Journal of Qualitative Research in Health Sciences 2021; 10(3):153-167

http://jqr1.kmu.ac.ir//

10.22062/JQR.2021.193517.0

Open Access Publish Free

Original Article

Epidemiological Indices of Sports Injuries in Male Students of Physical Education High Schools in Kerman and Explanation of Causes of Sports Injuries in the Sports Injury

Mehdi Erfani[1], Mansour Sahebozamani[2]*, Abdolhamid Daneshjoo[3]

1. PhD Candidate in Sports Injuries and Corrective Exercises, Faculty of Sport Sciences, Shahid Bahonar University of Kerman, Kerman, Iran
2. Professor, Faculty of Sport Sciences, Shahid Bahonar University of Kerman, Kerman, Iran
3. Associate Professor, Faculty of Sport Sciences, Shahid Bahonar University of Kerman, Kerman, Iran

Received: 18.09.2018
Accepted: 04.11.2019
Published online: 20.09.2021

***Corresponding Author:**
Mansour Sahebozamani

Email:
sahebozamani@uk.ac.ir

Citation:
Erfani M, Sahebozamani M, Daneshjoo A. Epidemiological Indices of Sports Injuries in Male Students of Physical Education High Schools in Kerman and Explanation of Causes of Sports Injuries in the Sports Injury. J Qual Res Health Sci. 2021; 10(3):153-167.

Abstract

Introduction: Since school sports are the main cause of students' injuries, awareness of the causes and factors underlying these injuries can pave the way for the development and planning of injury prevention strategies. The present study was conducted in two quantitative and qualitative phases using the data in the sports injury surveillance system and the interviews designed by the researchers to analyze the epidemiological indicators and causes of students' injuries.

Methods: This mixed-method study was conducted using qualitative and quantitative descriptive techniques. The injuries made to male students of physical education high schools in Kerman were recorded for 6 months in a sports injury surveillance system developed by the researchers. Then, the qualitative data were collected using in-depth and semi-structured interviews to explore the possible causes of sports injuries. The collected data were analyzed using a content analysis method via descriptive statistics and the chi-square test with SPSS software (version 21) at a significance level of P=0.05. Besides, the qualitative data were analyzed using a conventional content analysis technique.

Results: The results of data analysis indicated that most of the injuries occurring in sports movements to the student-athletes were caused by collision. Moreover, muscle strain injuries were the most frequently found sports injuries. Improper techniques were also reported as the most important cause of sports injuries. Pain was found as the most significant indicator of the early post-injury symptoms. An analysis of the quantitative-descriptive data recorded in the sports injury surveillance system showed the injury incidence rate of 33.3 injuries per 100 student-athletes and 63.3 injuries per 100 hours of training and competition. Furthermore, the lower extremity with 51.6% and minor injuries with 45.3% showed the highest rate and improper techniques accounting for 25% of the injuries were the most important risk factor for injury.

Conclusion: Given the high prevalence of muscle strains and the highest percentage of lower extremity injuries in students caused by using improper techniques, addressing sports injury indicators, as well as explaining their causes and underlying factors can significantly contribute to reducing students' injuries. Moreover, regular systematic reviews of epidemiological studies can be effective in developing practical programs for injury prevention in students.

Keywords: Epidemiology, Sports injuries, Male students, Mixed-method research

Introduction

Exercise is essential for ensuring individual health and wellbeing. Besides, participation in sports activities is the way to achieve a healthy and happy life, and physical education and sports activities mainly aim to help improve the physical fitness of community members (1). To achieve this goal, different sports disciplines and branches have been established and the number of these fields is growing (2, 3). However, participation in sports activities can cause serious injuries and problems (4). Furthermore, given the large number of people who participate in such activities, it can be expected that the rate of sports injuries will also increase (5).

Research in the United States has shown that each year about 3.7 million people refer to emergency departments due to injuries caused by sports and recreation activities, indicating the high prevalence of sports injuries. Besides, various studies have shown that exercise is one of the main causes of injury in people aged 11 to 18 years old in Europe and North America (5, 6).

Moreover, 62% of sports injuries occur in organized sports, 20% of injuries in physical education classes, and 18% of injuries in non-organized sports. Previous studies have also indicated that school sports are the leading cause of injury to adolescents. Besides, of about 40 million students (18.5 years old) who attend US school sports each year, about 4 million cases with sports injuries refer to emergency departments, costing about $2 billion per year (6-8).

Additionally, epidemiological studies have suggested that one-sixth of the injuries observed in Scandinavia have occurred in sports activities (6, 7). Thus, given the high prevalence of injuries, especially in students, scientists seek to determine the epidemiology of such injuries to increase athletic performance and develop strategies to prevent injury to athletes. Since sports injuries in developmental ages can cause long-term physical and mental complications, an exploration of the causes of these injuries is very important especially for physical education students who are engaged in doing different sports activities during the school year (9). For this purpose, first, risk factors for injury and relative increase in risks must be identified. Besides, risk management principles and strategies need to be developed based on risk detection, assessment, and control within sports complexes (10, 11).

Although sports injuries cannot be eliminated, continuous and professional evaluation of annual injury patterns can help focus on the development and evaluation of injury prevention strategies in athletes (12, 13). Prevention strategies are developed based on basic epidemiological information. The prevention of sports injuries is currently an important issue in rich countries. However, the highest mortality rates and permanent disability due to injuries are currently reported in less developed countries. These countries seem to be in urgent need of developing cost-effective and efficient prevention strategies. Thus, organizing intervention programs for students can reduce the rate of injuries in them (14). Furthermore, to improve the effectiveness of physical activity in adolescent athletes, their health problems should be addressed professionally by not only providing effective care for injured persons but also developing and expanding active injury prevention measures (15-16).

Møller et al. argued that the accurate measurement of sport exposure time and injury occurrence is the key to effective injury prevention and management. They also believed that current measures are limited by their inability to identify all types of sport-related injury and the narrow scope of injury information (17-18). Moreover, the major problem of many studies is the sources used to collect injury-related data. A retrospective examination of athletes will not be a reliable way to collect data because, due to the lapse of time and forgetfulness, the use of these data will raise concerns about reducing the rate of injuries. Researchers have long used various methods of collecting sports injuries information including manual injury reporting methods, interviews, and video analysis. However, sports injury monitoring and surveillance systems are currently used to eliminate the disadvantages of traditional methods. Accordingly, there is a growing bulk of research on these systems in the world (19-22).

Orchard et al. compared different injury surveillance methods and reported that addressing injuries is almost impossible without the presence of standard definitions and sports injury surveillance data collection methods (23). Besides, the consensus on developing a standard definition allows making a meaningful comparison of injury surveillance data. Meeuwisse et al. suggested that researchers should apply general recommendations when collecting and disseminating information to maximize the comparability of data, through specific reporting and data collection methods (24). The authors also argued that if you want the data in your surveillance system to be useful, there must be a clear definition

of how the data are collected, so that the results are comparable to other sources. In recent years, there has been a consensus on the design of sports injury data collection systems (24). Researchers believe that preventive measures can be effective for sports injuries when there is a reliable surveillance system to help to conduct epidemiological studies. Sports injury prevention and reduction programs require basic documented and easily accessible data. A study by van Mechelen showed that the information in surveillance systems is a prerequisite for the development and evaluation of prevention strategies. By developing a surveillance system and evaluation system and recording information in the system, the incidence of sports injuries can be adequately prevented (20). Numerous studies have been performed on sports injury surveillance systems by sports medicine researchers. Thus, it seems that injury surveillance will seek to create a standard dataset for sports injury descriptions, incidence, occurrence, and risk factors in a sports population (24- 26). It should be noted that sport injury data in traditional epidemiological approaches in Iran were collected through retrospective questionnaires. However, only a limited number of studies have used new methods for recording sports injuries. One of the most important sports injuries registration systems is owned by the International Federation of Sports Medicine, which is limited to athletes covered by the federation's insurance, and data of this system are exclusively accessible to the federation. Moreover, the first professional football injury registration portal in Iran, approved by FIFA (IFMARC), was launched in September 2005 for online registration of football injury data following FIFA and AFC standards. The physician of each team receives a username and password and records injuries during training sessions and competitions daily. Thus, by collecting this information, the FIFA-approved medical center can develop injury prevention strategies, monitor the incidence and prevalence of injuries in clubs daily, and offer instructions for injury prevention to clubs.

