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Sports injury prevalence and associated factors in functional fitness: a cross-sectional study

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ABSTRACT
Purpose. We investigated injury rates over the previous 12 months, associated factors, and injury characteristics in a cohort of recreational functional fitness training participants.
Methods. A cross-sectional study was conducted with a convenience sample of 304 participants (175 females and 129 males; mean age: 32.6 ± 7.2 years; mean training experience: 27.6 ± 21.4 months) from three CrossFit™ affiliated gyms in Brazil. Data were collected via face-to-face interviews, using a questionnaire that focused on functional fitness-related injuries in the previous year and included data on participant demographics and training regimens.
Results. Out of all the participants, 82 (27.0%) experienced a functional fitness-related injury with an incidence rate of 1.22 injuries/1000 hours of participation. The practice of other sports activities and dissatisfaction with joint mobility of the shoulders increased the odds of being injured in the multivariate logistic regression. The shoulder was the most affected body part (26.6%). A gradual injury mechanism was the most commonly reported (36.2%), and joint sprain (18.1%), cartilage injury (11.7%), and tendinopathy (10.6%) were the most common pathology types. Concerning symptom severity, in most cases, participants referred to the injury as severe (36.2%), with a sporting time loss greater than 28 days (50%).
Conclusions. Injury prevalence over the last 12 months was 27.0% (82/304), with an incidence of 1.22 injuries/1000 hours. The practice of other sports activities and dissatisfaction with joint mobility of the shoulders increased the odds of injury. Most injuries occurred in the shoulder, with a gradual injury mechanism, and participants classified symptoms as severe, leading to significant sporting time loss.
Key words: observational study, athletic injuries, risk factors

Introduction

Functional fitness, known as CrossFit™ or high-intensity functional training, is a comprehensive type of training characterized by a variety of movement patterns, activities (such as weight lifting, strength, gymnastics, metabolic conditioning, aerobic conditioning), and energy systems (ATP-PC/phosphagen, glycolytic, and oxidative) [1]. Functional fitness has been shown to be an effective strategy for healthy adults seeking health benefits, as well as diversified training routines [2], and is commonly characterized by high levels of adherence and satisfaction among participants [3]. In addition, during functional fitness training, body movements can be adapted for practitioners of any level of physical conditioning. In general, the exercises are comprised of high muscle recruitment levels and considerable overloads on cardiovascular/respiratory endurance, stamina, power, strength, and flexibility [2, 4–7].

Despite the reported benefits, the Consortium for Health and Military Performance and American College of Sports Medicine consensus paper on extreme

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conditioning programs in military personnel [8] has raised concerns about the safety of the modality and the epidemiological profile of musculoskeletal injuries started to be explored [9–18].

A systematic review highlighted a wide range of prevalences among injury studies, with a mean of 32.8% and injury incidence per 1000 hours ranging from 0.21 to 36. The shoulder was the most commonly affected body location, and the most frequently reported diagnoses were muscle, joint, and ligament/tendon injuries [19]. Furthermore, the authors emphasized the need for further research on injury characteristics, including severity and mechanisms [19]. Clarification is also required concerning factors associated with injury occurrence, as different conditions have been pointed out as potential risk factors for musculoskeletal injury onset, and to date, the impact of biomechanical factors seems unexplored. In addition, the findings are conflicting among studies [13, 15, 16, 18, 20, 21], and most studies collected data through virtual surveys, dependent on the participant's self-reports [11, 13, 17, 22], which can contain biases in injury diagnosis, classification, and severity.

Identifying potential etiological factors of sports injury onset is crucial for prevention strategies. Thus, the current study aimed to investigate injury rates, associated factors, and injury characteristics in functional fitness in a cohort of recreational participants.

Material and methods

A cross-sectional study was conducted according to the International Olympic Committee's consensus statement on the methods for the recording and reporting of epidemiological data on injury and illness in sports [23].

