student-athletes, from the six-year medical course, were included. 57.3% were men and 53% were enrolled from 1<sup>st</sup> to 3<sup>rd</sup> year, with a mean age of 22.51 ( $\pm$  2.6) years. 159 (73%) integrated a single sport modality, whereas 59 (27%) were multi-sport athletes.

### Number of injuries

Among the 218 student-athletes, 118 (54%) suffered at least one injury during the season. Among those, 72% (85) suffered just one injury, 23% (27) suffered two injuries, 3.2% (5) suffered three injuries and 0.6% (1) suffered four injuries. Altogether, in 2017, 25.622 exposures and 158 injuries were totaled.

### Game and practice injury rates

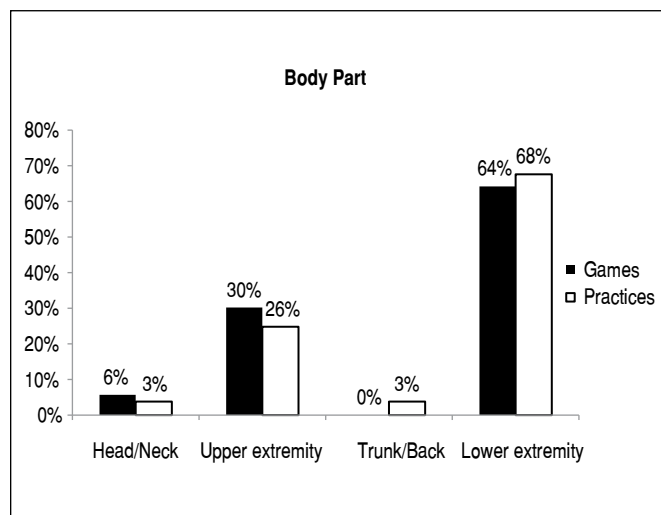
The game injury rate (15.18 per 1000 A-E, 95%CI = 10.96-19.40) was 3.21 times higher than the practice injury rate (4.72 per 1000 A-E, 95%CI = 3.8-5.6) (Table 1). These rates equal one injury every 3.3 games and 1 injury every 10.6 practices for a team of 20 participants, across all sports.

**Table 1.** Comparison of injury rates in three categories: Sports event, Year of Medical School, and Number of Sports Practiced.

Sports event	Injury rate per 1000 A-E, (95%CI)	p
Game	15.18 (10.96-19.40)	< 0.001
Practice	4.72 (3.8-5.6)	
Year of medical school		
Juniors (1 <sup>st</sup> -3 <sup>rd</sup> year)	7.58 (6.11-9.06)	< 0.001
Seniors (4 <sup>th</sup> -6 <sup>th</sup> year)	4.49 (3.26-5.73)	
No. of sports practiced		
Single-sport athlete	4.49 (3.51-5.47)	0.002
Multi-sports athlete	10.69 (8.22-13.17)	

### Distribution of injuries by body part

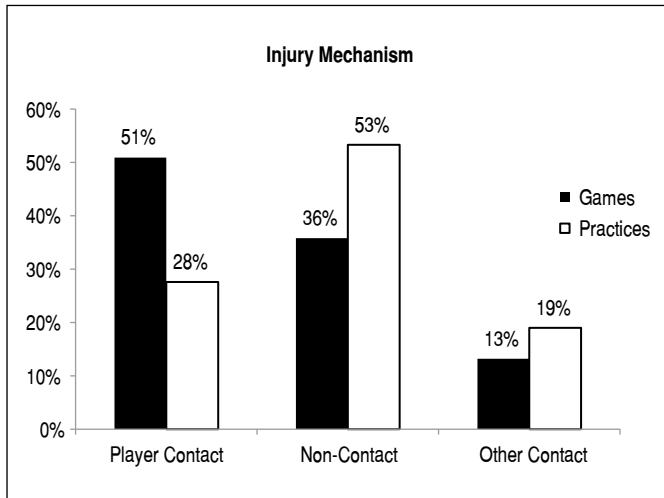
Figure 1 shows the distribution of injuries by body part. In both practices and games, more than 60% of the reported injuries were located in the lower limbs. Ankle (24.7%) and knee (14.6%) accounted for the most injuries. The incidence of ankle sprain was 1.40 per 1000 A-E (95%CI = 0.93-1.87) and incidence of anterior cruciate ligament (ACL) tear was 0.39 per 1000 A-E (95%CI = 0.14-0.63).