The existence of a national sports injury registration system can be a great help for athletes, coaches, managers, and most importantly future researchers and the scientific community of sports in the country. This system makes it possible to develop a model for recording collected data and information and provides easy, fast, secure, and effective access to users and professionals. It also provides the possibility of analysis and dissemination of data and information in a more reliable way (27-29).

Accordingly, the existence of a national system to create a database for recording and surveillance of sports injuries is essential. The present study attempted to develop a web-based system for the first time in Iran through the unification of definitions in the field of epidemiology of sports injuries to eliminate gaps and shortcomings of similar studies and provide accessibility in any place and time for professionals, relevant organizations, and researchers. It is noteworthy that this study was conducted in several sections including system design, creating a suitable platform for collecting sports injury data, operational recording of injuries, and examining the epidemiology of sports injuries using the data in the system as well as using the results of this data for strategic planning to prevent and reduce injuries. The present study also aimed to record injuries to students in physical education high schools in Kerman and examined several epidemiological indicators. Furthermore, given the importance of identifying the epidemiology of injury of student-athletes, this study explored the possible causes of sports injuries by analyzing the data recorded in the developed system through a qualitative content analysis technique.

Methods

One of the main features of qualitative research is the focus on studying a certain sample of a phenomenon. The number of qualitative studies conducted in Iran using the data from a sports injury registration system is very small compared to quantitative studies in this field. The present study employed a mixed-method design using descriptive quantitative-quantitative methods. Besides, a content analysis technique was used to analyze the data and identify the challenges and limitations of sports injury registration in the developed system.

To this end, first, a system was developed by the researchers to record the injuries to student-athletes. This system aimed to provide a suitable space for collecting information on athletes' injuries and the epidemiology of students' injuries. The data were recorded in the system by users including sports physicians, physiotherapists, sports medicine specialists, physical education teachers, and students (with a physician's approval). To record injuries in the developed system, users were given the necessary training.

The participants in this study were 285 male students of tenth to twelfth grades at physical education high schools in districts 1 and 2 of Kerman in the academic year 2017-2018. They were selected using

purposive sampling and examined for 6 months. The injuries that occurred to the students during the same period were recorded in the injury registration and surveillance system by users including physicians (n=39), orthopedists (n=18), physiotherapists (n=12), and sports medicine specialists (n=38). If any student suffered from any injury, he would refer to a physician and upon the diagnosis of the injury, the information requested from the student was recorded in an injury registration electronic form by the user. First, the user logged into the system, and the information of the person completing the form was registered. In the next step, the user accessed the injury registration form, which included instructions for completing and objectives of the system. The user was ensured that his information would be kept confidential. The user then selected the student form and answered the questions therein (Figure 1).

The student injury registration form contained 20 questions that assessed the type of injury (acute injury such as tendon muscle strain, sprains and fractures, and overuse injury) and location of injury including various anatomical areas, and causes of the injury during exercise. The questions aimed to find out whether the injury was caused by a collision or not. The injury symptoms were pain, swelling, inflammation, and joint relaxation. The mechanism of the occurrence of sports injuries was an event that led to the injury in the athlete, such as improper warm-up, lack of preparation, the use of non-standard equipment, and other indicators recorded in the system. The severity of the injury was assessed in terms of recovery time; less than 7 days (minor), 7-14 days (mild), 14-21 days (moderate), and more than 21 days (severe).

Finally, the athletes were asked to report the early symptoms after the injury. One of the most important features of the system developed in this study was the presentation of a clear and coherent definition of sports injuries which appeared on the home page of the system so as to ensure users had a clear understanding of sports injuries, eliminate the user's perception, and unify the answers into reliable data. Injury was operationalized in the present study as an event that leads to a physical problem in the sports environment and causes the athlete to miss the training session or competition, or for any reason require medical attention (27-31). The severity of sports injuries was assessed based on the number of days of absence or (partial or total) functional restriction of the athlete from the time of injury to a full return to normal training or competition (32-34). Moreover, injuries were classified into two types of collision injuries due to contact with another player or an object, and non-collision injuries caused by reasons other than contact with players and objects (35, 36). In the next section, injuries were recorded as acute (strain, sprain, dislocation) and overuse (inflammation). Furthermore, exposure to injury was recorded in both training and competition as individual and team training activities under the coach's control or guidance based on the number of hours in which players were at risk of injury in training sessions or during competitions. The rate of the injury was defined as the number of injuries per 1000 hours of players' activity, as well as the number of injuries per 1000 athletes in training or competition to determine the probability of injury to an athlete (32, 37-39). Given the number of participants in this study, exposure to injury was assessed based on 100 hours of athletic activity (39).

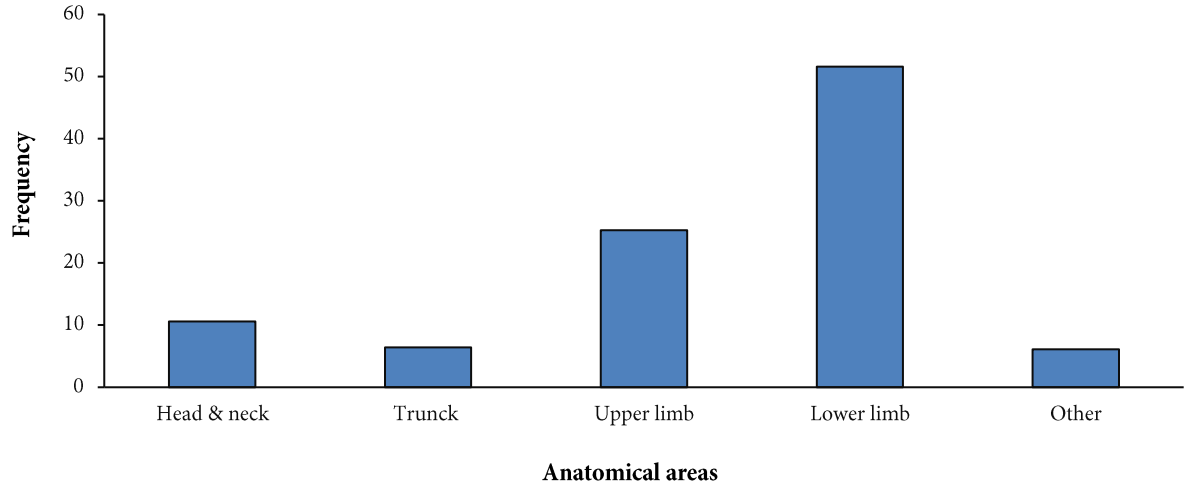

Figure 1. The frequency of sports injuries in different anatomical areas

Finally, the user confirmed the data and submitted the completed form. Immediately after submitting the form in the system management panel and the database, the recorded data could be reported or exported in Excel format. All statistical analyses were performed using SPSS software (version 21). Descriptive statistics including mean and standard deviation were used to describe the variables and the chi-square test was run to evaluate and compare the ratios.

