

# Prevalence of Ankle Injuries in Physical Education and Sports Classes among Saudi High School Male Students in Riyadh, Saudi Arabia

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## ABSTRACT

**Objective:** Physical education and sports classes are mandatory for male high school students in Saudi Arabia. Nevertheless, participation in sports activities increases the risk of injury. This study aims at assessing risk factors and estimating the prevalence of ankle injuries in physical education and sports classes among high school male students in Riyadh, Saudi Arabia. **Methods:** A cross-sectional study was conducted, using a data collection sheet about demographic and clinical characteristics of students and Foot and Ankle Disability Index to measure the degree of disability. Schools were chosen by cluster sampling of the four regions of Riyadh city. Three schools from each region were selected by simple random sampling. In each school, one section randomly selected from each grade, and eleven students were selected from each section by simple random sampling. **Results:** The prevalence of ankle injuries of the included participants ( $n = 399$ ) at the study time, last month, last 6 months, last 12 months, and high school time were 14%, 21.1%, 30.3%, 31.7%, and 34.7%, respectively. **Conclusions:** One-third of students had an ankle injury during the high school time; only one-fifth needed treatment.

**Keywords:** Ankle, injury, prevalence, Saudi Arabia, sports, students

## INTRODUCTION

In Saudi Arabia, physical education and sports classes are mandatory for high school students. There are more than 500,000 male high school students in Saudi Arabia.<sup>[1]</sup> Sports activities benefits are many such as increase physical fitness, establish a healthy lifestyle, and better academic performance.<sup>[2]</sup> Nevertheless, the risk of injury increases from participation in sports activities. The increased number of activities among young adults lead to musculoskeletal injuries, which is considered as a public health burden.<sup>[3-5]</sup>

Playing with an injured ankle will apply more pressure and may lead to long-term effects and more injuries if not treated properly.<sup>[6]</sup> Furthermore, a significant economic cost affects the society from high school sports injuries.<sup>[7]</sup>

Ankle sprain is defined as a sudden twist that tenses the structures around the joint. It can be no more than painful wrenching of soft tissue. However, ligament rupture may

result if a severe force is applied.<sup>[8]</sup> Inversion of the planter flexed foot is the most common injury mechanism,<sup>[9]</sup> which affects the lateral ligaments of the ankle in more than 90% of the cases.<sup>[8]</sup> Risk factors include those involved in jumping sports such as basketball, having conditions such as hindfoot varus or history of ankle sprain.<sup>[10]</sup> The typical presentation is a history of twisting ankle followed by pain, tenderness, swelling, and ecchymosis.<sup>[8]</sup> Ankle sprain is diagnosed through a history of the incident and physical examination to rule out other conditions.<sup>[11]</sup>

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In high school sports, the ankle is one of the frequent sites of injury in the musculoskeletal system in this age group.<sup>[12]</sup> Ankle sprains are common sports injuries that are usually encountered by primary care physicians, especially from teenagers and young adults.<sup>[11]</sup> They account for 22.6% of all injuries, with a total ankle injury rate of 5.23 injuries per 10,000 people in the US.<sup>[13]</sup> In the United States, a study on high school students revealed that ankle sprain was the most reported sports injury with approximately 15% of all injuries in high school students. About 49% of ankle sprains caused loss of participations from 1 to 6 days, and 42% were caused by accident with another person.<sup>[14]</sup> Certainly, we do not have studies in Saudi Arabia on ankle injuries among high school students.

From an economic perspective, ankle injuries are a significant burden on families and society. In a study done in 2007 in North Carolina High School, United States, ankle injuries were found to cost \$ 11,925 per injury.<sup>[7]</sup> From this study, the significance of our study becomes evident, as our study aims to provide the prevalence of ankle injuries in Riyadh's city population, which may help to develop cost-effective programs aimed at injury prevention in the schools' settings.

## MATERIALS AND METHODS

### Subjects

This is a cross-sectional study conducted in Riyadh city in the academic year 2016–2017. Ethical approval was obtained from the institutional review board. The patient's data were dealt with full confidentiality, and the data were kept on a file in a secure location in work PC's only. It included students at the high schools only, Saudi national, male gender, and excluded students with any underlying inflammatory symptoms (assessed through proper history taking) and any foot or ankle congenital diseases. Riyadh has 132,490 male high school students.<sup>[1]</sup> Using the website Raosoft, with a 95% confidence level, and  $\pm 5\%$  margin of error and assuming injury prevalence in high school athletes during their high school time of 50%, the estimated sample size was 384. We have increased the total number to 399 for sampling purposes. Schools were chosen by cluster sampling by regions (North, South, West, and East). Three schools were selected from each region by simple random sampling. In each school, one section was picked randomly from each grade, and from each section, eleven students were selected by simple random sampling.

