ISSN 2674-8169
BJIHS
Qualis B3 CAPES 2021-2024 | Latindex | DOI | Google Acadêmico

EPIDEMIOLOGICAL ANALYSIS OF INJURIES IN YOUTH ATHLETES PARTICIPATING IN THE 2023 BRAZILIAN SCHOOL GAMES (JEB'S) - CROSS-SECTIONAL STUDY

Igor Borges Silva[1]; Thaís Santos Tavares[1]; Domingos Corrêa Júnior[2]; Ayla Karolina Americo Lima Souza[3]; Jorge Augusto Almeida Garcez[2]; Riziane Ferreira da Mota[4]; Suziany dos Santos Caduda[1]; Flavia Diana Santos Figueiredo[4]; Victor Hugo dos Santos Souza de Santana[5]; Thiago Ferreira Rabelo[5]; Anne Augusta Affiune Peixoto[5]; Antonio Hora Filho[6]; José Aderval Aragão[7]; Walderi Monteiro da Silva Junior[8].

https://doi.org/10.36557/2674-8169.2026v8n6p164-185
Artigo recebido em 3 Maio e publicado em 3 de Junho de 2026

ARTIGO ORIGINAL

RESUMO

Os Jogos Escolares Brasileiros são um evento multiesportivo que reúne atletas de todo o país, com o objetivo de promover a participação esportiva. No entanto, o risco de lesões é inerente à prática esportiva. Este estudo teve como objetivo analisar e descrever as lesões em atletas jovens participantes dos Jogos Escolares Brasileiros de 2023 (JEB's). Trata-se de um estudo epidemiológico observacional, transversal e descritivo, que analisou as lesões de 750 atletas com idades entre 12 e 14 anos. A coleta de dados ocorreu durante 14 dias, incluindo atendimentos em pronto-socorro e consultas ambulatoriais. As lesões musculares foram as mais frequentes (48,8%), seguidas pelas lesões articulares (34,53%), ósseas (11,06%), tendíneas (5,06%) e ligamentares (1,06%). As regiões mais acometidas foram o tornozelo (16,13%), o joelho (15,6%) e a coxa (14,66%). Futsal, basquetebol e handebol foram as modalidades esportivas com maior incidência de lesões, representando 22%, 12% e 9,6% dos casos, respectivamente. Os traumatismos cranianos foram registrados com baixa frequência (8 casos). Houve predominância de atendimentos ambulatoriais (63,03%), e 8,93% dos casos necessitaram de afastamento das competições. A análise destacou diferenças na distribuição das lesões entre os sexos, com maior frequência observada entre as atletas do sexo feminino (57,46%). Conclui-se que a análise epidemiológica é essencial para compreender o perfil das lesões e, assim, direcionar de maneira mais eficaz a atenção à saúde do atleta.

Palavras-chave: Lesão; Sistema de Vigilância em Saúde; Medicina Esportiva.

EPIDEMIOLOGICAL ANALYSIS OF INJURIES IN YOUTH ATHLETES PARTICIPATING IN THE 2023 BRAZILIAN SCHOOL GAMES (JEB'S) - CROSS-SECTIONAL STUDY

ABSTRACT

The Brazilian School Games are a multisport event that brings together athletes from all over the country, aiming to promote sports participation. However, the risk of injury is inherent to sports participation. This study aimed to analyze and describe injuries in youth athletes participating in the 2023 Brazilian School Games (JEB's). This is an observational, cross-sectional, and descriptive epidemiological study that analyzed the injuries of 750 athletes aged between 12 and 14 years. Data collection took place over 14 days, including emergency room visits and outpatient consultations. Muscle injuries were the most common (48,8%), followed by articular (34.53%), bone (11.06%), tendon (5.06%) and ligament (1.06%) injuries. The most affected regions were the ankle (16.13%), knee (15.6%) and thigh (14.66%). Futsal, basketball, and handball were the sports with the highest incidence of injuries, representing 22%, 12%, and 9.6% of cases, respectively. Head trauma was recorded with low frequency (8), there was a predominance of outpatient care (63.03%), and 8.93% of cases required time off from competition. The analysis highlighted differences in the distribution of injuries between the sexes, with a higher frequency observed among female athletes (57.46%). It is concluded that epidemiological analysis is essencial for understand the injury profile of injuries and, thus, to direct attention to the athlete's health more effectively.

Keywords: Injury; Health Surveillance System; Sports Medicine.

Instituição afiliada
[1] PhD student in the Postgraduate Program in Health Sciences at the Federal University of Sergipe, Aracaju, Sergipe, Brazil, and Physiotherapist at the Brazilian Confederation of School Sports, Brasília, Federal District, Brazil.
[2] Physiotherapist at the Brazilian Confederation of School Sports, Brasília, Federal District, Brazil.
[3] PhD student in the Postgraduate Program in Movement Sciences at the Federal University of Sergipe, Aracaju, Sergipe, Brazil.
[4] PhD student in the Postgraduate Program in Health Sciences at the Federal University of Sergipe, Aracaju, Sergipe, Brazil.
[5] Physiotherapy student at the Federal University of Sergipe (UFS).
[6] President of the Brazilian Confederation of School Sports (CBDE), Brasília, Federal District, Brazil.
[7] Titular Professor of Clinical Anatomy, Department of Morphology, Federal University of Sergipe (UFS), Aracaju, Sergipe, Brazil.
[8] Professor in the Department of Physical Therapy at the Federal University of Sergipe, Aracaju, Sergipe, Brazil

Autor correspondente: *Igor Borges Silva* igor_fisio@yahoo.com.br Tel.: +55 (79) 98105-5725.

Introduction

Sports participation by children and adolescents brings physiological, psychological, and social benefits, such as improved health, self-esteem, social interactions, and a lower risk of depression [1]. However, participation in sports activities at more competitive levels increases the risk of injury and musculoskeletal disorders [2]. Given this scenario, it is important to develop effective strategies for understanding sports-related injuries and, consequently, to provide preventive measures, mitigating risks and promoting safe sports participation [3].