This study, a qualitative approach was used to come up with a profound understanding of the recorded data since qualitative methods can examine phenomena in more detail (40). In-depth semi-structured interviews were used to collect data. For this purpose, 98 interviews were conducted with tenth to twelfth-grade students of physical education high schools. Examples of the questions asked in the interviews are as follows: Did you collide with another athlete that led to the injury? Was the injury caused in training or a match? What part of your body has been injured? Who diagnosed your injury? How many days did your injury prevent you from exercising or doing sports activities? Before starting the interviews, the necessary information about the study, the interview method, and the students' right to participate or not participate in the study were given to the participants. They were also assured in writing and orally that their information would remain confidential. Then, informed written consent was obtained from the participants. All interviews were recorded, and each interview lasted an average of forty-five minutes. Upon the participants' request, the interviews were conducted in the school, the office of the Sports Medicine Board, and the sports clubs.

The collected data were analyzed using qualitative content analysis. This technique is used to subjectively interpret the content of textual data. With the help of this method, the hidden themes can be revealed from the content of the data collected from the participants through the systematic classification of relevant categories and subcategories (41). Ethical considerations were of great importance in this study. To protect the participants' rights, the researcher first provided some information about the research procedure to the participants and after obtaining their consent invited them to the interviews. The participant was completely free to participate or not to participate in the interviews, and the researcher did not force them to participate in the interviews. Besides, the researcher tried to conduct the interviews at the participants' comfort and convenience. Therefore, the interview time was determined by the participants themselves and the researcher tried to conduct the interviews comfortably and quietly and respect the participants' dignity. Moreover, in cases where a participant did not agree with his voice being recorded, his right was respected and his voice was not recorded. The participants' identities were also kept confidential and their names were not revealed. Finally, data analysis was performed at the time of collecting the data. To this end, the recorded interviews were transcribed line by line, and the transcripts were read several times to come up with a general understanding of the participants' statements. Then, meaning units or primary codes were extracted. Afterward, the extracted codes were categorized based on their similarity (42). Finally, the core theme and its categories were identified.

Results

Data analysis revealed 5 categories including the type of injury (with 2 subcategories of collision and non-collision injuries), causes of injury (with 2 categories of acute and chronic injuries and 5 subcategories), mechanism of injury (with 8 subcategories), the severity of injury (with 4 subcategories), and early symptoms after injury (with 4 subcategories). The data were collected using semi-structured in-depth interviews due to the flexibility of this technique and its adaptation to the requirements for qualitative research (43). Out of a total of 285 male students of tenth to twelfth-grades at physical education high schools in Kerman, 95 students recorded their injuries in the sports injury surveillance system during the 6 academic months. The student injury data were recorded by sports physicians, coaches, or students after approval by a physician or specialist.

One of the main themes identified in this study was the "type of injury" caused by sports movements. These injuries were subdivided into collision and non-collision injuries. For example, a tenth-grade student said, "*I was injured when a player of the other team hit me in the thigh*". Sports injuries happened in various forms during the exercise. One of the students stated, "I felt a burning sensation in my arm muscle when I was blocking the ball" (12^{th}-grade volleyball player). The context/mechanism of the occurrence of sports injuries was another issue that has been considered one of the most important factors for the epidemiology of sports injuries; "*When practicing keeping balance against the wall in the gymnastics class, I fell due to fatigue and I had*

pain in my spine" (an 11th-grade student).

In this study, the severity of the injury was assessed in terms of recovery time (44), which is one of the most important indicators for returning to exercise. One of the 10th-grade students having previous athletic background stated, "*To show my fitness to my friends and other students in the handball class, I did a triple jump and suffered a minor injury in the ankle in the landing position and I could not continue my activities for two days*".

Referring to the early signs after the injury as one of the most common themes pointed out by the participants, one of the students stated, "*During the school football team's training for inter-school matches, when I was about to kick the ball, one of the opponents hit me in the foot when tackling to catch the ball. At that moment, I had severe pain in my knee so that I could not continue playing*" (a 12th-grade student) (Table 1).

The descriptive results of the study suggested that the incidence of students' injuries was 33.3 per 100 athletes and 63.3 injuries per 100 hours of training and competition. These findings confirmed the high frequency of injuries in students of physical education high schools in Kerman.

It was also shown that 28.3% of all injuries registered in the student sports injury surveillance system were of collision type. Furthermore, the most frequent injury was muscle strains accounting for 21.1% of all injuries followed by sprains with an incidence rate of 18.9% (Table 2). Moreover, a survey of the recorded injuries indicated that the highest incidence of injuries was found in the lower extremity accounting for 51.6% of injuries (49 injuries) followed by the upper extremity with a frequency rate of 25.3% (24 injuries). In contrast, the lowest incidence rate of injuries was found in the trunk accounting for 6.4% of the reported injuries (6 injuries) (Figure 1). The high frequency of injuries in the lower extremity, especially the ankles and knees, has been reported in many epidemiological studies on sports injuries, highlighting the need to address the possible causes of injuries in the lower extremity and take effective measures to reduce this type of injuries.

The severity of the injury was assessed in terms of recovery time. Accordingly, the recorded injuries were classified into four groups: less than 7 days (minor), 7-14 days (mild), 14-21 days (moderate), and more than 21 days (severe) (45,46). According to the results, the most frequently reported injuries were minor injuries with a rate of 45.3% followed by severe injuries that accounted for more than 21% of the reported injuries. This indicates a serious warning to reduce the severity of injuries in the students (Figure 2).

This study also examined the risk factors for injury in terms of internal (intrinsic) and external (environmental) factors (44-46). The results indicated that the use of improper techniques was the most frequent internal risk factor for injury (25%), followed by inadequate physical fitness (17%) as the second risk factor and the most frequent external risk factor, and use of non-standard equipment as the third frequently reported risk factor (14.7%) (Table 3).

Discussion

The main purpose of this study was to develop a system for recording epidemiological data on student-athletes' injuries. It also attempted to provide the possibility of online registration of sports injuries for the first time in Iran in a coherent manner. Finally, it surveyed the epidemiological data on sports injuries that occurred to male students in physical education high schools in Kerman and explored the reasons of sports injuries. It should be noted that most studies have used a quantitative approach and there are only a few qualitative studies in this field.

The most common injuries reported by the participants in this study were muscle strains and joint sprains. Likewise, previous studies (e.g., Dyakova et al. (47); Pierpoint (48); reported the highest rate of muscle strain and sprains. Besides, the most common site of injury in the present study was the lower extremity. This finding was consistent with a study conducted by Schroeder et al. who reported the highest rate of injury in the lower extremity (49); This finding was confirmed by other studies including Roos et al. (50); The present study also found that most of the recorded injuries were of minor severity. Accordingly, Pfirrmann et al. found minor injuries were most frequent in elite youth soccer players (51). However, Nejaati (9) and Abernethy et al. (52) found that most of the injuries were moderate and mild. The students in the present study reported that the most frequent risk factors for injury were improper techniques followed by inadequate physical fitness and the use of non-standard equipment and tools, respectively. In a similar vein, Ryman Augustsson et al. and Pfeifer et al. found that the most important risk factors for injury were the use of improper techniques and student-athlete's lack of physical fitness (53-54).

