



Journal Homepage: -www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI:10.21474/IJAR01/11513
DOI URL: <http://dx.doi.org/10.21474/IJAR01/11513>



RESEARCH ARTICLE

A PROSPECTIVE STUDY OF SPORTS RELATED INJURIES AMONG ATHLETES

Serghei Cebanu¹, Grigore Friptuleac¹, Svetlana Cociu¹, Raisa Deleu¹ and Eve Unt²

1. Nicolae Testemitanu State University of Medicine and Pharmacy from the Republic of Moldova.
2. University of Tartu, Estonia.

Manuscript Info

Manuscript History

Received: 15 June 2020
Final Accepted: 17 July 2020
Published: August 2020

Key words:-

Exercise, Sports Related Injuries, Risk Factors, Prevention

Abstract

The purpose of the current study was to evaluate hospitalized sports related injuries.

Methods: Data were analyzed as part of the iCREATE database project, using patients' medical records with sports-related injury and received care at the ED within the Institute of Emergency Medicine and Municipal Children Hospital V. Ignatenco from Chisinau municipality, Republic of Moldova. Data were collected over a period of 12 months by four trained resident doctors. There were analyzed individual demographics data; mechanism, nature, place, and activity of injury; injury types, body regions affected and discharge state. Data were uploaded using the existing electronic data collection tool - Red Cap and analyzed through Microsoft Excel, Epi Info 7. The ethics committee's approval has been obtained.

Results: Most of the medical care addresses were registered in the day of the injury (49.3%). During the first three days there have been registered 85.5% of people, which shows a large number of late medical care addresses. The majority of injuries (90.1%) occurred in the sports area and only 6.2% of the injuries occurred in school or in the educational area. Regarding the mechanism of injury, the most were produced by fall (81.1%). Regarding the type of injury, sprains or dislocations (40.4%) are on the first place, followed by contusions and bruises (18.8%). With the regard to the location of the injury, the most common is the ankle (21.1%), followed by the knee (15.2%), head (7.2%), carp and the sole of the foot (by 6.7% each).

Conclusions: Most of those who addressed after medical assistance as a result of sports activities were men, aged between 18-24 years old. The majority of sports injuries occurred in the sports area. Therefore, a higher attention should be taken in order to ensure adequate conditions of those who practice systematic physical activities. Identifying the causes and circumstances of sports injuries among athletes will allow the development of evidence-based prevention measures and increase their effectiveness, which will ultimately lead to lower rates of sports injuries and their complications.

Copy Right, IJAR, 2020.. All rights reserved.

Corresponding Author:- Serghei Cebanu

Address:- Nicolae Testemitanu State University of Medicine and Pharmacy from the Republic of Moldova.

Introduction:-

Sport, together with other types of physical activity, such as leisure activities, work activities, can make an important contribution in avoiding sedentary lifestyles and therefore plays a key role in preventing non-communicable diseases (Matheson GO. et al., 2013; WHO, 2011).

A wellbeing perception and well planned results in sport is achieved only when it is carried out rationally, with optimal load, in an adequate hygienic environment, etc. and depends largely on the qualification level of the teachers and coaches, the correct choice of teaching-learning methods and the quality of educational work among athletes (Frisch A., 2009; Cebanu S., 2017). Equally important is the systematic medical check-up of people who practice sport. Passing over them, for one reason or another inevitably leads to negative consequences on the health status of the athletes and may increase the sport-related injuries (Patel DR et al, 2017; Vriend I. et al, 2017).

Sport injuries is an important problem for both public health and sports medicine. There is an increase tendency of injuries within the osteo-articular system, which increases the likelihood of post-traumatic diseases during physical and sports activities. Sports-related injuries, according to different references, represent 2-9% of the total number of injuries (habitual, road, industrial, etc.) (Khodasevich LS, 2013).

An annual average of 8.6 million of sports and recreation-related injuries was reported, with an age-adjusted rate of 34.1 per 1,000 populations. Men (61.3%) and people aged between 5-24 years old (64.9%) accounted for more than half of the injuries (Sheu Y., 2016).