Participants and setting

Participants were recruited from three functional fitness gyms affiliated with CrossFit™ in Brazil. A convenience sample of practitioners of both sexes, aged 18 years or over, with any experience level in functional fitness, who trained under professional supervision and reported a training frequency of at least twice a week. Exclusion criteria were considered as any acute or chronic condition that limited the ability to answer the survey (due to inconsistent or uncertain responses, such as those with cognitive disabilities) or practitioners who performed functional fitness exercises in the "adaptive" modality (for example, people with disabilities performing exercises in a wheelchair). Finally, 304 participants met the eligibility criteria and were included. Participants had a mean age of 32.6 ± 7.2 years, with the majority within the age range of 30–39 (51%) and were mostly women (57.6%). Most participants reported training in the scaled category (68.1%), and approximately half reported performing other sports activities in addition to functional fitness (51.6%). The sample reported an average of 27.6 ± 21.4 months of experience in functional fitness training and trained for an average of 5.26 ± 1.54 hours per week. For data collection, the researchers attended three gyms with different scheduled training sessions and invited all potential participants after their training session. Individuals interested in contributing to the research were submitted to a face-to-face interview by a qualified physical therapist, using a structured questionnaire previously submitted to a pilot test to detect possible inconsistencies or difficulties in interpreting the questions. After the interview, the participant's body mass and height were measured.

Questionnaire

Due to the absence of standardized, validated instruments for the characterization of functional fitness injury characteristics, the data were collected using a previously developed questionnaire, according to the International Olympic Committee consensus statement regarding methods for recording and reporting epidemiological data on injuries in sports [23] and a series of semi-structured interviews with functional fitness gym owners, coaches, and practitioners. The questions were modified during the interviews to facilitate understanding and capture all relevant information regarding training exposure, possible risk factors, and injury characteristics. The questionnaire was then piloted with five functional fitness practitioners and adjusted according to feedback.

The questionnaire included demographic data, the concurrent practice of other sports activities, and the current functional fitness training regimen. Participants were also asked to respond regarding the level of satisfaction related to the joint mobility of wrists, shoulders, spine, hips, and ankles, considering functional fitness demands. This assessment was conducted using a 5-point Likert scale (ranging from 'very satisfied' to 'very dissatisfied'). Among the questions about the functional fitness training regimen, participants were asked about their current training level and were categorized into two levels: prescribed or scaled. In the prescribed level, participants were included if they predominantly reported performing training sessions with more complex movements, higher loads, and/or a greater number of repetitions, following the original programming. In the scaled level, participants were included if they predominantly reported performing training sessions with simplified movements tailored to their level of technical skills, with a reduction in load and/or number of exercise repetitions.

Lastly, participants were asked whether they had experienced any functional fitness-related injuries in the previous 12 months. Those who reported an injury were asked to answer the second part of the questionnaire to register details regarding each injury.

An injury was defined, as in previous studies [9, 10, 13, 17, 22, 24, 25], as any new musculoskeletal pain, feeling, or injury that resulted from a functional fitness workout and led to one or more of the following options:

1. Withdraw from functional fitness training and other outside routine physical activities for more than one week.
2. Modification in the duration, intensity, or mode of normal training activities for more than two weeks.
3. Any physical complaint severe enough to warrant a visit to a health professional.

Data collected included injury criteria, mode of onset, body region and area, tissue and pathology types (according to the Orchard Sports Injury and Illness Classification System – OSIICS [26]), the need to seek a health care professional, symptom severity, and injury severity, considered as sporting time loss in terms of duration of impaired participation/limited performance in functional fitness due to injury. Time loss was categorized, as recommended [23], using the following time bins: 0, 1–7 days, 8–28 days, and > 28 days.

Statistical analysis

The forms were manually entered and analyzed using the SPSS Statistics for Windows (Version 29.0, Armonk, NY: IBM Corp). The Kolmogorov-Smirnov test was performed to test the normality of continuous variables. Comparisons between groups regarding continuous variables were performed using the Mann–Whitney test, while Pearson's chi-square or Fisher's exact tests were used to test the unadjusted association of categorical variables. Factors that showed significance levels lower than 0.10 ($p < 0.10$) via univariate analyses were included in the multivariate logistic regression based on the enter method. In the multivariate regression, p-values < 0.05 were considered statistically significant, and odds ratios (OR) and 95% confidence intervals (CI) were reported.