**Figure 1.** Distribution (percentages) of injuries by body part for games and practices for 6 sports in 2017.

### Injury mechanism

Figure 2 shows the injury mechanisms in relation to practice and game. The mechanism involved in most injuries in games was player contact (51%) and in practice was non-contact (53%).



**Figure 2.** Distribution (percentages) of injuries by injury mechanism for practice and games for 6 sports in 2017. Player contact: contact with another competitor; Other contact: contact with the playing surface, apparatus, ball or with other in the environment (e. g., wall, fence, spectators); Non-contact: no apparent contact (rotation on a planted foot) or other.

### Juniors x seniors injury rates

Junior student-athletes (1<sup>st</sup> – 3<sup>rd</sup> year) injury rate (7.58 per 1000 A-E 95%IC = 6.11-9.06) was 1.68 times higher than senior student-athletes (4<sup>th</sup> – 6<sup>th</sup> year) injury rates (4.49 per 1000 A-E 95%IC = 3.26-5.73), across all sports (Table 1).

### Single-sports x multi-sports athletes injury rate

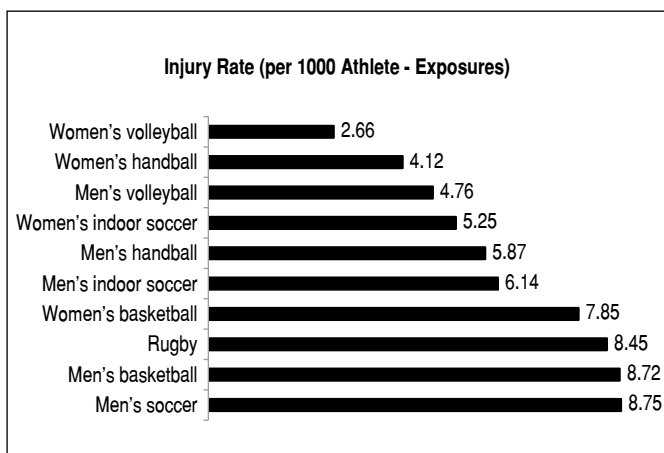
Multi-sports athletes' injury rate (10.69 per 1000 A-E, 95%IC 8.22-13.17) was 2.40 times higher than single sports injury rate (4.49 per 1000 A-E, 95%IC 3.51-5.47), across all sports (Table 1).

### Time loss

The mean time loss was 40.1 days (95%CI = 30.62-49.59). There was a high incidence of severe injuries (48%). The knee accounted for most of the severe injuries (25.9%) followed by leg and ankle (20.7%), and shoulder (14.2%).

### Injury rates by sport

As shown in Figure 3, the highest injury rates were: men's indoor soccer (8.75 per 1000 A-E), men's basketball (8.72 per 1000 A-E), and rugby (8.45 per 1000 A-E).



**Figure 3.** Injury rate (game + practice) by sports in 2017.

## DISCUSSION

This study analyzes the injury rate and nature of sports injuries in medical students. Although enrolled in a high demanding course with 6 years of duration and full-term classes, medical students engage in weekly practices and competitive sports tournaments in Brazil. We found high rates of game and practice injuries (15.18 per 1000 A-E, 95%CI = 10.96-19.40 or one injury every 3.3 games and 4.72 per 1000 A-E, 95%CI = 3.8-5.6 or 1 injury every 10.6 practices for a team of 20 participants). A retrospective analysis of 396 student-athletes – including medical students – conducted by our group for the 2013 season, found similar rates.<sup>7</sup>

The sudden increase in physical demand, considering that most students lead a sedentary lifestyle prior to entering Medical School, may explain the higher incidence of injuries in junior students (1<sup>st</sup> – 3<sup>rd</sup> years) compared with seniors (4<sup>th</sup> – 6<sup>th</sup> years), 7.58 per 1000 A-E 95%CI = 6.11-9.06 and 4.49 per 1000 A-E 95%CI = 3.26-5.73, respectively. A Chinese study with university athletes identified freshman students as a risk group for sports injuries.<sup>8</sup> These findings reinforce the importance of an adequate pre-participation assessment as well as a pre-season plan.