In the US, approximately 30 million children and adolescents are enrolled in different sport activities and over 3.5 million injuries are registered each year, thus causing loss of participation time. Almost a third of all injuries listed in childhood are sport-related injuries; sprains and dislocations remaining the most common types of injuries (<https://www.stanfordchildrens.org/en/topic/default?id=sports-injury-statistics-90-P02787>).

Another study of Chena Sinovas M et al. (2019) identified that the incidence of accidents was 3.82 injuries per 1000 hours of exposure. Approximately 83.6% of the injuries were located in the lower limbs. The thigh and ankle were the most affected joints. Most injuries had repercussions of 1-8 days of absence from training.

According to the European Injury Database, approximately 4.5 million people aged 15 and above are treated annually in EU hospitals with various sports injuries. Team ball sports represent 40% of all sports injuries, unquestionably driven by football. Two-thirds of injuries affect men, although with huge differences in various types of sports (Kisser and Bauer, 2010).

The most common sports injuries are caused by accidents, training mistakes or incorrect use of tools or equipments. Athletes can also be injured if they are not in good athletic shape, or because they have not met the warm-up or stretching requirements (Rössler R. et al, 2014; Leppanen M. et al, 2014).

Injury prevention has received increasing attention in sports medicine, and recently, international bodies such as the International Olympic Committee have declared the protection of athletes' health as one of the major objectives (Hespanhol Junior LC et al, 2015; Bizzini M. et al, 2013).

One of the biggest problems in our country is the lack of a data register regarding the causes of injuries, the lack of standard age groups, the classification on sports events, etc. The current study, based on the evaluation of data regarding all types of injuries from the iCREATE Injury Registry is the first study of this type conducted in the Republic of Moldova.

The aim of the study was to evaluate hospitalized sports related injuries.

Materials and Methods:-**Data and study design:**

This is a prospective study of patients treated for sport-related injuries admitted to the Emergency Department of two major emergency hospitals- the Emergency Medicine Institute (EMI) and the Municipal Hospital for Children "V. Ignatenco" (MHC) in 2018, in Chisinau, the capital of Republic of Moldova, with a population of nearly 800

000 inhabitants. There have been used data from the iCREATE Injury Registry piloted for the first time in the country. The data collection tool (questionnaire) was developed taking into account the WHO Recommendations, ICD-10, IDB-JAMIE Project and Iowa Emergency Unit Registry. Data for this pilot project were coordinated nationally by the Nicolae Testemitanu State University of Medicine and Pharmacy from the Republic of Moldova, and internationally by the Department of Public Health, Babeş-Bolyai University, Cluj-Napoca and College of Public Health, The University of Iowa; with the aim of increasing capacity in research related to injury and violence within tree LMIC countries of Armenia, Georgia and Moldova.

Settings and population:

A sample of 7301 patients aged between 5 – 64 years old who presented with different types of injuries and received care at EMI and MHC in Chisinau, between 1 March 2018 and 28 February 2019 were included in the analysis.

Data collection process:

Four resident physicians trained in data collection and coding procedures, collected data by hand from the patients' medical records. Collected variables were defined by the iCREATE Injury Database Project, and after collection, the information was uploaded into computer databases using the existing electronic data collection tool - Red Cap. The study form (questionnaire) contains general data and 5 additional modules with both open-ended questions and close-ended questions. The main module includes general information about the patient, details about the medical care, the circumstances in which the injury occurred, the type and location of the injuries. The additional modules included information about different types of injuries: traffic injuries, self-harm, violence, sports-related injuries and traumatic brain injuries. The sport related injury module contains information describing the type of sport/physical activity, purpose of sport/physical activity and previous sport injuries in the last 12 months. Data included for analysis took into account the pre-established inclusion criteria.

Study variables:

The unit of our analysis was the sport injured individual, which received care within those two emergency departments of Institute of Emergency Medicine and Municipal Children Hospital V. Ignatenco from Chisinau municipality, Republic of Moldova. Data from the study form included demographic variables and variables related to the circumstances of the injury event from the general data module and sport related injury module.