Injury prevalence was determined as the proportion of participants who reported at least one functional fitness-related injury at any time during the previous 12 months and was expressed as a percentage. To enable comparisons between injury rates in functional fitness training studies and other sports modalities [27], injury incidence was quantified as injuries per 1000 hours, as in previous studies [22, 24, 28]. In this regard, the total number of functional fitness-related injuries was divided by the estimated total time of training exposure for the sample (77,013 hours) and then multiplied by the scaling factor (1000) [23]. The sample's total time of training exposure during the 12 months was estimated as follows: for those who reported less than one year of experience in functional fitness, the reported mean weekly hours of training exposure of each participant was multiplied by weeks of experience, and for those with one year or more of experience, the reported mean weekly hours of exposure was multiplied by 52 (the number of weeks in a year).

Results

Participants' characteristics and associated factors with injury occurrence

Table 1 presents the demographic, training, and other characteristics of participants, and between-group (injured and non-injured) comparisons. The negative responses regarding joint mobility satisfaction were grouped and reported as "joint mobility dissatisfaction". Univariate analyses revealed a higher rate of injury for male participants ($p = 0.032$; OR 1.74; 95% CI 1.05 to 2.91), those who participated in other sports activities ($p = 0.025$; OR 1.80; 95% CI 1.07 to 3.02), and those who reported dissatisfaction with joint mobility of the shoulders ($p = 0.006$; OR 2.64; 95% CI 1.31 to 5.34) and the ankles ($p = 0.048$; OR 2.08; 95% CI 1.00 to 4.34).

All variables with p-values < 0.10 were used for the multivariate analysis, which included sex, height, functional fitness training minutes per session, practice of other sports activities, and dissatisfaction with joint mobility of the shoulders, ankles, and hips. Results are presented in Table 2. In the multivariate logistic regression, the practice of other sports activities ($p = 0.047$; OR 1.72; 95% CI 1.01 to 2.9) and joint mobility-related dissatisfaction of the shoulders increased the odds of being injured ($p = 0.025$; OR 2.30; 95% CI 1.11 to 4.79).

Table 1. Demographic and training characteristics according to functional fitness training-related injury occurrence (n = 304)

Variables	Mean ± *SD* or [*n* (%)]			*p*-value
	all (304)	injured (82)	non-injured (222)	
Age (years)	32.6 ± 7.2	33.5 ± 7.0	32.3 ± 7.3	0.136
18 to 29	106 (34.9)	23 (28.0)	83 (37.4)	0.205
30 to 39	155 (51.0)	45 (54.9)	110 (49.5)	
40 to 49	36 (11.8)	13 (15.9)	23 (10.4)	
50 or older	7 (2.3)	1 (1.2)	6 (2.7)	
Sex				
female	175 (57.6)	39 (22.3)	136 (77.7)	**0.032**
male	129 (42.4)	43 (33.3)	86 (66.7)	
Body mass (kg)	73.4 ± 14.6	74.7 ±13.7	73.0 ± 14.9	0.223
Height (m)	1.69 ± 0.10	1.70 ± 0.1	1.69 ± 0.1	0.076
BMI (kg/m^2)	25.5 ± 3.7	25.6 ± 3.0	25.5 ± 3.6	0.426
< 18.5 (kg/m^2)	1 (0.3)	0 (0.0)	1 (0.3)	0.488
18.5–24.9 (kg/m^2)	145 (47.7)	35 (24.1)	110 (75.9)	
25–29.9 (kg/m^2)	124 (40.8)	39 (26.9)	85 (58.6)	
≥ 30 (kg/m^2)	34 (11.2)	8 (5.5)	26 (17.9)	
Training level				
scaled	207 (68.1)	51 (24.6)	156 (75.4)	0.180
prescribed	97 (31.9)	31 (32.0)	66 (68.0)	
FFT exposure				
FFT experience (mo)	27.6 ± 21.4	29.4 ± 19.2	26.9 ± 22.2	0.151
≤ 12 (mo)	87 (28.6)	19 (21.8)	68 (78.2)	0.382
13–24 (mo)	91 (29.9)	24 (26.4)	67 (73.6)	
25–36 (mo)	46 (15.1)	12 (26.1)	34 (73.9)	
> 36 (mo)	80 (26.3)	27 (33.8)	53 (66.3)	
FFT exposure (min/s)	62.0 ± 11.6	63.7 ± 14.7	61.4 ± 10.2	0.054
FFT frequency (d/w)	5.07 ± 0.93	5.03 ± 0.90	5.08 ± 0.94	0.641
FFT exposure (h/w)	5.26 ± 1.54	5.38 ± 1.76	5.21 ± 1.45	0.867
Practice of other sports activities (yes)	157 (51.6)	51 (62.2)	106 (47.7)	**0.025**
Joint mobility dissatisfaction				
spine	33 (10.9)	8 (9.8)	25 (11.3)	0.708
shoulders	37 (12.2)	17 (20.7)	20 (9.0)	**0.006**
wrists	26 (8.6)	4 (4.9)	22 (9.9)	0.164
hips	29 (9.5)	12 (14.6)	17 (7.7%)	0.066
ankles	34 (11.2)	14 (17.1)	20 (9.0%)	**0.048**