Another possible risk factor of injuries in this population is the considerable number of students practicing more than 1 sport modality (27%). These multi-sports athletes presented a higher injury rate (10.69 per 1000 A-E, 95%CI = 8.22-13.17) than students practicing a single modality (4.49 per 1000 A-E, 95%CI = 3.51-5.47). The frequency of practices and games was strongly associated with physical activity-related injuries in a study with more than four thousand university students.<sup>8</sup> Moreover, it is well known that insufficient sleep time, less than six hours per day, is associated with fatigue injuries,<sup>9</sup> a very common concern among medical students.

In contrast with NCAA, a high prevalence of non-contact injuries was found. This was the main mechanism of practice injuries (53%) and the second most common of game injuries (36%). Non-contact injuries represented just 36% and 17% of practices and game injuries in the NCAA, respectively (10). Medical students also had a high incidence of ACL tear (0.39 per 1000 A-E, 95%CI = 0.14-0.63) compared with NCAA (0.15 per 1000 A-E, 95%CI = 0.14-0.15).<sup>10</sup> The high incidence of non-contact injuries may reflect poor physical conditioning of medical students, reinforced by the fact that neuromuscular training programs decrease non-contact injuries such as ACL tear.<sup>11</sup>

Regarding body part injuries, lower limbs represented most of practice and games injuries. Following previous literature,<sup>12</sup> the ankle was the most common location of injury (26%), followed by the knee (15%). However, considering severe injuries, the knee was the most affected (26%), followed by the leg and the ankle (21%). The well-established preventive programs to reduce lower limbs injuries are a potential alternative to improve sports safety among medical students.<sup>13</sup>

## CONCLUSION

Junior medical students presented a higher injury rate than seniors. Medical students practicing more than one modality had a higher injury rate than those involved in just one sport modality. Future preventive programs should focus on lower limb injuries, especially in junior medical students and in those practicing more than one sport modality.

### Study limitations

This study may be susceptible to memory bias, meaning that a subject may have reported only the injuries that he was able to remember at the end of the season. Another important limitation

is that participating in a match accounted for 1 A-E regardless of time played, due to the technical limitation on accurately assessing time on court or field. Therefore, the expected injury rate may vary significantly among participants with drastically different amounts of minutes played per match.

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**AUTHORS' CONTRIBUTIONS:** Each author contributed individually and significantly to the development of this article. AMA: manuscript drafting, data acquisition, and interpretation, critical review of the study's intellectual content; IJ: data acquisition and interpretation, critical review of the study's intellectual content; NABC: data acquisition and interpretation, statistical analysis, critical review of the study's intellectual content; AP: statistical analysis, critical review of the study's intellectual content; AJH: critical review of the study's intellectual content, final review, and approval of the manuscript version; TLF: manuscript drafting, critical review of the study's intellectual content, final review, and approval of the manuscript version.

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**APPENDIX I**  
**2017 EXPOSURE REPORT**

**EXPOSURE DEFINITION:** One athlete participating in one practice or competition where he or she is exposed to the possibility of an athlete injury (athlete-exposure, A-E). Game participants must have actual playing time.

1. Sport:

(1) men's soccer (2) rugby (3) men's volleyball (4) women's volleyball (5) men's handball (6) women's handball (7) men's indoor soccer (8) women's indoor soccer (9) men's basketball (10) women's basketball

2. Week: .....

3a. Number of practices this week: .....

3b. Average number of participants per practice: .....

4a. Number of games this week: .....

4b. Number of participants with actual playing time:

Game 1: ..... ..

Game 2: .....

Game 3: .....

Game 4: .....

Game 5: .....

Additional comments (optional):

This questionnaire is a version of Injury Surveillance System from NCAA (Dick, R., Agel, J., and Marshall, S.W. (2007). National collegiate athletic association injury surveillance system commentaries: Introduction and methods. Journal of Athletic Training 42, 173-182.)

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NCAA Chief Medical Officer

**APPENDIX II**  
**2017 INJURY QUESTIONNAIRE**

**INJURY DEFINITION: A reportable injury is defined as one that:**

1. Occurs as a result of participation in an organized university practice or contest; and 2. Injury resulted in restriction of the student-athlete's participation or performance regardless of time loss.