### Study protocols

The data were collected using a data collection sheet including demographical and clinical characteristics of the students, with a Foot and Ankle Disability Index (FADI) questionnaire to assess the disability of students. Each participant in each group has filled the attached data collection sheet and the informed consent. The questionnaires and data collection sheets were distributed and collected personally by the researchers. The following main variables were included in the data collection sheet: Demographic data, information

about lifestyle, work environment, and information about ankle injuries. FADI questionnaire was provided to measure the index of FADI. The latest version of FADI, which was published in 1999 by Martin *et al.*, Many consider FADI to be the gold standard for the degree of disability measurement, and to look for quality of life and estimate it in foot and ankle injured patients. This self-completed questionnaire contained four pain-related items and 22 activity-related items.<sup>[15]</sup>

### Statistical analysis

#### Score interpretation

Each of the 34 items is scored on a 5-point Likert scale from zero to four. The FADI has a total point value of 104 points.<sup>[15]</sup> All collected data were coded in Excel sheet and then transferred to SPSS, version 20, IBM company, New York, USA, which was used for data analysis. Categorical variables were presented by frequencies and percentages, while numerical variables were presented as a mean and standard deviation. Logistic regression was used to assess the risk factors of ankle injuries among students. A two-sample *t*-test was used to assess the difference between mean FADI score with and without ankle injury for all categories. All tests were declared significant whenever the  $P < 0.05$ .

## RESULTS

The study included 399 high school students from grade ten to twelve. Students' baseline characteristics and level of training are presented in Table 1. Majority of students 275 (69%) had normal weight, 55 (14%) were underweight, 50 (13%) were overweight, and only 19 (5%) were obese. Regarding physical activities, 86 (22%) students exercised at most 1 h/week, whereas 108 (27%) exercised from 2 to 3 h/week, 85 (21%)

**Table 1: Baseline characteristics and level of training among participants ( $n=399$ )**

| Variable                                 | Category                   | <i>n (%)</i> |
|--|----------------------------|--------------|
| Age                                      | 15                         | 13 (3.3)     |
|  | 16                         | 142 (35.6)   |
|  | 17                         | 117 (29.3)   |
|  | 18                         | 121 (30.3)   |
|  | 19                         | 3 (0.8)      |
|  | 20                         | 3 (0.8)      |
| BMI ( $\text{kg}/\text{m}^2$ )<br>groups | Underweight (<18.5)        | 55 (13.8)    |
|  | Healthy weight (18.5-24.9) | 275 (68.9)   |
|  | Overweight (25-29.9)       | 50 (12.5)    |
|  | Obese (>30)                | 19 (4.8)     |
| Exercise per<br>week (h)                 | 0-1                        | 86 (21.6)    |
|  | 2-3                        | 108 (27.1)   |
|  | 4-6                        | 85 (21.3)    |
|  | 7+                         | 120 (30.1)   |
|  |                            |              |
| Doing stretching<br>exercise             | Yes                        | 206 (51.6)   |
|  | No                         | 193 (48.4)   |
| Doing preventive<br>strategies           | Yes                        | 139 (34.8)   |
|  | No                         | 260 (65.2)   |

BMI: Body mass index

exercised from 4 to 6 h/week, and 120 (30%) of students exercised at least 7 h/week. The percentages of students who do stretching exercises and preventive strategies were 52% and 35%, respectively.

Table 2 shows that the prevalence of ankle injury in the study group. The main source of ankle injuries among high school students was soccer with 31%. However, 74 (19%) students received treatment because of the ankle injury, Table 3.

Table 4 summarizes the prevalence of ankle injuries among high school students by the baseline characteristics. Body mass index, number of hours of exercise per week, and doing stretching exercises before the session have no significant effect on the prevalence of ankle injury for at the study time, last month, or high school time. High school time and the last 12 months prevalence of ankle injuries are higher among those who do preventive strategies ( $P = 0.022$  and  $0.031$ , respectively).

Percentages are within each category for at the study time, last month, last 6 months, last 12 months, and high school time (row percent).