Significant differences ($p < 0.05$) between the groups are highlighted in bold. Scaled – training level with simplified movements tailored to their level of technical skill, with a reduction in load and/or the number of exercise repetitions. Prescribed – training level with higher loads, a greater number of repetitions, and/or more complex movements, BMI – body mass index, FFT – functional fitness training, mo – months, min/s – minutes per session, d/w – days per week, h/w – hours per week

Table 2. Results of multivariate logistic regression analyses

Variables	OR	95% CI	*p*-value
Sex			
female	–	–	
male	1.47	0.63–3.39	0.370
Height	0.43	0.01–28.81	0.691
functional fitness training minutes per session	1.01	0.99–1.04	0.182
practice of other sports activities	**1.72**	**1.01–2.95**	**0.047**
Joint mobility dissatisfaction			
shoulders	**2.37**	**1.1 –4.95**	**0.021**
hips	1.67	0.68–4.06	0.261
ankles	1.59	0.71–3.56	0.255

Bold text indicates significance.

Injury rates and criteria

Of all respondents, 82 participants (27.0%) mentioned having experienced at least one functional fitness-related injury in the previous 12 months, with an overall incidence rate of 1.22 injuries/1000 hours of participation. More details on injury rates and criteria are presented in Table 3.

Injury location and characteristics

The upper limb region had the most significant number of reported injuries (44.7%; $n = 42$), and the shoulder was the most affected body part (26.6%; $n = 25$), followed by the lumbosacral spine (21.3%; $n = 20$) and the knee (18.1%; $n = 17$). The most frequently reported mode of onset among shoulder and knee injuries was gradual, with 48% (12) and 52.9% (9), respectively, while in wrist and ankle injuries, sudden onset after acute trauma was most commonly reported (70% and 77.8%, respectively). Further details regarding the etiology of injuries categorized by body part can be found in Table 4. Table 5 provides an overview of the injury inci-

Table 3. Overall functional fitness training-injury rates and injury criteria

	Value
Total injuries reported	94 (100)
Male [*n* (%)]	52 (55.3)
Female [*n* (%)]	42 (44.7)
Reported at least 1 injury [*n* (%)]	82 (27.0)
Reported 2 injuries [*n* (%)]	12 (3.6)
Male [*n* (%)]	9 (75)
Female [*n* (%)]	3 (25)
Injuries (per 1000 h)	1.22
Male (injuries per 1000 h)	1.55
Female (injuries per 1000 h)	0.97
Injury criteria	
Total removal from functional fitness training and other training routine physical activities for > 1 week [*n* (%)]	42 (44.7)
Modification of normal training activities for > 2 weeks [*n* (%)]	72 (76.6)
Any physical complaint severe enough to warrant a visit to a health professional [*n* (%)]	49 (52.1)