1. Name: .....
2. Phone number: .....
3. Medical School Year (1<sup>st</sup> – 6<sup>th</sup>): .....
4. Gender: (1) male (2) female
5. Height: .....
6. Weight: .....
7. Sports practiced: (1) soccer (2) rugby (3) volleyball (4) handball (5) indoor soccer (6) basketball
8. Playing position: .....
9. Dominant body side: (1) right (2) left

**INJURY No.1**

**1. Sport of injury no.1:** .....

**2. Month of injury no.1:**

(1) jan (2) feb (3) mar (4) apr (5) may (6) jun (7) jul (8) aug (9) sep (10) oct (11) nov (12) dec

**3. Injury no.1 occurred during:**

- (1) Preseason (before first regular-season match) (3) Postseason (after final regular-season match)  
(2) Regular season (99) other: .....

**4. Injury no.1 occurred in:**

- (1) Practice (2) Game

**5. Injury no.1 occurred during:**

- (1) game or practice first half (2) game or practice second half

**6. This injury no.1 is a:**

- (1) New injury (5) Recurrence of other-sport injury  
(2) Recurrence of injury from this season (6) Recurrence of non-sport injury  
(3) Recurrence of injury from previous season (this sport) (7) Complication of other-sport injury  
(4) Complication of previous injury (this sport)

**7. Main body part injured in injury no.1:**

- |                |                |                     |                         |
|----------------|----------------|---------------------|-------------------------|
| (1) head       | (10) shoulder  | (20) pelvis or hips | (29) stomach            |
| (2) face       | (11) clavicle  | (21) groin          | (30) spleen             |
| (3) teeth      | (12) scapula   | (22) buttocks       | (31) kidney             |
| (4) neck       | (13) upper arm | (23) upper leg      | (32) external genitalia |
| (5) upper back | (14) forearm   | (24) knee           | (33) coccyx             |
| (6) ribs       | (15) elbow     | (25) lower leg      | (34) breast             |
| (7) sternum    | (16) wrist     | (26) ankle          | (99) other: .....       |
| (8) lower back | (17) hand      | (27) foot           |                         |
| (9) abdomen    | (18) finger(s) | (28) toe (s)        |                         |

**8. Body side injured:**

- (1) right
- (2) left

**9. Knee injury:**

- (1) collateral ligament
- (2) anterior cruciate ligament
- (3) posterior cruciate ligament
- (4) torn cartilage (meniscus)
- (5) patella and or patella tendon
- (6) other tendon
- (99) other: .....

**10. This injury involved:**

- (1) contact with another competitor
- (2) no apparent contact (other)
- (3) contact with apparatus/ball
- (4) contact with other in environment (e.g., wall, fence, spectators)
- (5) no apparent contact (rotation on planted foot)
- (6) contact with playing surface
- (99) other: .....

**11. Primary type of injury no.1:**

- (1) contusion
- (2) laceration
- (3) bursitis
- (4) tendinitis
- (5) ligament sprain (incomplete tear)
- (6) ligament sprain (complete tear)
- (7) muscle-tendon strain (incomplete tear)
- (8) muscle-tendon strain (complete tear)
- (9) osseous edema
- (10) torn cartilage
- (11) AC separation
- (12) dislocation (partial)
- (13) dislocation (complete)
- (14) fracture
- (15) stress fracture
- (16) concussion
- (17) heatstroke
- (18) hemorrhage
- (19) infection
- (20) avulsion (tooth)
- (21) nerve injury
- (22) blisters
- (23) hernia
- (24) foreign object in body orifice
- (25) internal injury (non-hemorrhage)
- (26) infection
- (27) periostitis
- (28) inguinal hernia
- (99) other: .....

**12. Did this injury require surgery?**

- (1) Yes, in-season
- (2) Yes, postseason
- (3) No

**13. Describe the joint surgery?**

- (1) Arthrotomy
- (2) Diagnostic arthroscopy
- (3) Operative arthroscopy
- (4) no joint surgery:
- (99) other: .....

**14. Injury assessment (best assessment procedure):**

- (1) clinical exam by athletic trainer
- (2) clinical exam by physician
- (3) X-ray
- (4) MRI
- (5) other image technique
- (6) surgery
- (7) blood work lab test
- (99) other: .....

**15. Days lost from sport activity:** .....

Additional comments (optional):

This questionnaire is a version of Injury Surveillance System from NCAA (Dick, R., Agel, J., and Marshall, S.W. (2007). National collegiate athletic association injury surveillance system commentaries: Introduction and methods. Journal of Athletic Training 42, 173-182.)

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