## DISCUSSION

Playing soccer was the most common sports that caused ankle injuries in the current study. Nelson *et al.* reported that soccer accounted for 33.6% of all ankle injuries.<sup>[13]</sup> Soccer is considered the most popular sport in Saudi Arabia, and the most practiced in physical education classes specifically. Swift

changes in direction while running is the likely explanation for the findings that this sport had the highest ankle injuries rate in addition to the very high exposure to this specific sport in physical education classes.

Out of 399 students, only five injured when they were playing basketball (1.3%). It is suggested that when jumping, the foot would naturally fall into plantar flexion and inversion, so if the feet at the time of landing were incorrect, an ankle injury would occur in such sports that include repetitive jumping, which makes these sports players more prone to ankle injuries.<sup>[16]</sup> This result is consistent with those of published literature, which found that rebounding was the most common activity often associated with ankle injuries in high school basketball players<sup>[17]</sup> and that basketball players were most likely to sustain ankle injuries.<sup>[17-19]</sup>

There was no association between ankle injury and doing stretching exercises in our study. However, this finding is not consistent with the results of prior studies. Safran, illustrated that stretching up before physical activity will loosen muscles and increases joint range of motion, making the muscles less tight and less prone to trauma and tears.<sup>[20]</sup> However, these results can be explained probably by the inappropriate method of stretching or incorrect timing of the exercise either in duration or frequency or the interval between the exercise and starting the sports as our study sample students were not professional athletes nor they got professional advice.

Obesity and overweight were not firmly established by this study, as a risk factor for ankle injuries. This observation was also noted by Doan *et al.* in their report.<sup>[21]</sup> Additional studies are needed to examine further differences in ankle injuries based on age, height, weight, and body mass index.

During the study, we distributed FADI questionnaire, to assess the functional limitations related to foot and ankle conditions. There is a significant difference in the mean of disability index between students who did not complain of an ankle injury and students who complained of an ankle injury with a lower mean score (more disability) among students with an ankle injury. This index can help us to follow-up the students who go for a rehabilitation program. The FADI score is significantly increased after 4 weeks of rehabilitation indicating less disability.<sup>[22]</sup> Moreover, it can be used as a screening tool for students who are more at risk to develop chronic injuries. High school athletes should be screened using this tool as it highlights students with positive ankle injuries successfully.

As do all studies, this study has its limitations. Females were not included in this study. Female high school students in Saudi Arabia do not have sports activities in their curriculum until now, though they will start soon. Another limitation is that socioeconomic differences may exist between schools, and that could lead to differences involving other potential risk factors, like for example, the sports fields condition and

**Table 2: Prevalence of ankle injuries among participants**

| Period of prevalence | n (%)      | 95% CI for prevalence |
|----------------------|------------|-----------------------|
| At the study time    | 56 (14.0)  | 10.9-17.7             |
| Last month           | 84 (21.1)  | 17.3-25.3             |
| 6 months             | 121 (30.3) | 26.0-35.0             |
| Last 12 months       | 145 (36.3) | 31.7-41.1             |
| High school time     | 155 (38.8) | 34.2-43.7             |

CI: Confidence interval

**Table 3: Ankle injury history**

| Variable                                   | Category                               | n (%)      |
|--|--|------------|
| Type of sports caused the injury           | Soccer                                 | 122 (30.6) |
|  | Volleyball                             | 13 (3.3)   |
|  | Basketball                             | 5 (1.3)    |
|  | Not injured                            | 244 (61.2) |
|  | Not caused by sports                   | 15 (3.8)   |
| Seeking medical treatment for ankle injury | Yes                                    | 74 (18.5)  |
|  | No                                     | 81 (20.3)  |
|  | Not injured                            | 244 (61.2) |
| Type of treatment                          | Medication only                        | 33 (8.3)   |
|  | Medication and physiotherapy           | 39 (9.8)   |
|  | Medication, physiotherapy, and surgery | 13 (3.3)   |
|  | Did not receive any treatment          | 70 (17.5)  |
|  | Not injured                            | 244 (61.2) |