Table 1. The codes, categories, and subcategories identified in the study

Codes	Themes	Subcategories	Categories
In the football training session, when I tried to catch the ball, the opponent's foot hit the knee of my right foot.	-	Collision	Type of injury
In the badminton class, I got injured at the moment of landing after doing the technique.		Non-collision	
During the gymnastics exercise, I was injured while doing the forward roll.	Strain	Acute	Causes of injury
At the moment of the opponent player dribble, I got a sprain due to a spin on the knee.	Sprain		
My shoulder was sprained when I fell on the ground while performing a technique.	Contusion		
I injured my fingers while blocking the ball on the net.	Dislocation		
In table tennis, after a few training sessions, I felt pain in the inner area of my elbow.	Gradually and over time	Chronic	
I did not do proper stretching exercises before training.	Improper warm-up	-	Mechanism of injury
I suffered a muscle injury due to weakness in the front thigh muscles.	Inadequate physical fitness		
On the day of the wrestling class, I was very upset mentally as I scored low on the continuous test, which caused me to suffer from an injury.	Inadequate mental preparation		
I was injured due to the wrong execution of the triple jump in handball.	The use of incorrect techniques		
I got tired and injured due to the repetitive service movement at the end of the class.	Fatigue		
My ankle was twisted due to unsuitable flooring.	Non-standard tools and equipment		
Due to the lack of proper space in the salon, I hit the side of the wall and was injured.	The place of exercise		
According to the physician, the reason for my knee injury was the bow legs.	Skeletal abnormalities		
He has exercised after injury.	Recovery less than 7 days	-	The severity of injury
He exercised one or two days after the injury.	Recovery between 7 to 14 days		
He has been exercising for two weeks after the injury	Recovery between 14 to 21 days		
The ability to exercise 3 weeks after injury	Recovery over 21 days		
The feeling that the swollen joint cannot move well.	Incidence of pain	-	Early symptoms after injury
There is pain when the joint is touched.	Swelling and inflammation		
The joint is not able to do its normal movement well.	Sensitivity to touch		
	Movement restrictions		

Table 2. The frequency of sports injuries in the students

Type of injury	Frequency	Percentage
Strain	20	21.1%
Sprain	18	18.9%
Dislocation	1	1.1%
Contusion	3	3.2%
Collision	27	28.3%
Non-collision	5	5.3%
Other	21	22.1%
Total	95	100

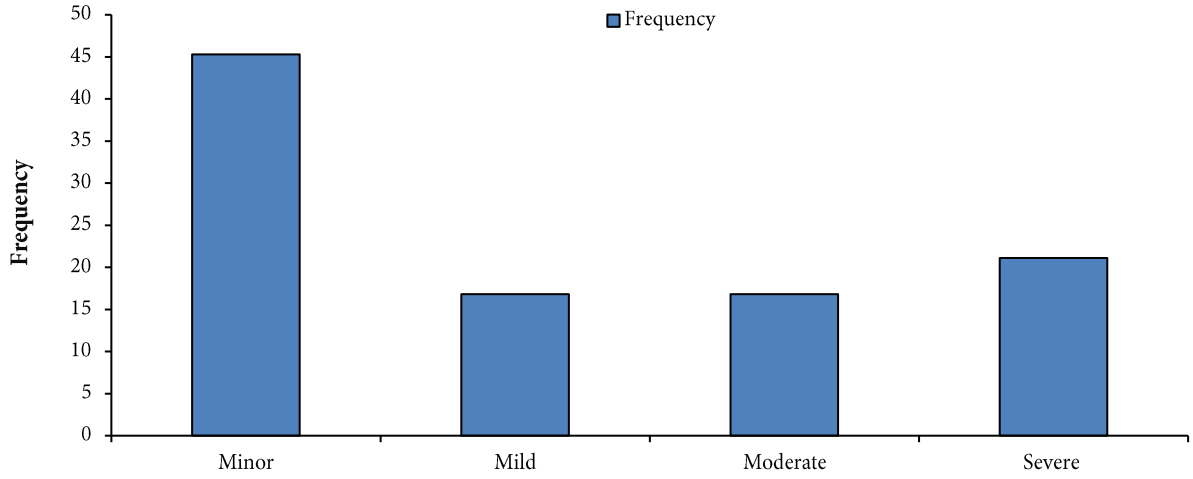

Figure 2. The frequency of the severity of sports injuries

Table 3. The frequency of the risk factors for sports injuries in the students

Risk factors	Frequency	Percentage
Improper warm-up	11	11.6%
Inadequate physical fitness	16	16.8%
Inadequate mental preparation	2	2.1%
The use of incorrect techniques	24	25.3%
Fatigue	11	11.6%
Nutrition	1	1.1%
Non-standard tools and equipment	14	14.7%
The place of exercise	8	8.4%
Type of sport	5	5.3%
Other	3	3.2%
Total	95	100

The present study also showed that the prevalence of students' injuries was 33.3 per 100 athletes and 63.3 injuries per 100 hours of training and competition. Kerr et al. (55) examined sports injuries among students and found the prevalence of injuries in high school students was 8.75 per 1000 athletes. Besides, other studies reported that a high prevalence of sports injuries (80.3%) in students (55, 56).(These findings were consistent with the data in the present study. Ebrahimi Varkiani et al. (57) reported a higher rate of injuries (4.1 injuries per 1000 athletes) for young athletes aged 15-24 years compared to other age groups, as was indicated in the present study. However, Rahimi et al. (1) reported a higher prevalence of injuries, i.e. 45.4 injuries per 100 athletes, which was contrary to the present study due to the level of competitions, age groups, and the focus on a single sports field.

Moreover, the present study found that the students were exposed to 33.3 injuries per 100 athletes and 63.3 injuries per 100 hours of training and competition, indicating the high frequency of injuries (1, 39). Rahimi et al. (1) examined the prevalence of karate injuries in international competitions and reported 45.4 injuries per 100 athletes, which was a high rate of injuries. This finding was contrary to the present study due to the level of competitions, age groups, the focus on a single sports field, the weather conditions, the time

of the competitions, and also the interval between the competitions (1).

Ziaee et al. examined karate injuries in Iranian clubs and reported the incidence of 20.2 injuries per 100 athletes. One of the most important reasons for the lower prevalence of injuries is the age group and the skills of the participants who were at the championship and professional level. This implies that athletic experience can help reduce the incidence of many common injuries in that sports field (58).

Ebrahimi Varkiani et al. performed an epidemiological study of table tennis injuries using the Sports Medicine Federation Damage Monitoring Database in young athletes aged 15-24 years. They reported an injury rate of 4.1 injuries per 1,000 athletes. One of the possible reasons for different results obtained in this study and the present study was the researchers' focus on only one sport, the athletes' age, and their athletic skills (57). Besides, the Sports Medicine Federation Damage Monitoring Database records only information provided by insured athletes, and it was possible that some participants did not have insurance coverage or did not refer to the federation for treatment. Moreover, injuries can be only recorded by the officials of the Sports Medicine Federation, and thus some injuries may go unnoticed. However, everyone can easily register their injuries online in the sports injury registration system developed in this study.

Kerr et al. examined high school and university students' sports injuries and found that high school students were more likely to be injured than university students (59).

The nature of sports branches, attention to injuries associated with them, the age group, and athletes' skills are very important factors in increased exposure to injury. This increase is evident in students who are trained in various sports branches during their school year and highlights the importance of proper physical condition and good physical fitness. Since these factors are the main indicators for admission to physical education programs, they should be considered by educational planners so that only applicants who meet the requirements, enroll in these programs.

The results of the present study showed muscle strain and sprains were the most common injuries in physical education students, and 28.3% of all injuries were reported as collision injuries. Similarly, Knobloch et al. reported ligament injuries and sprains as the most common injuries in school sports (60). Furthermore, in line with the present study, Dyakova et al. reported a high prevalence of muscle and joint injuries in students (47) and Pierpoint et al. examined the football and basketball injuries among female high school students and found the highest rate of injuries as muscle strain and joint sprain (53.7%) (61, 62).