Table 4. Injury etiology according to the injured body part

Body part	Mode of onset, *n* (row %)				Total of all injuries [*n* (column %)]
	gradual onset	sudden but no acute trauma	sudden after acute trauma	mixed	
Shoulder	12 (48.0)	8 (32.0)	1 (4.0)	4 (16.0)	25 (26.6)
Neck and lumbosacral spine	5 (23.8)	11 (52.4)	4 (19.0)	1 (4.8)	21 (22.3)
Knee	9 (52.9)	3 (17.6)	2 (11.8)	3 (17.6)	17 (18.1)
Lower leg and ankle	3 (27.3)	1 (9.1)	7 (63.6)	0 (0.0)	11 (11.7)
Wrist and hand	2 (18.2)	1 (9.1)	8 (72.7)	0 (0.0)	11 (11.7)
Upper arm and elbow	3 (50.0)	2 (33.3)	1 (16.7)	0 (0.0)	6 (6.4)
Hip/groin and thigh	0 (0.0)	1 (33.3)	1 (33.3)	1 (33.3)	3 (3.2)

Table 5. Injury incidence and time loss by body part

Body part	Injuries	Incidence		Time loss, *n* (row %)			
	n	injuries/1000 hours (95% CI)		no time loss	1 to 7 days	8 to 28 days	> 28 days
Shoulder	25	0.32	(0.19 to 0.44)	1 (4.0)	3 (12.0)	9 (36.0)	12 (48.0)
Lumbosacral spine	20	0.31	(0.15 to 0.46)	0 (0.0)	4 (20.0)	9 (45.0)	7 (35.0)
Knee	17	0.28	(0.12 to 0.43)	1 (5.9)	1 (5.9)	2 (11.8)	13 (76.5)
Wrist	10	0.13	(0.08 to 0.22)	0 (0.0)	1 (10.0)	2 (20.0)	7 (70.0)
Ankle	9	0.13	(0.08 to 0.23)	0 (0.0)	2 (22.2)	4 (44.4)	3 (33.3)
Elbow	5	0.10	(0.05 to 0.21)	0 (0.0)	2 (40.0)	2 (40.0)	1 (20.0)

Only body regions with an injury minimum number of 5 cases are included.

Table 6. Functional fitness training-related injury characteristics in the previous 12 months (n = 94)

	n (%)
Mode of onset	
gradual onset	34 (36.2)
sudden but no acute trauma	27 (28.7)
sudden after acute trauma	24 (25.5)
mixed	9 (9.6)
sudden or mixed	60 (63.8)
powerlifting and weightlifting	24 (40)
gymnastics	26 (43.3)
other or unknown	10 (16.7)
Pathology types	
joint sprain†	17 (18.1)
cartilage injury††	11 (11.7)
tendinopathy	10 (10.6)
muscle injury	9 (9.6)
nerve injury	7 (7.4)
bone stress injury	4 (4.3)
fracture	3 (3.2)
other or unknown	33 (35.1)
Health care professional	
physical therapist	54 (57.4)
medical doctor	40 (42.6)
none	22 (23.4)
other	7 (7.4)
Symptom's severity	
mild	12 (12.8)
moderate	29 (30.9)
severe	34 (36.2)
very severe	19 (20.2)
Duration of impaired participation	
no time loss	3 (3.2)
1–7 days	15 (16.0)
8–28 days	29 (30.9)
> 28 days	47 (50)

† includes partial and complete tears plus injuries to non-specific ligaments and joint capsule; includes joint dislocations/subluxations; †† includes meniscal, labral injuries and articular cartilage, osteochondral injuries

dence by specific body parts, along with the associated duration of lost sporting time for each body part.

Sudden and mixed mechanisms totaled 63.8% (60) of all injuries. Among these, 43.3% (26) reported that the injury occurred or was aggravated when performing a gymnastic movement, while 40% (24) reported that the injury occurred during powerlifting or an Olympic weightlifting movement (Table 6). The most common pathology types included joint sprain (18.1%; n = 17), cartilage injury (11.7%; n = 11), and tendinopathy (10.6%; n = 10), and in most cases, participants sought physical therapists for treatment (57.4%; n = 54). Among the categories of symptom severity, the participants generally referred to the injury as severe (36.2%; n = 34), leading to sporting time loss superior to 28 days in half of all cases (50%; n = 47). No differences were found in injury characteristics between men and women ($p > 0.05$).