Statistical analysis:

Descriptive statistics to compare patients that have suffered a sport-related injury were calculated using t-tests and the significance threshold "p" ($p < 0.05$), necessary for testing the statistical significance. The statistical analysis was performed by evaluating the quantitative and qualitative particularities of the patients enrolled in the study, according to the indicators provided in the iCREATE Injury Registry. Data analyses were analyzed trough Microsoft Excel and Epi Info 7.

Results:-

After medical care in the emergency departments with injury profile within the Institute of Emergency Medicine and the Municipal Children's Hospital "Valentin Ignatenco" have addressed 7301 patients with different types of injuries. From them, 315 (4.3%) patients were with sport-related injuries, aged between 5 and 64 years old (average 27.5 ± 0.74). Of the total number of injured during sports activities, 87.9% were men and 12.1% - women; 28.6% of cases - aged between 5 and 19 years old, followed by the age group of 20-24 years old (20.5%), 25 -29 years old (18.3%) and 30-39 years old (22.4%).

Most cases were registered in January (13.6%), February, March, and December (by 11% respectively) (Fig 1). There have been found statistically significant differences in the annual variable in junior athletes and people over 19 years old. February and June are the months with the highest incidence of injuries among young athletes with 20.0% and 15.5% corresponding cases, respectively. The level of sport-related injuries during June-August, November and February is mainly maintained on people up to 19 years old, the excess morbidity being from + 2.7% (November) to 8.1% (February).

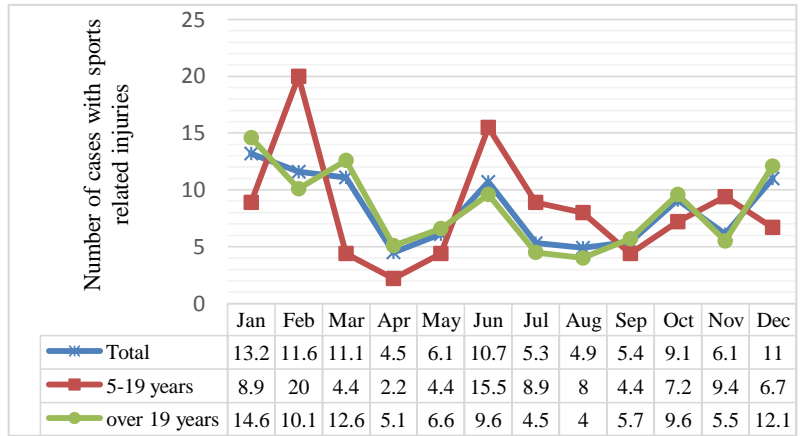


Figure 1:- The prevalence of sports-related injuries that attended the emergency department.

The most common sports injuries occurred in the second half of the month - 38.8% per total group and 39.7% - in the group of athletes over 19 years old. In the group of athletes up to 19 years old, the most common injuries occurred in the first half of the month - 46.7%.

Most of the addresses after medical care were registered on the day of the injury (49.3% total athletes and 46.5% junior athletes). In the first three days, 85.5% of injured per total group and 76.7% of junior athletes sought for medical help, which indicates a considerable rate of late addressability. More than seven days after the injury, 7.8% of injured per total group went for health care. Late addressing is practically 2 times more frequent found among people over 19 years old compared to people in the age group of 5-19 years old- 9.2% versus 4.7% respectively (p <0.05) (Fig 2). Delayed treatment after medical care in case of an injury is one of the causes leading to the development of post-traumatic conditions, which contributes to the loss of sports ability and performance over a longer period.