In a descriptive epidemiological study of football injuries, Kerr et al. (63); examined US high school students and reported that the highest rate of injury in student-athletes was joint injury (29%). This finding was contrary to the present study that found muscle injury as the most frequently reported sports injury. One important reason for this discrepancy was that the mentioned study focused on only one sport (football) and many studies have reported joint injuries in this field with a very high prevalence (58-60). The findings of the present study were not also in line with a study by McGuine et al. who reported the highest prevalence of ligament injuries (40.9%) and muscle (strain) injuries (25.4%) in athletes in grades 9 to 12 in the academic year 2015-2016 in 29 high schools in Wisconsin (64). These conflicting results can be attributed to inconsistent definitions of epidemiological indicators such as injury and severity of the injury. Furthermore, contrary to the observations made in the present study, Knobloch examined injuries caused by school sports and found that ligament strain was 21% and sprain was 20%. These inconsistent findings can be explained by different definitions of the types of injuries presented in the studies, the absence of accurate and uniform definitions, participants' age range and gender, and focusing on a single sport (60).

An analysis of the data recorded in the sports injury registration system showed the highest incidence of injuries in the lower extremity accounting for 51.6% of injuries followed by the upper extremity with a frequency rate of 25.3%. Accordingly, Ebrahimi Varkiani et al. reported that the most common area of injury in young athletes aged 15-24 years was the lower limb that accounted for 58.9% of all injuries (57).

Pierpoint et al. who studied student-athletes in US high schools from 2008-2009 to 2013-2014 showed that most injuries occurred in the lower extremity, as was confirmed in the present study (61). Likewise, McGuine et al. reported the highest rate of injuries (34.4%) in the lower limb (the ankle) (64).

Moreover, in line with the data in the present study, Schroeder et al. examined overuse injuries among high-school athletes in the United States and

reported the highest rate of injuries (21.8%) affecting the lower extremity. Additionally, Roos et al. reported lower limb injuries (70.4%) as the most frequent injuries in high school students (49, 54). Accordingly, it can be argued that since students are engaged in different sports activities that require good physical conditions, poor physical fitness, fatigue, and poor neuromechanical control are the reasons for the high prevalence of lower limb injuries in students (56, 65, 66).

Kerr et al. (63) in a descriptive epidemiological study of football injuries in US high schools, found that lower extremity injuries had the highest prevalence after head and face injuries (21.2% in competition and 17% in training) (16.5% knee injuries in competitions vs. 13.35% in training and 13.1% ankle injuries in competitions vs. 12.2% in training). One of the reasons for these inconsistent findings is that the participants were examined during several academic seasons and they were engaged in only one sport (56, 63).

The results of this study concerning the severity of injuries in the students indicated that minor injuries accounted for 45.3%, moderate and mild injuries accounted for 16.8%, and severe injuries accounted for more than 21% of all sports injuries. In line with these findings, Nejaati (9) who examined the prevalence of injuries of female student-athletes reported that minor, moderate, and server injuries in different sports were 80%, 11.6%, and 8.3%, respectively. Moreover, Abernethy et al. (52) studied the severity of sports injuries of Irish students and reported 71% of injuries as moderate and mild and 2% as severe. This finding was not consistent with the present study due to the number of sports and the participants' educational program and gender (53).

Pfirrmann et al. conducted a systematic analysis on adult and young professional players and showed the highest severity of minor injuries in young elite footballers with a prevalence rate of 60% (51). Besides, minor injuries were found to be the most server injuries (35.6%) in young elite athletes (Knobloch et al.) (60). These findings were consistent with the present study. It is noteworthy that, although minor injuries accounted for the largest number of sports injuries, given students' age sensitivity and field of study, careful monitoring is essential to reduce these injuries.

The present study showed that the use of improper techniques was the most frequent internal risk factor for injury (25%) followed by inadequate physical fitness (17%) as the second risk factor, and use of non-standard equipment as the third frequently reported risk factor in students (14.7%). These findings were consistent with a study by Niknejad et al. who reported that lack of good physical fitness was the most important internal risk factor (37.4%) and the non-standard and rough sports field surface as the most important external risk factor for injuries (40.9%) (65). Yalfani et al. compared the prevalence, type, and severity of injuries in professional and amateur wrestlers and reported that physical unpreparedness (8.37%) was the most important internal risk factor for injuries in these athletes (67). Hodgson et al. found that athletes' decreased physical fitness was the main cause of injuries in team sports (68). These results confirmed the findings of the present study.

Nejaati et al. reported that injuries due to wrong sports movements were more common in female students (9). Mohamadi et al. examined ACL ligament injuries in improving neuromuscular defects and reducing injury in girls and boys under 18 years of age. The results showed that improving movement biomechanics in modifying the landing technique pattern can be effective in reducing ACL ligament injuries. This observation was consistent with the results of the present study (69).

Lower levels of technical skills and experience in performing athletic techniques as well as the ineffective training of the techniques are effective factors in the greater prevalence of sports injuries. Therefore, improving trainers' knowledge and information about new and common training methods is essential (9).

Using a new approach, Bahr examined internal and external risk factors for injuries and found that the most important internal risk factors in hamstring muscle strain were lack of technical skills, fatigue, and decreased muscle strength (7).

Kramer et al. showed that decreased iliotibial band flexibility is one of the risk factors for ACL ligament injuries in young and older female athletes (70). Caine et al. examined the prevalence of adolescent and adult sports injuries and showed decreased muscle strength and sports equipment were the most important internal and external risk factors for injuries in these two groups (71). Saragiotto et al. studied the risk factors and injury prevention in elite athletes in a descriptive study by surveying physicians, physiotherapists, and trainers. This study was conducted as a qualitative survey of Brazilian athletes in 2011 at the Pan American Games, Mexico. The results showed that the most important internal risk factors were the use of

incorrect techniques that accounted for 46% of injuries and anatomical and physical factors accounting for 43% of injuries. Moreover, the most important external risk factors were the nature of sports and sports equipment both accounting for 37% of athletes' injuries. (72). Khayambashi et al. conducted a prospective study and examined the muscle strength of the thigh in the prevention of ACL injuries in male and female athletes and found that the decreased strength of the external rotator cuff muscles, as well as decreased strength of the extensor knee muscles, can increase the risk of ACL ligament injuries. (73)

Ryman Augustsson et al. examined risk factors for a traumatic knee injury. The results showed that the weakness of lower limb muscles in female athletes aged 15 to 19 years is a major factor in a traumatic knee injury. As it is evident, muscle strength is one of the important factors in physical fitness and plays an important role in preventing sports injuries. This finding was supported by the data in the present study (55)

Wang et al. examined the internal and external risk factors in training sessions for the Summer Olympic Games. They stated that one of the important external factors in causing sports injuries was the nature of the sport and the place of activity. This finding was confirmed in the present study (74).

In their review study, Pfeifer et al. examined the risk factors for non-collision ACL ligament injuries and found that decreased strength of central muscles and thighs, as well as reduced tolerance of fatigue, are the most influential factors in athletes' injuries. This indicates the importance of physical fitness factors in preventing ACL injuries, as was supported in the present study (54). Following the previous studies in the literature, the present study indicated that physical fitness indicators were the important indicators for preventing sports injuries. Physical fitness means the acquisition of skills that enable a person to perform various physical activities with less fatigue and better results. Physical fitness is divided into physical capabilities (health-dependent components) and motor abilities (skill-dependent components). Physical capabilities include strength, muscular endurance, cardiac and respiratory endurance, flexibility, and body composition, and motor abilities consist of speed, power, strength, agility, balance, and coordination. Therefore, promoting physical fitness by using correct techniques provided by exercise science and physiology is one the strategies to prevent sports and training injuries (75, 76).