The International Olympic Committee provides solid and consistent parameters, such as those established by the Strengthening the Reporting of Observational Studies in Epidemiology for Sports Injury and Illness Surveillance (STROBE - SIIS), for the prevention of injuries in sporting events [4]. National Olympic Committees and Sports Federations encourage research and the creation of effective measures for the identification of injuries, associated diseases and injury mechanisms, fundamental prerequisites for the development of preventive strategies. Therefore, knowledge and analysis of risk factors and injury mechanisms become essential in planning actions aimed at injury prevention. [5].

During sporting competitions, the injury and illness surveillance system provides significant epidemiological information about athletes' health. A large number of epidemiological studies have analyzed sporting competitions in different sports involving young athletes, Most injuries were mil dor gradual-onset. Most of these studies focus on athletes from the United States, England, and other countries. [6–8].

Therefore, this study aims to analyze and define the injury profile of youth category athletes during the 2023 Brazilian School Games (JEB's). The goal is to provide information and recommendations to assist healthcare teams and improve the management of athlete care during multi-sport events in this category.

MATERIALS AND METHODS

Study Design

This is an observational, cross-sectional, and descriptive epidemiological study in which injuries suffered by Brazilian school athletes during the 2023 Brazilian School

Games (JEB's) were analyzed. The event took place in the Federal District – Brasília and lasted 14 days, with participants from all Brazilian states.

Ethical Aspects

The study was authorized by the Brazilian Confederation of School Sports (CBDE), authorizing the analysis of the database, and by the Ethics Committee of the Federal University of Sergipe, according to substantiated opinion no. 6,554,588 and under protocol CAAE n. 75797323.1.0000.5546 approved in 2023.

It should be noted that no athlete was directly involved with the study, nor did they participate in disclosures or publications. All technical supervisors of each athlete signed the Free and Informed Assent Form (FIA) before any process related to the study, authorizing the analysis and disclosure of the data.

Participants

The sample consisted of 6,714 registered athletes participating in 16 different sports, under the age of 14, with a homogeneous distribution between genders. Eligible athletes were those who were regularly registered and participating in the competition. Athletes were identified by means of a registration number and personal identity record, ensuring the exclusion of duplicates in the records.

Injury Surveillance System

The data collection team consisted of 15 physiotherapists, who received explanations about the objectives of the study and participated in debates, discussions, and clarification of doubts. All had prior access to the electronic evaluation form and were uniformly trained to avoid errors during data collection. Every day after the competitions, the health team met to discuss the day's data collection and review the data obtained.

Data collection was divided into two phases: emergency care, which occurred during official matches, and outpatient care, which took place in health centers. Data collection began on the first day of competition and ended one day after the competitions concluded.

Athletes were identified by their registration number and personal identity record to avoid duplicate records. The following information was collected: name, place of birth, gender, sport practiced during the competition, main injury, anatomical

location and type of injury, injury mechanism, whether there was head trauma, need for time off from competition, and the need for further examinations.

The sports that included injured athletes in the research were: Wrestling, Karate, Judo, Taekwondo, Futsal, Basketball, Volleyball, Badminton, Beach Volleyball, Athletics, Adapted Athletics, Artistic Gymnastics, Rhythmic Gymnastics, Swimming, Cycling, and Handball.

Injury Classification

A standardized system used in epidemiological studies and sports injury surveillance systems was implemented.

Injuries were classified according to anatomical location and type of tissue affected, based on a system that provides injury coding, allowing standardization with other international studies [9].

The affected tissues were divided into: bone, muscle, tendon, joint, and/or neurological disorders of functional origin (NDFO), defined as a psychological disorder characterized by neurological symptoms that are not caused by other classic neurological or medical conditions, without detectable physical causes [10]. The anatomical structures were divided into cervical, thoracic, lumbar, and sacrococcygeal spine, the upper limbs into shoulder, arm, elbow, forearm, wrist, hands, and fingers, and the lower limbs into hip, anterior thigh, posterior thigh, knee, anterior leg, posterior leg, ankle, and foot, and head in cases of concussion.

Injuries were defined as any physical or musculoskeletal event that prevented the continuation of practice and/or required care from the health team during the competition period, following the IOC Injury Surveillance System recommendations [4]. The severity of the injuries was determined according to the need for time-loss from the competition, hospital referral, or suspicion of concussion. Suspected concussions were considered to be head trauma events or mild neurological symptoms after impact in the head region.

Statistical Analysis

The statistical analysis performed in this study was based on a variety of statistical methods, including descriptive measures and hypothesis tests. Descriptive measures such as mean, median, standard deviation, interquartile range, absolute

frequency, and percentages were used to describe the characteristics of the variables and provide summary information about the collected data. The Chi-square test was used to investigate the association between different categorical variables. This test allowed us to assess whether the observed frequencies differed from the expected frequencies, indicating possible statistically significant associations between the variables [11]. Fisher's exact test was applied when the sample size was small, allowing the assessment of the association between two categorical variables when the conditions for the applicability of the Chi-square test were not met [12]. Multiple comparisons between proportions were evaluated using the Z-test with Bonferroni correction [13]. The Shapiro-Wilk test is a statistical test used to verify whether the data follow a normal distribution. It plays an important role in statistical analysis by allowing the appropriate choice of parametric or non-parametric statistical methods, taking into account the normality of the data [14]. In the present study, all statistical analyses were performed using the R programming environment (version 4.3.2) [15] and the significance level adopted was 5%.

RESULTS

A total of 750 injuries were recorded, with females being more frequent at 57.46%. Muscle injuries were the most common type of injury in the competition (48.80%), followed by joint injuries (34.53%). The most frequent injury sites were the ankle (16.13%), knee (15.60%), thigh (14.66%), leg (9.86%), and shoulder (8.13%). Regard ing the location of treatment, outpatient care predominated (63.06%) (**Table** 1).