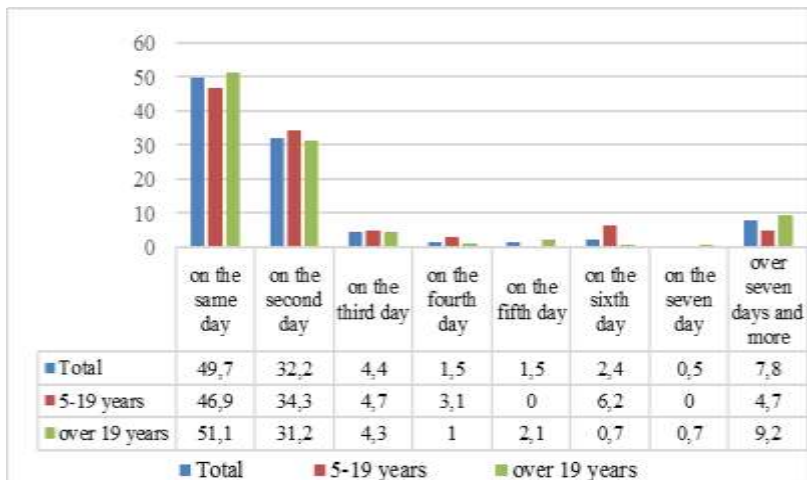


Figure 2:- Term of address after medical care of injured people.

The majority of patients with sports injuries (71.2%) presented mild clinical forms, which did not require hospitalization. Those persons received medical care with the indication of the treatment at home with the subsequent observation at the family doctor. Practically, every fourth patient (24.2%) needed treatment in inpatient conditions. It should be noted that the rate of junior athletes with injuries related to indications for treatment in hospital conditions was practically two times higher (58.3%) requiring treatment in inpatient conditions compared to the data recorded among patients older than 19 years old (P <0.01).

In 68.6% cases, the patients get to the hospital with personal or public transport units, and only in 29.6% cases - with the transport units for emergency medical assistance.

Most injuries (90.1% of total athletes and 85.7% of junior athletes) occurred in the sports area. At school or in the educational area, 6.2% of injuries occurred among junior athletes and 2.2% - in the total athletes.

Regarding the injury mechanism, those produced by falls prevail (81.1% in total athletes and 89.8% in junior athletes).

There are differences in the type of injury recorded in total and junior athletes. Thus, sprain or dislocation predominates on the first place in the structure of injuries, in total by 40.4%, and fractures among junior athletes by 38.8%, followed by contusion and bruising (18.8% in total athletes and 28.6 % in junior athletes).

Regarding the location of the injury, the most common is the ankle (21.1%), followed by the knee (15.2%) and head / skull (7.2%), carpus and sole of the foot (6.7% each). In junior athletes, the most common injuries are located in the head/ skull (16.3%), knee (14.3%), forearm, fingers and toes (10.2% each).

In 99.1% there is monotrauma, and in 100% cases with only one injured person.

The most common injuries were found in gymnasts (41.1% and 34.5% respectively in total and junior athletes), followed by those who practice American football (10.4% and 17.5% respectively in total and junior athletes) and running-athletes (5.7% and 12.5% respectively for total and junior athletes).

Discussions:-

The comparative analysis of the results obtained in the current study with the references in the specialized literature highlights the existence of both concordances and differences obtained in other studies.

A study by Kirkwood G. et al. (2019) in the UK established that almost half (47.4%) of sports injuries recorded in the emergency department were among children and adolescents aged between 0 and 19 years old and 7.7% of all injuries were sports related. Regional public health centers and schools should take under control the prevention of sport-related injuries among children and adolescents in middle schools and high schools.

In the US, 32% of all injuries among children who addresses for medical care at the emergency departments are related to sports (Meehan and Mannix, 2013). In our study, in 2018, out of 7301 addresses to the emergency department with various injuries, 315 were sport related, which represent 4.3%.

A study by Kirkwood, 2019, suggests that sports injuries are more common in men - 68% versus 32% in women. The data obtained in the current study confirm that association, but with a lower addressability rate among women.

Among various types of sports, injuries are most common in sports games (football, hockey, basketball, volleyball, etc.) (Theisen D. et al, 2013; Bizzini M., 2013; Al-Atbi AY et a., 2018). Unlike the literature data, the epidemiological analysis of sports injury cases in the current study established that they were most frequently recorded among people who practice gymnastics and sports games ranked secondly.