**Table 4: Ankle injury prevalence among high school students by baseline characteristics**

| Variable                             | Category                   | Prevalence                      |                   |                 |                       |                         |
|--------------------------------------|----------------------------|---------------------------------|-------------------|-----------------|-----------------------|-------------------------|
|                                      |                            | At the time of the study, n (%) | Last month, n (%) | 6 months, n (%) | Last 12 months, n (%) | High school time, n (%) |
| Age                                  | 16                         | 12 (8.5)                        | 23 (16.2)         | 34 (23.9)       | 44 (31)               | 47 (33.1)               |
|                                      | 17                         | 20 (17.1)                       | 32 (27.4)         | 41 (35)         | 47 (40.2)             | 49 (41.9)               |
|                                      | 18                         | 22 (18.2)                       | 26 (21.5)         | 41 (33.9)       | 48 (39.7)             | 53 (43.8)               |
|                                      | P                          | 0.044                           | 0.093             | 0.097           | 0.216                 | 0.162                   |
| BMI (kg/m <sup>2</sup> ) groups      | Underweight (<18.5)        | 11 (20)                         | 16 (29.1)         | 21 (38.2)       | 22 (40)               | 24 (43.6)               |
|                                      | Healthy weight (18.5-24.9) | 36 (13.1)                       | 56 (20.4)         | 80 (29.1)       | 97 (35.3)             | 102 (37.1)              |
|                                      | Overweight (25-29.9)       | 8 (16)                          | 10 (20)           | 17 (34)         | 20 (40)               | 22 (44)                 |
|                                      | Obese (>30)                | 1 (5.3)                         | 2 (10.5)          | 3 (15.8)        | 6 (31.6)              | 7 (36.8)                |
| Number of hours of exercise per week | P                          | 0.362                           | 0.319             | 0.259           | 0.818                 | 0.687                   |
|                                      | 0-1                        | 13 (15.1)                       | 20 (23.3)         | 23 (26.7)       | 26 (30.2)             | 27 (31.4)               |
|                                      | 2-3                        | 10 (9.3)                        | 15 (13.9)         | 27 (25)         | 35 (32.4)             | 38 (35.2)               |
|                                      | 4-6                        | 11 (12.9)                       | 17 (20)           | 25 (29.4)       | 29 (34.1)             | 33 (38.8)               |
| Doing stretching exercise            | 7+                         | 22 (18.3)                       | 32 (26.7)         | 46 (38.3)       | 55 (45.8)             | 57 (47.5)               |
|                                      | P                          | 0.256                           | 0.116             | 0.130           | 0.073                 | 0.094                   |
|                                      | Yes                        | 25 (12.1)                       | 39 (18.9)         | 62 (30.1)       | 76 (36.9)             | 79 (38.3)               |
|                                      | No                         | 31 (16.1)                       | 45 (23.3)         | 59 (30.6)       | 69 (35.8)             | 76 (39.4)               |
| Doing preventive strategies          | P                          | 0.259                           | 0.283             | 0.918           | 0.813                 | 0.833                   |
|                                      | Yes                        | 18 (12.9)                       | 28 (20.1)         | 50 (36)         | 61 (43.9)             | 64 (46)                 |
|                                      | No                         | 38 (14.6)                       | 56 (21.5)         | 71 (27.3)       | 84 (32.3)             | 91 (35)                 |
|                                      | P                          | 0.648                           | 0.745             | 0.073           | 0.022                 | 0.031                   |

Using Chi-square test. Percentages are within each category for at the study time, last month, last 6 months, last 12 months, and high school time (row percentage). BMI: Body mass index

the quality of the sports equipment available. Also in Saudi Arabia, the most common sport practiced by far is soccer, which affected the results.

Ankle injuries are often assumed as an unavoidable injury because of their high frequency. Many publications have discussed the burden of these injuries on health care.<sup>[19-23]</sup> These negative outcomes can be decreased by implementing preventive measures and by identifying those who are at more risk for ankle injuries.

Future researches are needed to empower the findings of this study and to increase the knowledge of ankle injuries and their mechanism to decrease their incidence. This can be done through combined efforts of multidisciplinary research teams. It is suggested that these teams include sports players, coaches, athletic trainers, and sports injuries physicians including orthopedic surgeons, emergency room physicians, and epidemiologists.

## CONCLUSIONS

One-third of students had ankle injury during high school time, whereas only one-fifth had treatment. Soccer had the highest prevalence compared to other sports.

We recommend adding educational lectures as a preventive measure to reduce ankle injuries in high schools. These lectures should talk about how to do proper stretching exercises before games, avoid running on uneven surfaces. Furthermore, we recommend providing schools with proper facilities for

practicing sports and facilities to manage ankle injuries cases among high school students.

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Nil.

## Conflicts of interest

There are no conflicts of interest.

## Author contributions

NNA conceived and designed the study. MAA and NAA conducted research, provided research materials, and collected and organized data. MIB analyzed and interpreted data. AMA and AKA wrote initial and final draft of the article and provided logistic support. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

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