Acevedo et al. examined risk factors for ACL ligament injuries with a prevention strategy in young athletes. Their report showed important internal risk factors are fatigue, external risk factors, type of sport, the intensity of activity, and sports equipment. The findings of this study concerning internal risk factors were not in line with the data in the present study. In contrast, the findings reported about the external factors causing injury in young athletes were confirmed by the results of the present study (68, 75). However, the observations made in the present study were not consistent with some studies in the literature (e.g., Emery et al. (76); Andersen et al. (77); Jacobsson et al. (78) These conflicting results can be accounted for by a large number of injuries addressed in studies including muscle and joint injuries in young athletes, as well as athletes' gender. One of the important implications of the present study is that instructing athletes on how to perform sports techniques by teachers and trainers is very important. Accordingly, the students in the present study reported the incorrect implementation of sports techniques was the main internal risk factor for injury. Paying attention to the good physical condition of physical education students due to their short semesters is highly essential. Furthermore, the use of inappropriate and non-standard equipment, including the rough surface of sports fields, non-standard tracks, inadequate flooring, use of worn-out and unusable equipment in technical and vocational schools in Kerman are the most important environmental factors leading to students' injuries. However, one of the limitations of the present study was the students' lack of knowledge of the sports injury surveillance system. Accordingly, increasing students' awareness of injury registration in the system can lead to the reduction and prevention of sports injuries in them. Another limitation was the students' unwillingness to record their injuries in the system as they were scared of the disclosure of their information. To this end, the students were reassured that their data would be kept confidential in the study and would be used only for scientific purposes.

Conclusion

The data from the semi-structured interviews in this study indicated that muscle strain injury was the most frequently reported injury, the lower extremity was the most frequent injury site, and the use of the improper technique was the most important cause of the students' sports injuries. It was also shown that the most frequently reported injuries were minor injuries with a rate of 45.3%. Besides, the

students were exposed to 33.3 injuries per 100 student-athletes and 63.3 injuries per 100 hours of training and competition. Therefore, addressing sports injury indicators is essential, and explaining their causes and risk factors will play a very important role in preventing injuries to students. Furthermore, students' awareness of correctly performing exercise techniques as a risk factor and trainers' awareness of injuries associated with various ports and types of preventive exercises may be effective in reducing the rate of sports injuries in schools. The present study showed that systematic reviews of epidemiological studies can lead to the development of injury prevention programs. Therefore, the existence of a database to collect information on the epidemiology of sports injuries seems to be a very valuable help in reducing and preventing sports injuries.

Acknowledgments

This study was approved under the code of ethics IR.KMU.REC.1397.05 by Kerman University of Medical Sciences. The authors would like to sincerely appreciate all those who contributed to conducting this research project.

Conflict of Interest

The authors declared no conflict of interest.

References

1. Rahimi M, Ghasemi Gh, Halabchi F, Zolaktaf V. Prevalence of karate injuries in professional karate athletes in Isfahan. J Mil Med Sci Univ Iran. 2009; 3(7):201-7. [In Persian].
2. Sahebozamani M, Beyranvand R. A review of injury assessment in Iranian martial artists: Systematic review. Scientific Journal of Rehabilitation Medicine. 2016; 5(2):235-48. [In Persian]. doi: 10.22037/JRM. 2016.1100189.
3. Rahnama N, Bambaeichi E, Nazariyan AB. Daneshjo A. Incidence and causes of acute injury among collegiate soccer players. Olympic. 2007; 15(2):39-47. [In Persian].
4. Lauersen JB, Bertelsen DM, Andersen LB. The effectiveness of exercise interventions to prevent sports injuries: a systematic review and meta-analysis of randomized controlled trials. Br J Sports Med. 2013; 48:871-877 doi: 10.1136/bjsports-2013-092538.
5. Fuller CW, Ekstrand J, Junge A, Andersen TE, Bahr R, Dvorak J, Hägglund M, McCrory P, Meeuwisse WH. Consensus statement on injury definitions and data collection procedures in studies of football (soccer) injuries. Clin J Sport Med. 2006; 16(2):97-106. doi: 10.1097/00042752-200603000-00003.
6. Foss KDB, Thomas S, Khoury JC, Myer GD, Hewett TE. A school-based neuromuscular training program and sport-related injury incidence: a prospective randomized controlled clinical trial. J Athl Train. 2018; 53(1):20-28. doi: 10.4085/1062-6050-173-16.
7. Bahr R, Holme I. Risk factors for sports injuries a methodological approach. Br J Sports Med. 2003; 37(5):384-92. doi: 10.1136/bjsm.37.5.384.
8. Varkiani ME, Alizadeh MH, Pourkazemi L. The epidemiology of futsal injuries via sports medicine federation injury surveillance system of Iran in 2010. Procedia-Social and Behavioral Sciences. 2013; 82:946-51. doi: 10.1016/j.sbspro.2013.08.001.
9. Nejaati V. Prevalence and causes of sports injuries in female athlete students. Harakat. 2008; 35:117-128. [In Persian].
10. Pakravan M, Sahebozamani M, Ghahramantabrizi K. Investigating the prevalence and causes of sports injuries among physical education students. J Sport Medicine. 2009; 2:81-95. [In Persian].
11. Baher R HLSM, Rahnama N, Mohammadi H. Rahnama N. Sports sciences research institute. Tehran: Sports Injuries Prevention Guide. 2002; (1):25-8.
12. Nelson LD, Guskiewicz KM, Barr WB, Hammeke TA, Randolph C, Ahn KW, Wang Y, McCrea MA. Age differences in recovery after sport-related concussion: a comparison of high school and collegiate athletes. J Athl Train. 2016; 51(2):142-52. doi: 10.4085/1062-6050-51.4.04.
13. Stracciolini A, Casciano R, Levey Friedman H, Stein CJ, Meehan WP 3rd, Micheli LJ. Pediatric sports injuries: a comparison of males versus females. Am J Sports Med. 2014; 42(4):965-72. doi: 10.1177/036354 6514522393.
14. Dadgar H, Sahebozamani M, Noraei T, Sharifiyan E. The relationship between angular Q amount and noncontact injuries of lower limbs in male karate. Journal of Sports Medicin. 2009; 1(3):97-83. [In Persian].
15. Daneshjoo A, Mokhtar AH, Rahnama N, Yusof A. The effects of injury preventive warm-up programs on knee strength ratio in young male professional soccer players. PLoS ONE. 2012; 7(12):e509.79. doi: 10.1371/ journal.pone.0050979.
16. Sharifi M, Sahebozamani M, Ghahramantabrizi K. The relationship between the prevalence of injury and the performance of women in the Premier League against injury prevention strategies. Sport Medicine Studies, 2010; 2(7):99-108. [In Persian].
17. Møller M, Wedderkopp N, Myklebust G, Lind M,

Sørensen H, Hebert JJ, Emery CA, Attermann J. Validity of the SMS, Phone, and medical staff Examination sports injury surveillance system for time-loss and medical attention injuries in sports. Scand J Med Sci Sports. 2018; 28(1):252-259. doi: 10.1111/sms.12869.

18. Meeuwisse WH, Love EJ. Athletic injury reporting. Development of universal systems. Sports Med. 1997; 24(3):184-204. doi: 10.2165/00007256-199724030-00008.

19. Sadeghi J. Yousefi S, Saeid S, Rezaei S, Sahebozamani M. Relationship between the prevalence of injury and the performance of rugby players against the prevention strategies of the eighth. International Sporting Medicine Congress of Iran, Tehran; 2014. [In Persian].

20. Van Mechelen W. Sports injury surveillance systems. 'One size fits all'? Sports Med. 1997; 24(3):164-8. doi: 10.2165/00007256-199724030-00003.

21. Daneshjoo A, Mokhtar A, Rahnama N, Toutouni M, Reisi J, Yusof A. The effects of injury prevention programs on anthropometric factors in professional male soccer players. Biol Sport. 2013; 30(4):281–288. doi: 10.5604/20831862.1077554.