Discussion

Injury surveillance, accurate data collection, and knowledge concerning risk factors are the core components of sports injury prevention programs. In this sense, this is the first study developed based on the International Olympic Committee consensus statement on methods for recording and reporting epidemiological data about injuries in sports, as well as the first to investigate the role of joint mobility satisfaction as a potential modifiable factor associated with injury occurrence in functional fitness. It should also be noted that this is the largest study using face-to-face interviews to collect information on the training regimen and functional fitness-related injury characteristics.

Our results showed a proportion of 27% of participants reporting at least one functional fitness-related injury during the previous 12 months, and the practice of other sports activities and dissatisfaction with the joint mobility of the shoulders increased the odds of being injured in our sample of recreational functional fitness participants. This proportion is lower than values reported in previous studies, which used the same injury criteria and 12-month prevalence, and reported proportions ranging from 30.5% to 56.1% of injured participants over 12 months [10, 22, 25, 29]. As a linear relationship between the incidence and exposure time was not expected, a better way to compare and interpret findings across studies is to compare the injury rate considering exposure (injury rate per 1000 hours of exposure) [21]. Regarding injury rate per 1000 hours of exposure, our study showed lower results than most published studies [9, 11, 13, 15, 18, 21, 24, 28].

These discrepancies in injury prevalence and incidence can be explained by methodological differences in data collection [30], as data collection through virtual forms can lead to participant interpretation errors, incomplete or incorrect responses, as well as which, individuals with a history of injuries might be more prone to participate. While online surveys enable a broader geographical reach, face-to-face interviews allow participants to clarify doubts regarding injury criteria and potential errors in diagnosing and classifying the reported injuries. In addition, the growing popularity of functional fitness in the past few years and the better understanding and greater knowledge of coaches regarding this modality may have affected the injury rates.

In accordance with our findings, considering the anatomical location, the most common injuries were in the shoulders and lumbosacral spine. Among studies analyzing injury rates in functional fitness training, shoulder injuries occur between 22% and 39% of the time. The shoulders are consistently documented as the anatomical region most frequently affected by injuries related to functional fitness training [13, 18, 24, 31, 32]. The incidence rates of shoulder injuries found in studies published to date are higher than those reported among elite Olympic weightlifting athletes, which reach 23% [33]. In addition to Olympic-style movements, functional fitness includes other barbell and free-weight exercises performed overhead, such as overhead squats, thrusters, and several shoulder-to-overhead variations, which expose the shoulder to extremes in range of motion involving elevation and internal rotation. This highlights the need to consider increasing the focus on the technical quality of movements and using lower loads to spare the shoulders from injury events.

These movements are usually executed throughout training sessions with high repetitions, high velocity, and typically with substantial intensity, and may lead to poor form and injury [11]. Coupled with axial loading, these conditions can lead to the detriment of the technique, rendering the shoulder tissues more susceptible and increasing the odds of developing injuries. In addition, in gymnastic movements, the modality has the addition of "kipping", which consists of using an impulse performed with the lower part of the body to generate explosive force and help complete the repetition. Kipping could place the shoulder into abrupt flexion and internal rotation extremes, with force transmitted through the shoulders to initiate the next repetition [11, 34], predisposing to soft tissue damage.

There is a body of evidence showing an association between shoulder range of motion impairments and injury, mostly in sports with significant shoulder demands [35–37]. However, there is no consensus regarding the cause-consequence relationship between these clinical entities. Considering the high flexibility demands inherent in functional fitness, we hypothesized that joint mobility dissatisfaction would be associated with injury occurrence, and a significant association was found between dissatisfaction with joint mobility of the shoulders and injury occurrence. Caution is required when interpreting this data, considering the cross-sectional design and reliance on self-reported participant data without objective mobility measurements. In this sense, it is not possible to be certain about mobility limitation, nor whether the perception of mobility limitation could be related to previous injury in the region, and further studies on this topic are needed.