Table 1. Descriptive statistics of demographic characteristics and injury profile of athlete.

	n	%	Average	SD	Median
Sex					
Female	431	57.46%			
Male	319	42.53%			
AGE			13.57	0.64	14.00
AGE RANGE					
14 years	476	65.20			
<= 13 years	254	34.79			
Injury or effect					
Muscular	366	48.80%			
Articular	259	34.53%			
Bone	83	11.06%			
Tendon	38	5.06%			
SU	4	0.53%			
Location of the injury					
Head	12	1.60%			
Cervical spine	21	2.80%			
Shoulder spine/thoracic	28	3.73%			
Lumbar spine	38	5.06%			
Sacral spine	0	0%			
Shoulder	61	8.13%			
Arm	6	0.80%			
Elbow	23	3.06%			
Forearm	3	0.40%			
Wrist	9	1.20%			
Hand	16	2.13%			
Hip	34	4.53%			
Thigh	110	14.66%			
Knee	117	15.60%			
Leg	71	9.86%			
Ankle	121	16.13%			
Foot	14	1.86%			
Fingers	45	6%			
Toes	20	2,66%			
DNOF	1	0.13%			
Emergency					
Yes	277	36.93%			
No	473	63.06%			

Legend: n – absolute frequency. % – relative percentage frequency. SD – Standard Deviation.

The most frequent injuries were muscular in both men (52.35%) and women (46.17%), with a significant difference compared to other types ($p < 0.001$). Regarding the location, men had more injuries to their wrists and legs ($p < 0.0011$ and $p < 0.0012$, respectively). The highest number of injuries occurred in the thigh in men (16.3%), and in the knee (17.63%) and ankle (16.7%) in women (**Table** 2).

Table 2. Distribution of Types and Locations of Lesions among Genders with Statistical Significance Analysis

	Gender		
Features	**Female**, N= 431	**Male**, N = 319	**Value p**
INJURY OR EFFECT:	**n/N(%)**		<0.001
MUSCULAR	199 / 431 (46.17%)	167/ 319 (52.35%)	
ARTICULAR	165 / 431 (38.28%)	94 / 319 (29.46%)	
BONE	43 / 431 (9.97%)	40 / 319 (12.53%)	
TENDON	20 / 431 (4.64%)	18 / 319 (5.64%)	
DNOF	4 / 431 (0.92%)	0 / 319 (0%)	
LOCATION OF THE INJURY			
Cervical spine	15 / 431 (3.48%)	6 / 319 (1.88%)	0.514[1]
Scapular/thoracic spine	16 / 431 (3.71%)	12 / 319 (3.76%)	0.187[1]
Lumbar spine	21 / 431 (4.87%)	17 / 319 (5.32%)	0.566[1]
Sacral/coccygeal spine	0 / 431 (0%)	0 / 319 (0%)	
Shoulder	36 / 431 (8.35%)	25 / 319 (7.83%)	0.693[1]
Arm	4 / 431 (0.92%)	2 / 319 (0.62%)	0.089[1]
Elbow	13 / 431 (3.01%)	10 / 319 (3.13%)	0.685[2]
Forearm	1 / 431 (0.23%)	2 / 319 (0.62%)	0.085[1]
Wrist	2 / 431 (0.46%)	7 / 319 (2.19%)	<0.001[1]
Hand	10 / 431 (2.32%)	6 / 319 (1.88%)	0.078[1]
Hip	17 / 431 (3.94%)	17 / 319 (5.32%)	0.674[1]
Thigh	58 / 431 (13.45%)	52 / 319 (16.3%)	0.356[1]
Knee	76 / 431 (17.63%)	41 / 319 (12.85%)	0.567[2]
Leg	32 / 431 (7.42%)	39 / 319 (12.22%)	<0.001[2]
Ankle	72 / 431 (16.7%)	49 / 319 (15.36%)	0.091[1]
Foot	10 / 431 (2.32%)	4 / 319 (1.25%)	>0.885[2]
Fingers	28 / 431 (6.49%)	17 / 319 (5.32%)	>0.885[2]
Toes	14 / 431 (3.24%)	6 / 319 (1.88%)	0.029[1]
DNOF	1 / 431 (0.23%)	0 / 319 (0%)	0.043
Head	5 / 431 (1.16%)	7 / 319 (2.19%)	0.056

Legend: n - Absolute frequency. N – Valid data. % – Percentage. DO – Standard Deviation

Futsal, basketball, and handball were responsible for the highest frequency of injuries, with 22%, 12%, and 9.6%, respectively. The number of head injuries was considered low (1.06%), occurring more frequently in karate (25%), basketball (25%), and judo (12.5%) (**Table** 3).

Table 3. Sports injuries, head trauma, need for screening

	N	%
Sports		
Wrestling	43	5.7
Karate	27	3.6
Judo	60	8
Taekwondo	53	7.1
Futsal	168	22
Basketball	93	12
Volleyball	66	8.8
Badminton	57	7.6
Beach Volleyball	20	2.7
Athletics	37	4.9
Adapted Athletics	8	1.1
Artistic Gymnastics	6	0.8
Rhythmic Gymnastics	5	0.7
Swimming	31	4.1
Cycling	4	0.5
Handball	72	9.6
Head Trauma		
Yes	8	1.06
No	742	98.93
Time-loss from Competition		
Yes	67	8,93
No	683	91.06

Legend: n – absolute frequency. % – relative percentage frequency.

Muscle injuries occurred mainly in futsal (22.67%) and badminton (12.02%), joint injuries were more frequent in basketball (15.05%) and judo (11.58%), bone injuries were more associated with futsal (32.53%) and judo (20.48%), tendon injuries in futsal (26.31%) and taekwondo (13.15%), and DNOF type injuries were found in rhythmic gymnastics (100%)

(**Table** 4).