22. Llinas PJ, Serrano RF, Quintero Barrera L, Quiceno Noguera JC, Martinez Cano JP. Sports injuries and ill-health episodes in the Cali 2013 World Games. BMJ Open Sport Exerc Med. 2016; 2(1):e000072. doi: 10.1136/bmjsem-2015-000072.

23. Orchard J, Newman D, Stretch R, Frost W, Mansingh A, Leipus A. Methods for injury surveillance in international cricket. J Sci Med Sport. 2005; 8(1):1-14. doi: 10.1016/s1440-2440(05)80019-2.

24. Meeuwisse WH, Sellmer R, Hagel BE. Rates and risks of injury during intercollegiate basketball. Am J Sports Med. 2003; 31(3):379-85. doi: 10.1177/03635465030310030901.

25. Hammond LE, Lilley JM, Ribbans WJ. Defining recovery: an overlooked criterion in sports injuries surveillance. Clin J Sport Med. 2013; 23(3):157-9.

26. Rahnama N, Bambaeichi E, Daneshjoo A. The epidemiology of knee injuries in Iranian male professional soccer players. Sport Sciences for Health. 2009; 5(1):9-14.

27. Olsen L, Scanlan A, MacKay M, Babul S, Reid D, Clark M, et al. Strategies for prevention of soccer-related injuries: a systematic review. Br J Sport Med. 2004; 38(1):89-94. doi: 10.1136/bjsm.2002.003079.

28. Vanderlei FM, Bastos FN, Tsutsumi GY, Vanderlei LC, Netto Júnior J, Pastre CM. Characteristics and contributing factors related to sports injuries in young volleyball players. BMC Res Notes. 2013; 6:415. doi: 10.1186/1756-0500-6-415.

29. Erfani M, Saheboamaani M, Marefati H, Sharifin E. The survey of Sole Arch index and its relation to non-contact ankle sprain in athlete. Journal of Exercise Science and Medicine. 2011; 1(3):99-112. [In Persian].

30. Caswell S, Prebble M, Romm K, Ambegaonkar J, Caswell A, Cortes N. Epidemiology of sports injuries among middle school students. Br J Sports Med. 2017; 51(4):305. doi: 10.1136/bjsports-2016-097372.56.

31. Timpka T, Jacobsson J, Bickenbach J, Finch CF, Ekberg J, Nordenfelt L. What is a sports injury? Sports Med. 2014; 44(4):423-8. doi: 10.1007/s40279-014-0143-4.

32. Speziale HS, Streubert HJ, Carpenter DR. Qualitative research in nursing: advancing the humanistic imperative. Philadelphia :Wolters Kluwer; 2011.

33. Hsieh HF, Shannon SE. Three approaches to qualitative content analysis. Qual Health Res. 2005; 15(9):1277-88. doi: 10.1177/1049732305276687.

34. Graneheim UH, Lundman B. Qualitative content analysis in nursing research: concepts, procedures and measures to achieve trustworthiness. Nurse Educ Today. 2004; 24(2):105-12. doi: 10.1016/j.nedt.2003.10.001.

35. Polit DF, Beck CT, Hungler BP. Essentials of nursing research: methods, appraisal, and utilization. Philadelphia: Lippincott Williams & Wilkins; 2006.

36. Del Coso J, Herrero H, Salinero JJ. Injuries in Spanish female soccer players. J Sport Health Sci. 2018; 7(2): 183-190. doi: 10.1016/j.jshs.2016.09.002.

37. Hamilton B, Alonso JM, Best TM. Time for a paradigm shift in the classification of muscle injuries. J Sport Health Sci. 2017; 6(3):255-261. doi: 10.1016/j.jshs.2017.04.011.

38. Montalvo AM, Shaefer H, Rodriguez B, Li T, Epnere K, Myer GD. Retrospective injury epidemiology and risk factors for injury in cross fit. J Sports Sci Med. 2017; 16(1):53-59.

39. DiStefano LJ, Dann CL, Chang CJ, Putukian M, Pierpoint LA, Currie DW, Knowles SB, Wasserman EB, Dompier TP, Comstock RD, Marshall SW, Kerr ZY. The first decade of web-based sports injury surveillance: descriptive epidemiology of injuries in us high school Girls' soccer (2005-2006 through 2013-2014) and national collegiate athletic association women's soccer (2004-2005 through 2013-2014). J Athl Train. 2018; 53(9):880-892. doi: 10.4085/1062-6050-156-17.

40. Rossler R, Junge A, Chomiak J, Němec K, Dvorak J, Lichtenstein E, Faude O. Risk factors for football injuries in young players aged 7 to 12 years. Scand J Med Sci Sports. 2018; 28(3):1176-1182. doi: 10.1111/sms.12981.

41. Schroeder AN, Comstock RD, Collins CL, Everhart J, Flanigan D, Best TM. Epidemiology of overuse injuries among high-school athletes in the United States. J Pediatr. 2015; 166(3):600-6. doi: 10.1016/j.jpeds.2014.09.037.

42. Alentorn-Geli E, Mendiguchía J, Samuelsson K, Musahl

V, Karlsson J, Cugat R, Myer GD. Prevention of anterior cruciate ligament injuries in sports. Part I: systematic review of risk factors in male athletes. Knee Surg Sports Traumatol Arthrosc. 2014; 22(1):3-15. doi: 10.1007/s00167-013-2725-3.

43. Dai B, Herman D, Liu H, Garrett WE, Yu B. Prevention of ACL injury, part I: injury characteristics, risk factors, and loading mechanism. Res Sports Med. 2012; 20(3-4):180-97. doi: 10.1080/15438627.2012.680990.

44. Colston MA, Wilkerson GB, ATC, Dreyfus H, Ross R. Methods for prediction of core or lower extremity injury among high school football players as a strategy for longitudinal reduction of injury risk. International Journal of Athletic Therapy and Training. 2018; 23(5):205-9. doi: 10.1123/ijatt.2017-0085.

45. Raschner C, Platzer HP, Patterson C, Werner I, Huber R, Hildebrandt C. The relationship between ACL injuries and physical fitness in young competitive ski racers: a 10-year longitudinal study. Br J Sports Med. 2012; 46(15):1065-71. doi: 10.1136/bjsports-2012-091050.

46. Goossens L, De Ridder R, Cardon G, Witvrouw E, Verrelst R, De Clercq D. Injury prevention in physical education teacher education students: lessons from sports. A systematic review. European Physical Education Review. 2017; 25:156-173. doi: 10.1177/1356336X17711675.

47. Dyakova G, Angelova P, Angelova I, Dyakov T, Belomazheva-Dimitrova S. Sports injuries in student-athletes. Trakia Journal of Sciences. 2017; 15(1):369-74. doi: 10.15547/tjs.2017.s.01.062.

48. Pierpoint LA, Williams CM, Fields SK, Comstock RD. Epidemiology of injuries in united states high school track and field: 2008-2009 through 2013-2014. Am J Sports Med. 2016; 44(6):1463-8. doi: 10.1177/0363546516629950.

49. Schroeder AN, Comstock RD, Collins CL, Everhart J, Flanigan D, Best TM. Epidemiology of overuse injuries among high-school athletes in the United States. J Pediatr. 2015; 166(3):600-6. doi: 10.1016/j.jpeds.2014.09.037.

50. Roos KG, Marshall SW, Kerr ZY, Golightly YM, Kucera KL, Myers JB, Rosamond WD, Comstock RD. Epidemiology of overuse injuries in collegiate and high school athletics in the United States. Am J Sports Med. 2015; 43(7):1790-7. doi: 10.1177/0363546515580790.