Regarding injury mechanisms, most studies categorize injuries dichotomously between acute and chronic onset [13, 15, 18, 21], unlike our study. Adapting our results to the means of analysis used by most other studies, acute injuries (sudden or mixed) accounted for the majority of injuries, as in previous studies [13, 15, 18, 21], and occurred in gymnastics exercises. Surprisingly, in the current study, a considerable number of injuries occurred after acute trauma (e.g., sprains and fractures after falls or accidental contact with the loaded barbell, box, among other pieces of equipment), and the most common pathology type was joint sprains. That being said, functional fitness should not be considered a trauma-free activity. It should also be noted that in more than one-third of injury cases, participants did not receive a diagnosis.

Multiple criteria can be used to assess the injury burden, such as monetary cost, duration, nature of treatment, sporting time loss, and permanent damage [38]. In our study, it was feasible to collect symptom severity and sporting time loss. Time loss was considered as the period in which the participant was unable to train or needed to modify their training intensity, frequency, or other. In half of the cases, participants lost more than 28 days due to the injury. Concerning symptom severity, participants referred to the injury as severe or very severe in most cases. Because of the study design, we could not interview participants who quit functional fitness due to injury. Therefore, injury prevalence could be underestimated, and injury severity may be worse than reported.

Our study has limitations due to its retrospective design, which may have introduced a recall bias. This bias implies that participants might predominantly recall more severe injuries, as injuries with prolonged symptoms or requiring medical attention are more likely to be remembered than minor injuries [39]. Recall bias may also have affected the estimation of the total time of training exposure during the period. Additionally, although the data collection method involving face-to-face interviews with a qualified physical therapist allowed us to collect precise data regarding the injury characterization, this method has inherent limitations. Participants may provide biased responses influenced by a desire to please the interviewer or conform to societal expectations, and interviewers themselves can inadvertently impact participant responses, in addition to difficulties in standardizing data collection. Moreover, it is important to acknowledge the limitation of recruitment bias in our study. The sampling occurred by convenience, and we lacked information about the characteristics of practitioners who did not participate in the study, introducing potential bias in the generalizability of our findings. Also, we did not use a validated tool to measure joint mobility satisfaction. This assessment was conducted using a 5-point Likert scale (ranging from 'very satisfied' to 'very dissatisfied').

Finally, the results of this study could help coaches and healthcare professionals become aware of injury patterns in this exercise modality, offer specialized organization of training routines, and provide assertive information regarding functional fitness-related injury prevention. Further studies are required to expand the knowledge concerning possible modifiable risk factors and their role in injury patterns. Moreover, longer studies with a prospective design should be conducted to capture individuals who discontinue functional fitness training due to injuries, and to analyze the characteristics of individuals who remain injury-free, to identify protective factors and develop targeted prevention strategies.

Conclusions

Overall, 27% of participants reported sustaining at least one injury in the previous 12 months, and the injury incidence per 1000 hours of exposure was 1.22. Among all analyzed variables, only the practice of other sports activities and dissatisfaction with joint mobility of the shoulders increased the odds of being injured in the multivariate logistic regression. The shoulder was the most affected body part, followed by the lumbosacral spine and the knee. A gradual injury mechanism was the most commonly reported, followed by sudden onset but with no acute trauma. The most common pathology type was joint sprain. Concerning symptom severity, in most cases participants reported the injury as severe, which was aligned with the high sporting time loss of more than 28 days in 50% of all injuries and a high injury burden.

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Ethical approval

This research related to human use has complied with all the relevant national regulations and institutional policies, has followed the tenets of the Declaration of Helsinki, and has been approved by the Federal University of Mato Grosso do Sul (UFMS) Ethics Committee (approval No.: 4.859.381).

Informed consent

All participants received verbal and written information about the benefits and risks of participation. Informed consent was obtained from all individuals included in this study.

Disclosure statement

No author has any financial interest or received any financial benefit from this research.

Conflicts of interest

The authors state no conflicts of interest.

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