Table 4. Sports injuries and types of injuries

Features	**MUSCULAR**, N = 366	**JOINT**, N = 259	**BONE**, N = 83	**TENDINOSISA**, N = 38	**DNOF**, N = 4
SPORTS			**n/N(%)**		
Wrestling	28/366 (7.65%)	12/259 (4.63%)	3/83 (3.61%)	0/38 (0%)	0/4 (0%)
Karate	8/366 (2.18%)	17/259 (6.56%)	2/83 (2.4%)	0/38 (0%)	0/4 (0%)
Judo	12/366 (3.27%)	30/259 (11.58%)	17/83 (20.48%)	1/38 (2.63%)	0/4 (0%)
Taekwondo	22/366 (6.01%)	16/259 (6.17%)	10/83 (12.04%)	5/38 (13.15%)	0/4 (0%)
Futsal	83/366 (22.67%)	48/259 (18.53%)	27/83 (32.53%)	10/38(26.31%)	0/4 (0%)
Basketball	36/366 (9.83%)	39/259 (15.05%)	13/83 (15.66%)	5/38 (13.15%)	0/4 (0%)
Volleyball	35/366 (9.56%)	27/259 (10.42%)	2/83 (2.40%)	2/38 (5.26%)	0/4 (0%)
Badminton	44/366 (12,02%)	10/259 (3.86%)	1/83 (1.20%)	2/38 (5.26%)	0/4 (0%)
Beach Volleyball	12/366 (3.27%)	5/259 (1.93%)	0/83 (0%)	3/38 (7.89%)	0/4 (0%)
Athletics	24/366 (6.55%)	15/259 (5.79%)	2/83 (2.40%)	4/38 (10.52%)	0/4 (0%)
Artistic Gymnastics	5/366 (1.36%)	1/259 (0.38%)	0/83 (0%)	0/38 (0%)	0/4 (0%)
Rhythmic Gymnastics	0/366 (0%)	1/259 (0.38%)	0/83 (0%)	0/38 (0%)	4/4(100%)
Swimming	22/366 (6.01%)	5/259 (1.93%)	1/83(1.20%)	3/38 (7.89%)	0/4 (0%)
Cycling	4/366 (1.09%)	0/259 (0%)	0/83 (0%)	0/38 (0%)	0/4 (0%)
Handball	31/366 (8.46%)	33/259 (12.74%)	5/83 (6.02%)	3/38 (7.89%)	0/4 (0%)

Legend: n – Absolute frequency. N – Valid data. % – Percentage.

The main injuries occurred in the lower limbs, and were associated with the Legend: n – Absolute frequency. N – Valid data. % – Percentage. upper limb injuries occurred mainly in judo (16.56%), handball (12.88%), and volleyball (9.81%). The spine was affected in rhythmic gymnastics (2.2%) (**Table** 5).

Table 5. Injuries in different regions of the body associated with sports participation.

Features	**Head**, N = 12	**Spine**, N = 87	**ULs**, N = 163	**LL** , N = 487	**DNOF**, N = 1
SPORTS:			**n/N(%)**		
Wrestling	1 / 12 (8.3%)	14 / 87 (16.09%)	14 / 163 (8.58%)	14 / 487 (2.87%)	0 / 1 (0%)
Karate	2 / 12 (16.6%)	1 / 87 (1.1%)	11 / 163 (6.74%)	13 / 487 (2.66%)	0 / 1 (0%)
Judo	1 / 12 (8.3%)	4 / 87 (4.5%)	27 / 163 (16.56%)	28/ 487 (5.74%)	0 / 1 (0%)
Taekwondo	0 / 12 (0%)	0 / 87 (0%)	16 / 163 (9,81%)	36 / 487 (7,39%)	1 / 1 (100%)
Futsal	3 / 12 (25%)	17 / 87 (19.5%)	9 / 163 (5.52%)	139 / 487 (28.54%)	0 / 1 (0%)
Basketball	4 / 12 (33.3%)	7 / 87 (8.04%)	14 / 163 (8.58%)	68 / 487 (13.96%)	0 / 1 (0%)
Volleyball	0 / 12 (0%)	15 / 87 (17.2%)	16 / 163 (9.81%)	35 / 487 (7.18%)	0 / 1 (0%)
Badminton	0 / 12 (0%)	5 / 87 (5.7%)	10 / 163 (6.13%)	42 / 487 (8.62%)	0 / 1 (0%)
Beach Volleyball	0 / 12 (0%)	7 / 87 (8.04%)	2 / 163 (1.22%)	11 / 487 (2.25%)	0 / 1 (0%)
Athletics	0 / 12 (0%)	0 / 87 (0%)	6 / 163 (3.68%)	31 / 487 (6.36%)	0 / 1 (0%)
Adapted Athletics	0 / 12 (0%)	1 / 87(1,1%)	1 / 163 (0.61%)	6 / 487 (1.23%)	0 / 1 (0%)
Artistic Gymnastics	0 / 12 (0%)	0 / 87 (0%)	4 / 163 (2.45%)	2 / 487 (0.41%)	0 / 1 (0%)
Rhythmic Gymnastics	0 / 12 (0%)	2 / 87 (2.2%)	1/ 163 (0.61%)	2 / 487 (0.41%)	0 / 1 (0%)
Swimming	0 / 12 (0%)	9 / 87 (10,3%)	11/ 163 (6,74%)	11 / 487 (2,25%)	0 / 1 (0%)
Cycling	0 / 12 (0%)	0 / 87 (0%)	0/ 163 (0%)	4 / 487 (0.82%)	0 / 1 (0%)
Handball	1 / 12 (8.3%)	5 / 87 (5.7%)	21/ 163 (12.88%)	45 / 487 (9.24%)	0 / 1 (0%)

Legend: n – Absolute frequency. N – Valid data. % – Percentage

The number of absences was considered low (8.93%), futsal was the sport that caused the most athletes to be absent due to injury (37.31%), followed by athletics (11.94%) and basketball (8.95%). Karate and taekwondo had the same number of absences, 7.46% each. The sports with the lowest absence rates were volleyball 2.98%, adapted athletics 2.98% and swimming 1.49% (**Table** 6).