51. Pfirrmann D, Herbst M, Ingelfinger P, Simon P, Tug S. Analysis of injury incidences in male professional adult and elite youth soccer players: a systematic review. J Athl Train. 2016; 51(5):410-24. doi: 10.4085/1062-6050-51.6.03.

52. Abernethy L, MacAuley D, McNally O, McCann S. Immediate care of school sport injury. Inj Prev. 2003; 9(3):270-3. doi: 10.1136/ip.9.3.270.

53. Pfeifer CE, Beattie PF, Sacko RS, Hand A. Risk factors associated with non-contact anterior cruciate ligament injury: a systematic review. Int J Sports Phys Ther. 2018; 13(4):575-587.

54. Ryman Augustsson S, Ageberg E. Weaker lower extremity muscle strength predicts traumatic knee injury in youth female but not male athletes. BMJ Open Sport Exerc Med. 2017; 3:e000222. doi: 10.1136/bmjsem-2017-000222.

55. Kerr ZY, Quigley A, Yeargin SW, Lincoln AE, Mensch J, Caswell SV, Dompier TP. The epidemiology of NCAA men's lacrosse injuries, 2009/10-2014/15 academic years. Inj Epidemiol. 2017; 4(1):6. doi: 10.1186/s40621-017-0104-0.

56. Franco MF, Madaleno FO, de Paula TMN, Ferreira TV, Pinto RZ, Resende RA. Prevalence of overuse injuries in athletes from individual and team sports: A systematic review with meta-analysis and GRADE recommendations. Brazilian Journal of Physical Therapy; 2021. (In Press).

57. Ebrahimi Varkiani M, Nayeb Mahdi Abadi F, Shakourian A, Najafi M. Epidemiologic table tennis damage using the sports medicine federation damage monitoring database. 2nd National Conference on Physical Education and Sports, Chabahar International University, Chabahar; 2016. [In Persian].

58. Ziaee V, Shobbar M, Lotfian S, Ahmadinejad M. Sport injuries of karate during training: an epidemiologic study in Iran. Asian J Sports Med. 2015; 6(2):e26832. doi: 10.5812/asjsm.26832.

59. Kerr ZY, Lynall RC, Roos KG, Dalton SL, Djoko A, Dompier TP. Descriptive epidemiology of non-time-loss injuries in collegiate and high school student-athletes. J Athl Train. 2017; 52(5):446-456. doi: 10.4085/1062-6050-52.2.15.

60. Knobloch K, Rossner D, Gossling T, Richter M, Krettek C. Volleyballverletzungen im schulsport [volleyball sport school injuries]. Sportverletz Sportschaden. 2004; 18(4):185-9. German. doi: 10.1055/s-2004-813481.

61. Pierpoint LA, LaBella CR, Collins CL, Fields SK, Dawn Comstock R. Injuries in girls' soccer and basketball: a comparison of high schools with and without athletic trainers. Inj Epidemiol. 2018; 5(1):29. doi: 10.1186/s40621-018-0159-6.

62. Owoeye OBA, Ghali B, Befus K, Stilling C, Hogg A, Choi J, et al. Epidemiology of all-complaint injuries in youth basketball. Scandinavian Journal of Medicine &Science in Sports. 2020; 30(12):2466-2476. doi: 10.1111/sms.13813.

63. Kerr ZY, Wilkerson GB, Caswell SV, Currie DW, Pierpoint LA, Wasserman EB, Knowles SB, Dompier TP, Comstock RD, Marshall SW. The first decade of web-based sports injury surveillance: descriptive epidemiology of injuries in united state high school football (2005-2006 through 2013-2014) and national collegiate athletic association football (2004-2005

through 2013-2014). J Athl Train. 2018; 53(8):738-751. doi: 10.4085/1062-6050-144-17.

64. McGuine TA, Post EG, Hetzel SJ, Brooks MA, Trigsted S, Bell DR. A Prospective Study on the Effect of Sport Specialization on Lower Extremity Injury Rates in High School Athletes. Am J Sports Med. 2017; 45(12):2706-2712. doi: 10.1177/0363546517710213.

65. Niknejad M, Balochi R, Ghadimy Ilkhanlar H. The survey of physical education teachers' viewpoints on causes and prevalence of sport injury at school. Sports Medicine Journal. 2010; 2(1):91-101. [In Persian].

66. Hoge C, Sabbagh R, Morgan M, Grawe BM. Epidemiology of youth and high school American football-related injuries presenting to United States emergency departments: 2010-2019. Phys Sportsmed. 2021; 31:1-6. doi: 10.1080/00913847.2021.1931980.

67. Yalfani A, Naderi A, Anbariyan M, Biglarbigi A. The comprasion of prevalance, type and severity of injury in professional and amateur freestyles' wrestlers Journal of Research in Rehabilitation Sciences. 2013; 9(4):606. doi: 10.22122/jrrs.v9i4.866.

68. Hodgson L, Gissane C, Gabbett TJ, King DA. For debate: consensus injury definitions in team sports should focus on encompassing all injuries. Clin J Sport Med. 2007; 17(3):188-91. doi: 10.1097/JSM.0b013e 3180547513.

69. Mohamadi H, Daneshmandi H, Alizadeh MH, Shamsimajlan A. The effect of ACL intervention programs on the improvement of neuromuscular deficiencies and reducing the incidence of ACL injury. Scientific Journal of Rehabilitation Medicine. 2015; 4(2):159-169. [In Persian].

70. Kramer LC, Denegar CR, Buckley, WE, Hertel J. Factors associated with anterior cruciate ligament injury: history in female athletes. J Sports Med Phys Fitness. 2007; 47(4):446-54.

71. Caine D, Maffulli N, Caine C. Epidemiology of injury in child and adolescent sports: injury rates, risk factors, and prevention. Clin Sports Med. 2008; 27(1):19-50. doi: 10.1016/j.csm.2007.10.008.

72. Saragiotto BT, Di Pierro C, Lopes AD. Risk factors and injury prevention in elite athletes: a descriptive study of the opinions of physical therapists, doctors and trainers. Braz J Phys Ther. 2014; 18(2):137-43. doi: 10.1590/s1413-35552012005000147.

73. Khayambashi K, Ghoddosi N, Straub RK, Powers CM. Hip muscle strength predicts noncontact anterior cruciate ligament injury in male and female athletes: a prospective study. Am J Sports Med. 2016; 44(2):355-61. doi: 10.1177/0363546515616237.

74. Wang V, Mayer F, Bonaventura K, Wippert M. Intrinsic and extrinsic injury risk factors of elite winter sports athlete in training. Br J Sports Med. 2017; 51(4):406. doi: 10.1136/bjsports-2016-097372.309.

75. Acevedo RJ, Rivera-Vega A, Miranda G, Micheo W. Anterior cruciate ligament injury: identification of risk factors and prevention strategies. Curr Sports Med Rep. 2014; 13(3):186-91. doi: 10.1249/JSR.00 00000000000053.

76. Emery C, Tyreman H. Sport participation, sport injury, risk factors and sport safety practices in Calgary and area junior high schools. Paediatr Child Health. 2009; 14(7):439-44. doi: 10.1093/pch/14.7.439.

77. Andersen LB, Riddoch C, Kriemler S, Hills AP. Physical activity and cardiovascular risk factors in children. Br J Sports Med. 2011; 45(11):871-6. doi: 10.1136/bjsports-2011-090333.

78. Jacobsson J, Timpka T, Kowalski J, Nilsson S, Ekberg J, Dahlström O, Renstrom PA. Injury patterns in Swedish elite athletics: annual incidence, injury types and risk factors. Br J Sports Med. 2013; 47(15):941-52. doi: 10.1136/bjsports-2012-091651.