The specialized literature suggests that the most vulnerable in terms of the injury risk during sports activities is the knee joint (Swenson DM. et al, 2013; Thomas AC. et al, 2017).

Injuries related to meniscus and anterior cruciate ligament accounts for 23 and 25% of knee injuries, respectively (Swenson DM. et.al, 2013). Injuries of the anterior cruciate ligament are often accompanied by damage to other structures in the knee joint, including articular cartilage, subchondral bone and collateral ligaments.

The locations of injuries identified in the current study differ significantly from those mentioned, both in terms of articulation and frequency of recording, in the first place being placed the ankle injury (21.1%). The knee joint is also at increased risk of injury, but at about 3 times lower compared to specialized literature data. It should be mentioned that injuries in junior athletes are located most frequently at the level of head / skull (16.3%). This is followed by the ankle joint (10%), the lumbar and thoracic spine (approximately 10%).

External risk factors of sport-related injuries mentioned in the literature are: deficiencies and errors in the methodology of trainings; deficiencies in the organization of trainings and competitions; particularities of the

technique performing the exercises; poor technical and material support; unfavorable hygienic and meteorological conditions; inappropriate behavior of athletes; violation of medical requirements (Caine D. et.al, 2008; Saragiotto BT et al, 2014).

Sports injuries are associated with the techniques (biomechanics) performing the exercise. This is characteristic for complex sports events from the technical point of view and is the result of an intense exercise or with complex coordination (eg. boxing, football, wrestling, gymnastics, acrobatics, etc.). We consider that production of injuries by falling, identified in a decisive proportion in the current study can be considered as a consequence including non-compliance with the technique of performing the exercise.

It is expected that preventive biomechanics could be uniquely adapted to sport-specific needs in order to more effectively reduce incidence of additional traumatic and overuse injuries such as ankle sprains, epicondylitis, ulnar collateral ligament tears, or lower back pain. Widespread implementation of preventive biomechanics in today's athletic community is feasible and could significantly improve health outcomes as well as reduce medical expenses (Hewett and Bates, 2017).

Some studies are mentioning about the poor technical-material endowment that can be the cause of sports injuries (McIntosh A., 2014; Committee on Sports-Related Concussions in Youth, 2014). This refers to the unsatisfactory condition of the equipment, sports facilities and equipment of athletes involved in trainings and competitions (clothing, footwear and protective equipment). Thus, the cause of injury may be the uneven surface of the football field, the treadmill, undetected defects of sports equipment, etc. (McIntosh A., 2014).

Unfavorable hygiene and weather conditions can also cause injuries. Within the sports buildings, this is presented by non-compliance with the hygienic regulations of lighting, ventilation, microclimatic conditions (temperature and humidity) in the gym or pool water. During outdoor activities, the damage can be caused by neglect of weather conditions and temperature standards (weather precipitation, alternating atmospheric pressure, high or low temperature) (Racinais S. et.al, 2017; Cebanu S., 2017).

Behavioral risk factors play an important role in the etiology of sports injuries. Most often, this is expressed in haste, indifference, indiscipline, use of prohibited methods (shocks, steps, blows, etc.), violation of the regime (nutrition, sleep, etc.) (Saragiotto BT. et al, 2014; Moreira NB. et.al, 2014).

Regarding the internal risk factors for sports injuries, the specialized literature mentions pathological conditions and diseases associated with the congenital characteristics of the athlete's body or changes in the physical condition during trainings and competitions. Among these factors, it is very important to list the following: states of overwork, fatigue and overwork; the presence in the athlete's body of the chronic infections; the individual characteristics of the athlete's body; breaks in sports (Lepanen M. et al, 2014; Saragiotto BT et al, 2014; Cebanu S., 2017).

Several authors (Soligard T. et al, 2016; Meeusen R. et al, 2013) mention that the states of overtraining, fatigue and overwork lead to disorders of coordination of movements in athletes, affect the attention and protective reactions of the body. This induces a decrease in the force of muscle contraction, disrupts the processes of extensibility and relaxation.