Table 6. Competition absenteeism rate by sport

	Total
Time-loss from competition	67/683 (9.8%)
Wrestling	4 / 67 (5.97%)
Karate	5/ 67 (7.46%)
Judo	3/ 67 (4.47%)
Taekwondo	5/ 67 (7.46%)
Futsal	25/ 67 (37.31%)
Basketball	6/ 67 (8.95%)
Volleyball	2/ 67 (2.98%)
Badminton	0/ 67 (0%)
Beach Volleyball	0/ 67 (0%)
Athletics	8/ 67 (11.94%)
Adapted Athletics	2/ 67 (2.98%)
Artistic Gymnastics	0/ 67 (0%)
Rhythmic Gymnastics	0/ 67 (0%)
Swimming	1/ 67 (1.49%)
Cycling	0/ 67 (0%)
Handball	6/ 67 (8.95%)

Legend: n – Absolute Frequency; % – Percentage.

Cryotherapy, myofascial release, and photobiomodulation were the most frequently used resources, with 34.15%, 22.44%, and 14.52%, respectively. Therapeutic ultrasound, dry needling, and pneumatic boots were the least frequently used resources, with 0.08%, 0.17%, and 0.026%, respectively (**Table** 7).

Table 7. Therapeutic resources used in treatments

	Total
Therapeutic resources	58/1136(5.11%)
Myofascial Release	255 / 1136 (22.44%)
Cryotherapy	388 / 1136 (34.15%)
Photobiomodulation	165 / 1136 (14.52%)
Electrotherapy	56 / 1136 (4.92%)
Mobilization	81 / 1136 (7.13%)
Exercise	19 / 1136 (1.67%)
Functional Bandaging	89 / 1136 (7.83%)
Rigid Bandaging	58 / 1136 (%)
Cupping Therapy	19 / 1136 (1.67%)
Pneumatic Boot	3 / 1136 (0.26%)
Therapeutic Ultrasound	1 / 1136 (0.08%)
Dry Needling	2 / 1136 (0.17%)

	Total

Legend: n – Absolute Frequency; % – Percentage.

The most frequently used resources for spinal injuries were myofascial release (38.09%), cryotherapy (26.53%), and photobiomodulation (12.92%). For upper limb injuries, the most frequently used resources were cryotherapy (36.9%), myofascial release (20.2%), and photobiomodulation (15.7%). For lower limb injuries, the most frequently used resources were cryotherapy (34.7%), myofascial release (20.1%), and photobiomodulation (14.4%). And in the case of non-osseous spinal cord injury, only cryotherapy was used (100%) (**Table** 8).

Table 8. Therapeutic resources by location

Features	**Spine,** N = 147	**ULs**, N = 222	**LL**, N = 766	**DNOF**, N = 1
Therapeutic resources		**n / N (%)**		
Myofascial release	56/147 (38.09%)	45/222 (20.2%)	154/766 (20.1%)	0/1(0%)
Cryotherapy	39/147 (26.53%)	82/222 (36.9%)	266/766 (34,7%)	1/1(100%)
Photobiomodulation	19/147 (12.92%)	35/222 (15.7%)	111/766 (14.4%)	0/1 (0%)
Electrotherapy	1/147 (0.68%)	6/222 (2.7%)	49 / 766 (6.3%)	0/1 (0%)
Mobilization	16/147 (10.88%)	14/222 (6.3%)	51 / 766 (6.6%)	0/1 (0%)
Exercise	1/147 (0.68%)	1/222 (0.4%)	17 / 766 (2.2%)	0/1 (0%)
Functional taping	4/147 (2.72%)	21/222 (9.4%)	64/766 (8.3%)	0/1 (0%)
Rigid taping	0/147 (0%)	12/222 (5.4%)	46 / 766 (6%)	0/1 (0%)
Cupping	11/147 (7.48%)	6/222 (2.7%)	2 / 766 (0.2%)	0/1 (0%)
Pneumatic boot	0/147 (0%)	0/222 (0%)	3 / 766 (0.3%)	0/1 (0%)
Therapeutic ultrasound	0/147 (0%)	0/222 (0%)	1 / 766 (0.1%)	0/1 (0%)
Dry needling	0/147 (0%)	0/222 (0%)	2 / 766 (0.2%)	0/1 (0%)

Legend: n – Absolute frequency. N – Valid data. % – Percentage.

Discussion

This study analyzed and described the injuries of athletes during the Brazilian School Games in 2023. The injuries were considered mild, with a low rate of absence from competition and a greater predominance of outpatient care. The results are different from those found in the study of the 2016 Summer Olympic Games competition, which showed that 40% of injuries led to the athlete's absence from sports activity [16].

The analysis of the care revealed a higher frequency of injuries in female athletes. The study that analyzed the injuries of athletes in the Tokyo 2020 and Beijing 2022 Olympic

and Paralympic Games identified that female athletes have twice the probability of injuries when compared to those observed in male athletes [17]. However, it is not possible to say that this difference has a single reason, since there are several factors, such as risk behaviors, different training loads and performances that differ in each sport [18].