A detailed analysis of the causes of sports-related injuries will allow us to develop a set of measures to prevent them. Their main content is the continuous education of teachers and coaches (teaching staff); compliance with the organization and conduct of training and competitions; improving the logistics of training camps and competitions, as well as the conditions for their conduct; proper educational work among athletes; regular medical supervision of athletes.

Conclusions:-

Injuries are one of the priority issues of sports medicine and public health, being the most common form of disorder in the health status of young athletes.

According to the results of this study, the majority of sports injuries occurred in the sports area. Most of those who addressed for medical care, as a result of sports activities were men, aged between 18 and 24 years old. The prevalence of sports injury in people up to the age of 19 in June-August, associated with the summer holidays, indicates the need for more rigorous supervision by parents and family, as well as by coaches at that time of year.

It is very important to pay much more attention to ensuring adequate conditions for those who are engaged in systematic physical activities, although, identifying the causes and circumstances of sports injuries among athletes will allow the development of evidence-based prevention measures and increase their effectiveness, which will help reduce the rate of sports injuries and their complications.

Acknowledgement:-

The work reported in this publication was funded by the NIH-Fogarty International Trauma Training Program at the University of Iowa (2D43TW007261). The authors gratefully acknowledge all members of the iCREATE grant for their work on the project overall and for the contributions of project documentation used in this manuscript.

Conflict of interest:

The authors report no conflict of interest.

References:-

1. Al-Atbi AY, Kashmiri AA, Shaqsi SA. Epidemiology of Sport and Active Recreation Injuries Presenting to a Tertiary Emergency Department in the Sultanate of Oman. *Emerg Med (Los Angel)*, 2018, 8: 363
2. Bizzini M, Junge A, Dvorak J. Implementation of the FIFA 11+ football warm up program: How to approach and convince the Football associations to invest in prevention. *Br J Sports Med*, 2013, vol. 47:803–806.
3. 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.
4. Cebanu S. Public Health measures and prevention of diseases among young athletes from the Republic of Moldova. *Young Scientist*, N 3.1 (43.1), 2017, p. 4-8.
5. Chena Sinovas M, Rodríguez Hernández ML, Bores Cerezal A. Epidemiology of injuries in young Spanish soccer players. *Med Sport*, 2019. Vol. 72:254-66.
6. Committee on Sports-Related Concussions in Youth; Board on Children, Youth, and Families; Institute of Medicine; National Research Council; Graham R, Rivara FP, Ford MA, et al., editors. *Sports-Related Concussions in Youth: Improving the Science, Changing the Culture*. Washington (DC): National Academies Press (US); 2014 Feb 4. 6, Protection and Prevention Strategies.
7. Ekegren CL, Gabbe BJ, Finch CF. Sports Injury Surveillance Systems: A Review of Methods and Data Quality. *Sports Medicine*, Volume 46, Number 1, 2016, page 49-65.
8. Frisch A., Croisier JL., Urhausen A., Seil R., Theisen D. Injuries, risk factors and prevention initiatives in youth sport. *British Medical Bulletin*, Volume 92, Issue 1, 2009, pages 95–121.
9. Hespanhol Junior LC, Barboza SD, van Mechelen W, Verhagen E. Measuring sports injuries on the pitch: a guide to use in practice. *Braz J Phys Ther*, 2015, vol. 19 (5):369-80.
10. Hewett TE, Bates NA. Preventive Biomechanics: A Paradigm Shift With a Translational Approach to Injury Prevention. *Am J Sports Med*. 2017;45(11):2654-2664.
11. Khodasevich L.S., Khodasevich A.L., Kuzin S.G. Fatal Injuries in Sports. *European Journal of Physical Education and Sport*, 2013, Vol.(1), No 1, p. 38-48.
12. Kissler R, Bauer R. Sport injuries in the European Union. *Injury Prevention* 2010;16:A211.
13. Kirkwood G, Hughes TC, Pollock AM. Results on sports-related injuries in children from NHS emergency care dataset Oxfordshire pilot: an ecological study. *J R Soc Med*. 2019;112(3):109-118 Matheson GO., Kluĝl M., Engebretsen L., et al. Prevention and Management of Non-Communicable Disease: The IOC Consensus Statement, Lausanne 2013. *Sports Med*, 2013, 43:1075–1088.
14. Leppänen M, Aaltonen S, Parkkari J, Heinonen A, Kujala UM. Interventions to prevent sports related injuries: a systematic review and meta-analysis of randomised controlled trials. *Sports Med*. 2014;44(4):473-486.
15. Matheson GO., Kluĝl M., Engebretsen L., et al. Prevention and Management of Non-Communicable Disease: The IOC Consensus Statement. *Sports Med*, 2013, Vol. 43:1075–1088.

16. McIntosh A. Technology and equipment in sports injury prevention – The performance challenge. *Journal of Science and Medicine in Sport*, 2014, Volume 18, Supplement 1, p.e108.
17. Meehan WP 3rd, Mannix R. A substantial proportion of life-threatening injuries are sport-related. *Pediatr Emerg Care*. 2013;29(5):624-627.
18. Meeusen R, Duclos M., Foster C., et al. Prevention, diagnosis, and treatment of the overtraining syndrome: joint consensus statement of the European College of Sport Science and the American College of Sports Medicine. *Med Sci Sports Exerc*, 2013, Vol. 45 (1):186-205.
19. Moreira N.B., Vagetti G.C., Oliveira V.J., & Campos W.D. Association between injury and quality of life in. *Apunts. Medicina De L'esport*, 2014, 49, 123-138.
20. Patel DR, Yamasaki A, Brown K. Epidemiology of sports-related musculoskeletal injuries in young athletes in United States. *Transl Pediatr* 2017;6(3):160-166.
21. Paterno MV, Taylor-Haas JA, Myer GD, Hewett TE. Prevention of overuse sports injuries in the young athlete. *Orthop Clin North Am*. 2013;44(4):553-564.
22. Racinais S, Cocking S. & Périard JD. Sports and environmental temperature: From warming-up to heating-up, *Temperature*, 2017, 4:3, 227-257.
23. Rössler R, Donath L, Verhagen E, Junge A, Schweizer T, Faude O. Exercise-based injury prevention in child and adolescent sport: a systematic review and meta-analysis. *Sports Med*, 2014, 44 (12), pp. 1733-48.
24. Saragiotto BT, Di Piero 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):137-143.
25. Sheu Y, Chen LH, Hedegaard H. Sports- and Recreation-related Injury Episodes in the United States, 2011-2014. *Natl Health Stat Report*. 2016;(99):1-12.
26. Soligard T, Schwellnus M., Alonso JM, et. al. How much is too much? (Part 1) International Olympic Committee consensus statement on load in sport and risk of injury. *British Journal of Sports Medicine*, 2016, Volume 50, Issue 17, 1030-1043.
27. Swenson DM, Collins CL, Best TM, Flanigan DC, Fields SK, Comstock RD. Epidemiology of knee injuries among U.S. high school athletes, 2005/2006-2010/2011. *Med Sci Sports Exerc*. 2013 Mar; 45(3):462-9.
28. Theisen D, Frisch A, Malisoux L, Urhausen A, Croisier JL, Seil R. Injury risk is different in team and individual youth sport. *J Sci Med Sport*. 2013;16(3):200-204.
29. Thomas AC, Hubbard-Turner T, Wikstrom EA, Palmieri-Smith RM. Epidemiology of Posttraumatic Osteoarthritis. *J Athl Train*. 2017;52(6):491-496.
30. Vriend I., Gouttebargé V., Finch CF, van Mechelen W and Verhagen EA. Intervention strategies used in sport injury prevention studies: a systematic review identifying studies applying the Haddon Matrix. *Sports Med*, 2017; 47, 2027-43.
31. WHO. Promoting sport and enhancing health in European Union countries: a policy content analysis to support action, 2011;
32. <https://www.stanfordchildrens.org/en/topic/default?id=sports-injury-statistics-90-P02787>.