There was a higher frequency of muscle injuries with homogeneity between the sexes. Another study found similar results, identifying muscle injuries as prevalent in athletes, followed by sprains, with a higher incidence in the ankle, knee, and shoulder regions [19]. In addition, Quimera et al., 2022 reinforce this perspective by analyzing 3160 injuries recorded during the Canadian Summer and Winter Games over 10 years of competition (2009-2019), where muscle injuries were the most prevalent [20]. RUIZ-PÉREZ, I. et al. 2019 found that most injuries were muscle injuries, followed by joint injuries in sub-elite female futsal players in three consecutive seasons (2015-2018) [21]. MARCHENA-RODRIGUEZ, A. et al 2020, observed in badminton that muscle injury (n=126, 39.1%) was the most prevalent type during the 2018 BWF Senior European Championship, corroborating our study [22].

The main injuries occurred in the lower limbs, mainly in the knee, ankle, and thigh segments. It is noteworthy that, in futsal, basketball, and handball, the lower limbs were the most frequently injured areas. This corroborates our study, LOPES, M. et al 2023 in futsal, identifying the lower limb as the region with the highest prevalence of injuries [23]. In basketball, the study by OWOEYE OBA et al 2020 found that the lower limbs were the most affected areas among the 63 children's basketball teams analyzed. The study identified the ankle (45%) as the main injury site in females and the knee (51%) in males [24]. In the study by ASAI, K. et al., 2019, a 6-year longitudinal study with handball athletes in national competitions recorded 43.2% of injuries in the lower extremities. These patterns may be associated with the biomechanical demands of the sports analyzed, such as repetitive jumps, sudden decelerations and multidirectional movements, which overload joints and muscles in this region [25].

The highest incidence of knee injuries occurred in combat sports. In the study by FREY et al. 2019, 54.3% of injuries were sprains, with a significantly higher incidence of knee sprains among female judokas compared to males [26]. In wrestling, the results were

similar to the findings of POWELL et al. 2021, in a study with athletes from the National Collegiate Athletic Association (2014-2019), which reported the knee as the most affected region (21.4% of total injuries) [27]. In taekwondo, although our study pointed to the lower limbs as the most affected area, the findings differ from HAN, M.-O. et al. 2023, who highlighted finger injuries (17.3%) [28]. In karate, we found that the lower limbs were the most affected areas, in disagreement with LYSTAD et al. 2020, which identified the head and neck (57.9%) as the most frequently injured regions in Olympic-style karate competitions [29].

The upper limbs were more affected in judo and handball. The study by MOOREN, J. et al 2023, which analyzed injuries in Judo, identified the head as the most injured site in a systematic review, followed by the hand, knee, elbow, and shoulder [30]. In handball, there was a difference with the findings of MASHIMO, S. et al. 2021, who, when analyzing 1017 Japanese university handball players, documented a higher number of injuries in the ankle (33.3%), knee (23.6%), and shoulder only (12.6%) [31].

Head impacts are a relevant concern in sports competitions, especially due to the risk of concussion, which is common in young athletes [32,33]. However, in this competition, the frequency of head trauma was low, corroborating the findings of SHUJI SAKANASHI et al. 2024, which recorded a total of 567 injuries, including 11 head injuries at the Olympic Games and only 2 cases at the 2020 Paralympic Games [34].

The main therapeutic resource used was cryotherapy, followed by massage, mainly because these were gradual injuries with muscular characteristics. Therefore, cryotherapy is an effective resource in the recovery process similar to that found in the study by LI, S. et al. 2024, which showed the use of different resources in 1100 endurance athletes with positive effects with the use of cryotherapy [35]. This information is reaffirmed in the study by CULLEN, M.-F. L. et al. 2021, which analyzed cryotherapy as one of the most widely used resources as a passive post-exercise recovery strategy [36]. A systematic review showed that massage had positive results in reducing the level of pain or delayed onset muscle soreness in athletes by reducing the enzyme creatine kinase [37].

Conclusion

This study contributes to filling a gap in the literature by investigating the epidemiology

of injuries in Brazilian youth athletes. The findings identified injury patterns similar to those described in international studies, providing support for prevention strategies and improvement of physiotherapy care. However, limitations such as the absence of longitudinal follow-up, the lack of assessment of risk factors, and the possible underreporting of mild cases restrict the understanding of injury progression, reinforcing the need for prospective research with more comprehensive approaches to optimize sports health policies and the management of injuries in school competitions.

FUNDING

This research did not receive any specific funding from funding agencies in the public, commercial, or not-for-profit sectors.

CONFLICT OF INTERESTS

The authors declare no conflict of interests.

REFERENCES

1. Eime, R.M.; Young, J.A.; Harvey, J.T.; Charity, M.J.; Payne, W.R. A Systematic Review of the Psychological and Social Benefits of Participation in Sport for Children and Adolescents: Informing Development of a Conceptual Model of Health through Sport. *Int. J. Behav. Nutr. Phys. Act.* **2013**, *10*, 98, doi:10.1186/1479-5868-10-98.

2. Palmer, D.; Engebretsen, L.; Carrard, J.; Grek, N.; Königstein, K.; Maurer, D.J.; Roos, T.; Stollenwerk, L.; Tercier, S.; Weinguni, R.; et al. Sports Injuries and Illnesses at the Lausanne 2020 Youth Olympic Winter Games: A Prospective Study of 1783 Athletes from 79 Countries. **2021**, doi:10.1136/bjsports-2020-103514.

3. Prieto-González, P.; Martínez-Castillo, J.L.; Fernández-Galván, L.M.; Casado, A.; Soporki, S.; Sánchez-Infante, J. Epidemiology of Sports-Related Injuries and Associated Risk Factors in Adolescent Athletes: An Injury Surveillance. *Int. J. Environ. Res. Public. Health* **2021**, *18*, 4857, doi:10.3390/ijerph18094857.

4. Bahr, R.; Clarsen, B.; Derman, W.; Dvorak, J.; Emery, C.A.; Finch, C.F.; Hägglund, M.; Junge, A.; Kemp, S.; Khan, K.M.; et al. International Olympic Committee Consensus Statement: Methods for Recording and Reporting of Epidemiological Data on Injury

and Illness in Sport 2020 (Including STROBE Extension for Sport Injury and Illness Surveillance (STROBE-SIIS)). *Br. J. Sports Med.* **2020**, *54*, 372–389, doi:10.1136/bjsports-2019-101969.

5. Baroni, B.M.; Oliveira Pena Costa, L. Evidence-Based Prevention of Sports Injuries: Is the Sports Medicine Community on the Right Track? *J. Orthop. Sports Phys. Ther.* **2021**, *51*, 91–93, doi:10.2519/jospt.2021.0104.

6. Farooqi, A.S.; Lee, A.; Abreu, E.; Talwar, D.; Maguire, K.J. Epidemiology of Pediatric Baseball and Softball Player Injuries. *Orthop. J. Sports Med.* **2021**, *9*, 23259671211052585, doi:10.1177/23259671211052585.

7. Beech, J.; Jones, B.; King, R.; Bennett, P.; Young, S.; Williams, S.; Stokes, K.; Emmonds, S. The Incidence and Burden of Injuries in Elite English Youth Female Soccer Players. *Sci. Med. Footb.* **2022**, *6*, 605–615, doi:10.1080/24733938.2022.2051730.

8. Edouard, P.; Mulenga, D.; Dandrieux, P.-E.; Salati, F.; Wallace, J.; Owoeye, O. Coverage from Medical Teams and Injury/Illness Epidemiology within Youth Athletics in Africa: A Prospective Study during the 2023 African Youth Under 18/20 Athletics Championships. *J. Sci. Med. Sport* **2024**, *27*, 837–843, doi:10.1016/j.jsams.2024.07.014.

9. Orchard Sports Injury and Illness Classification System (OSIICS) version 16: Updated female athlete codes and Italian and Spanish translations. *JSAMS Plus* **2025**, *6*, 100119, doi:10.1016/j.jsampl.2025.100119.

10. Perjoc, R.-S.; Roza, E.; Vladacenco, O.A.; Teleanu, D.M.; Neacsu, R.; Teleanu, R.I. Functional Neurological Disorder–Old Problem New Perspective. *Int. J. Environ. Res. Public. Health* **2023**, *20*, 1099, doi:10.3390/ijerph20021099.

11. Turhan, N.S. Karl Pearsons Chi-Square Tests. *Educ. Res. Rev.* **2020**, *15*, 575–580, doi:10.5897/ERR2019.3817.

12. Lee, S.W. Methods for Testing Statistical Differences between Groups in Medical Research: Statistical Standard and Guideline of Life Cycle Committee. *Life Cycle* **2022**, *2*, doi:10.54724/lc.2022.e1.

13. Barnett, M.J.; Doroudgar, S.; Khosraviani, V.; Ip, E.J. Multiple Comparisons: To Compare or Not to Compare, That Is the Question. *Res. Soc. Adm. Pharm. RSAP* **2022**, *18*, 2331–2334, doi:10.1016/j.sapharm.2021.07.006.

14. Souza, R.R. de; Toebe, M.; Mello, A.C.; Bittencourt, K.C. Sample Size and Shapiro-Wilk Test: An Analysis for Soybean Grain Yield 2022.

15. Equipe Central Do R (2023) Linguagem e Ambiente RA Para Computação Estatística. Fundação R Para Computação Estatística, Viena. - Referências - Publicações de Pesquisa Científica Available online: https://www.scirp.org/reference/referencespapers?referenceid=3582659

(accessed on 27 May 2026).

16. Soligard, T.; Steffen, K.; Palmer, D.; Alonso, J.M.; Bahr, R.; Lopes, A.D.; Dvorak, J.; Grant, M.-E.; Meeuwisse, W.; Mountjoy, M.; et al. Sports Injury and Illness Incidence in the Rio de Janeiro 2016 Olympic Summer Games: A Prospective Study of 11274 Athletes from 207 Countries. *Br. J. Sports Med.* **2017**, *51*, 1265–1271, doi:10.1136/bjsports-2017-097956.

17. Post, E.G.; Anderson, T.; Shilt, J.S.; Dugan, E.L.; Clark, S.C.; Larson, E.G.; Noble-Taylor, K.E.; Robinson, D.M.; Donaldson, A.T.; Finnoff, J.T.; et al. Incidence of Injury and Illness among Paediatric Team USA Athletes Competing in the 2020 Tokyo and 2022 Beijing Olympic and Paralympic Games. *BMJ Open Sport Exerc. Med.* **2023**, *9*, e001730, doi:10.1136/bmjsem-2023-001730.

18. Zech, A.; Hollander, K.; Junge, A.; Steib, S.; Groll, A.; Heiner, J.; Nowak, F.; Pfeiffer, D.; Rahlf, A.L. Sex Differences in Injury Rates in Team-Sport Athletes: A Systematic Review and Meta-Regression Analysis. *J. Sport Health Sci.* **2022**, *11*, 104–114, doi:10.1016/j.jshs.2021.04.003.

19. Prieto-González, P.; Martínez-Castillo, J.L.; Fernández-Galván, L.M.; Casado, A.; Soporki, S.; Sánchez-Infante, J. Epidemiology of Sports-Related Injuries and Associated Risk Factors in Adolescent Athletes: An Injury Surveillance. *Int. J. Environ. Res. Public. Health* **2021**, *18*, 4857, doi:10.3390/ijerph18094857.

20. Chimera, N.J.; Merasty, D.; Lininger, M.R. Injuries and Illnesses Across 10 Years of Canada Games Competitions: 2009 - 2019. *Int. J. Sports Phys. Ther.* **2022**, *17*, 1372–1382, doi:10.26603/001c.39743.

21. Ruiz-Pérez, I.; López-Valenciano, A.; Jiménez-Loaisa, A.; Elvira, J.L.L.; De Ste Croix, M.; Ayala, F. Injury Incidence, Characteristics and Burden among Female Sub-Elite Futsal Players: A Prospective Study with Three-Year Follow-Up. *PeerJ* **2019**, *7*, e7989, doi:10.7717/peerj.7989.

22. Marchena-Rodriguez, A.; Gijon-Nogueron, G.; Cabello-Manrique, D.; Ortega-Avila, A.B. Incidence of Injuries among Amateur Badminton Players: A Cross-Sectional Study. *Medicine (Baltimore)* **2020**, *99*, e19785, doi:10.1097/MD.0000000000019785.

23. Lopes, M.; Martins, F.; Brito, J.; Figueiredo, P.; Tomás, R.; Ribeiro, F.; Travassos, B. Epidemiology of Injuries in Elite Male Futsal Players. *Clin. J. Sport Med. Off. J. Can. Acad. Sport Med.* **2023**, *33*, 527–532, doi:10.1097/JSM.0000000000001142.

24. Owoeye, O.B.A.; Ghali, B.; Befus, K.; Stilling, C.; Hogg, A.; Choi, J.; Palacios-Derflingher, L.; Pasanen, K.; Emery, C.A. Epidemiology of All-Complaint Injuries in Youth Basketball. *Scand. J. Med. Sci. Sports* **2020**, *30*, 2466–2476, doi:10.1111/sms.13813.

25. Asai, K.; Nakase, J.; Shimozaki, K.; Toyooka, K.; Kitaoka, K.; Tsuchiya, H. Incidence of Injury in Young Handball Players during National Competition: A 6-Year Survey.

J. Orthop. Sci. Off. J. Jpn. Orthop. Assoc. **2020**, *25*, 677–681, doi:10.1016/j.jos.2019.06.011.

26. Frey, A.; Lambert, C.; Vesselle, B.; Rousseau, R.; Dor, F.; Marquet, L.A.; Toussaint, J.F.; Crema, M.D. Epidemiology of Judo-Related Injuries in 21 Seasons of Competitions in France: A Prospective Study of Relevant Traumatic Injuries. *Orthop. J. Sports Med.* **2019**, *7*, 2325967119847470, doi:10.1177/2325967119847470.

27. Powell, J.R.; Boltz, A.J.; Robison, H.J.; Morris, S.N.; Collins, C.L.; Chandran, A. Epidemiology of Injuries in National Collegiate Athletic Association Men's Wrestling: 2014–2015 Through 2018–2019. *J. Athl. Train.* **2021**, *56*, 727–733, doi:10.4085/1062-6050-429-20.

28. Han, M.-O.; Lee, N.-K.; Jun, H.-P. Injury Incidence and Its Characteristics in Korean Youth and Collegiate Taekwondo Sparring Athletes: A Retrospective Study. *Int. J. Environ. Res. Public. Health* **2023**, *20*, 5528, doi:10.3390/ijerph20085528.

29. Lystad, R.P.; Augustovičová, D.; Harris, G.; Beskin, K.; Arriaza, R. Epidemiology of Injuries in Olympic-Style Karate Competitions: Systematic Review and Meta-Analysis. *Br. J. Sports Med.* **2020**, *54*, 976–983, doi:10.1136/bjsports-2020-101990.

30. Mooren, J.; von Gerhardt, A.L.; Hendriks, I.T.J.; Tol, J.L.; Koëter, S. Epidemiology of Injuries during Judo Tournaments. *Transl. Sports Med.* **2023**, *2023*, 2713614, doi:10.1155/2023/2713614.

31. Mashimo, S.; Yoshida, N.; Moriwaki, T.; Takegami, A.; Suzuki, K.; Fong, D.T.P.; Myklebust, G.; Onishi, S. Injuries in Japanese University Handball: A Study among 1017 Players. *Res. Sports Med.* **2021**, *29*, 475–485, doi:10.1080/15438627.2021.1937164.

32. Harmon, K.G.; Drezner, J.A.; Gammons, M.; Guskiewicz, K.M.; Halstead, M.; Herring, S.A.; Kutcher, J.S.; Pana, A.; Putukian, M.; Roberts, W.O. American Medical Society for Sports Medicine Position Statement: Concussion in Sport. *Br. J. Sports Med.* **2013**, *47*, 15–26, doi:10.1136/bjsports-2012-091941.

33. Jeckell, A.S.; Fontana, R.S. Psychosocial Aspects of Sport-Related Concussion in Youth. *Psychiatr. Clin. North Am.* **2021**, *44*, 469–480, doi:10.1016/j.psc.2021.04.013.

34. Sakanashi, S.; Tanaka, H.; Yokota, H.; Otomo, Y.; Masuno, T.; Nakano, K.; Inoue, J.; Sugita, M.; Tokunaga, T.; Kato, N.; et al. Injuries and Illness of Athletes at the Tokyo 2020 Olympic and Paralympic Summer Games Visiting Outside Facilities. *Sports Med. Health Sci.* **2024**, *6*, 48–53, doi:10.1016/j.smhs.2024.01.003.

35. Li, S.; Kempe, M.; Brink, M.; Lemmink, K. Effectiveness of Recovery Strategies After Training and Competition in Endurance Athletes: An Umbrella Review. *Sports Med. - Open* **2024**, *10*, 55, doi:10.1186/s40798-024-00724-6.

36. Cullen, M.-F.L.; Casazza, G.A.; Davis, B.A. Passive Recovery Strategies after Exercise: A Narrative Literature Review of the Current Evidence. *Curr. Sports Med. Rep.* **2021**, *20*, 351–358, doi:10.1249/JSR.0000000000000859.

37. Dakić, M.; Toskić, L.; Ilić, V.; Đurić, S.; Dopsaj, M.; Šimenko, J. The Effects of Massage Therapy on Sport and Exercise Performance: A Systematic Review. *Sports* **2023**, *11*, 110, doi:10.3390/sports11060110.