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Readiness for sport: focus on musculoskeletal injuries

Prontidão para o esporte: foco nas lesões musculoesqueléticas

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ABSTRACT
The aim of the study was to determine the prevalence of injuries and to screen these injuries in Crossfit practitioners. The practitioners answered sociodemographic questions related to the practice of the sport, injuries and the Sport Readiness Questionnaire with a Focus on Musculoskeletal Injuries (MIR-Q). Of the 368 practitioners evaluated, 57.33% were women, 54.61% of the practitioners answered YES in at least one of the MIR-Q questions, 48.91% reported injury to at least one body segment. In this study, a positive and moderate relationship between having an injury and a positive result on the MIR-Q was found and practitioners who reported an injury had 2.76 odds to have a positive result on the MIR-Q. The rate of injuries found was similar to other studies with similar populations and that more than half of the sample requires consultation with a specialist, based on the adopted screening method.

Keywords: Athletic injuries. Musculoskeletal system. Surveys and questionnaires.

RESUMO
O objetivo do estudo foi determinar a prevalência de lesões e realizar uma triagem dessas lesões em praticantes de *Crossfit*. Os praticantes responderam perguntas sociodemográficas, relacionadas à prática da modalidade, às lesões e ao Questionário de Prontidão para o Esporte com Foco nas Lesões Musculoesqueléticas (MIR-Q). Dos 368 praticantes avaliados, 57,33% eram mulheres, 54,61% dos praticantes responderam SIM em pelo menos uma das questões do MIR-Q, 48,91% relataram lesão em pelo menos um segmento corporal. Neste estudo foi encontrada uma relação positiva e moderada de se ter uma lesão com o resultado positivo no MIR-Q e os praticantes que relataram uma lesão tiveram 2,76 mais vezes ter resultado positivo no MIR-Q. A taxa de lesões encontrada foi semelhante à de outros estudos com populações semelhantes e que mais da metade da amostra necessita de uma consulta com um especialista, a partir do método de triagem adotado.

Palavras-chave: Inquéritos e questionários. Lesões esportivas. Sistema musculoesquelético.

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INTRODUCTION

Extreme Conditioning Programs (ECPs), Crossfit, Insanity, Gym Jones, are characterized by functional movements that are constantly varied and with high intensity, performed quickly and with small or no recovery time[1]. Training in this context associated with inadequate progression of training load increases the risk of injuries from overuse[2].

Overuse injuries are defined as injuries without a specific and identifiable event responsible for their occurrence[3]. They are considered a predominant type of injury in sports that involve long training sessions, as well as in technical sports that involve repetition of movement patterns[4-6].

ECPs have gained popularity in recent years, however, the safety of practicing this modality has received some criticism for involving high-intensity technical exercises and, in most cases, detection of these musculoskeletal injuries requires specialist doctors and high-cost examinations, many of them unavailable in sports environments[7,8]. The negative experience associated with these injuries can discourage participation in sport, and efforts to prevent these injuries are important[9].

When analyzing the number of injuries every 1000 hours of training, injury rate in this modality is not higher than other sports[10]. However, evaluation of these sports injuries should be part of the pre-participation assessment. The purpose in carrying out these assessments is to reduce the risk of injuries and improve the performance of these practitioners[11,12]. This assessment should be made in all practitioners, either in an affiliated location or in another space, to determine the impact of training on the incidence of these injuries[13].

The use of low-cost and easy-to-use instruments for the screening of athletes can assist in the detection of risk factors and even injuries in these practitioners, therefore, the aim of this study was to determine the prevalence of injuries and a screening of injuries associated with Crossfit.

METHODOLOGY

DESIGN AND SAMPLE

This is a quantitative and transversal study. It was developed through a data survey. To participate in this study, it was necessary for individuals to practice Crossfit, be over 18 years old, of both sexes, enrolled in a box affiliated to the brand, with at least one month of practice and with regular frequency of at least two times a week, both for recreational and competitive purposes. The research was approved by the Ethics and Research Committee of Federal University of Triângulo Mineiro under protocol number 3.290.661 and all practitioners signed the Informed Consent Form agreeing to participate voluntarily in the research.

DATA COLLECTION

The practitioners answered a questionnaire that contained sociodemographic questions, related to practice of sport, injuries and the Sport Readiness Questionnaire Focused on Musculoskeletal Injuries (MIR-Q) (Appendix 1).

The MIR-Q is a tool that allows screening and referral of practitioners with risk factors and/or possible injuries, helping

to identify practitioners who would not have access to diagnosis of injuries by specialist doctors, thus being able to enhance time of return to practice modality[14]. The questionnaire consists of six YES or NO questions, which, if the practitioner answers YES in at least one of the questions in the questionnaire, there is a need for a medical consultation, preferably with an orthopedics specialist or sports doctor, to assess their muscular and skeletal condition[14].

Other questions answered by practitioners were time of practice, weekly frequency, if they practiced another modality, if they had already participated in any competition and if they had any joint pain/injury in one or more segments during training/competitions, being that pain/injury defined as any joint discomfort that may or may not interfere with training. Pain intensity was measured by Visual Analogue Scale (VAS) for pain, considering values between 0 and 10[15].

Analyzes of the questionnaires were carried out by a different researcher from the one who carried out recruitment and screening of practitioners, thus ensuring data confidentiality and reducing the risk of bias.

DATA ANALYSIS

Data analysis was performed using descriptive statistics with mean, standard deviation and frequency values. Pearson's correlation test was used for correlation between positive for pain/injury and positive for MIR-Q with remaining variables. Correlation values will be classified as very low correlation between 0-0.01; low with 0.1-0.3 values; moderate between 0.3-0.5; high between 0.5-0.7; very high between 0.7-0.9; and between 0.9-1.0 almost perfect[16].

Association between pain/injury and positive for the MIR-Q, characteristics of practitioners and characteristics of the sports pratice were evaluated using binary logistic regression model, and results presented as Odds Ratio (OR) and intervalo of 95% confidence interval (95% CI). For binary logistic regression, variable time of practice was analysed in a categorized way (≤ 6 months;> 6 months and ≤ 12 months;> 12 months and ≤ 24 months; and> 24 months) and continuously. Analyzes were performed considering a significance level of 5% using the SPSS software (Statistical Package for the Social Science 20.0).

RESULTS

368 practitioners were evaluated, most of them women (57.33%, n = 211) as can be seen in Table 1. A total of 39.13% (n = 144) of the sample reported practice of another modality and modalities most cited were weight training, running, cycling, swimming and fighting and 50.27% (n = 185) reported having participated in some competition related to ECPs**.**

Table 1. General sample data

Variables	**Mean**	**SD**
Age (years)	30.45	6.63
Weight (kg)	71.81	12.50
Height (m)	1.69	0.09
Practice Time (months)	21.93	18.08
Weekly Frequency (days)	4.5	1.13
BMI (kg/m²)	24.90	2.9
VAS	3.96	1.86
Practice Time	**%**	**N**
≤6 months	18.48	68
>6 and ≤12 months	23.10	85
>12 and ≤24 months	27.71	102
>24 months	30.71	113
Number of Injuries	**%**	**N**
≤6 months	19.44	35
>6 and ≤12 months	22.77	41
>12 and ≤24 months	29.44	53
>24 months	28.35	51
MIR-Q Positive	**%**	**N**
≤6 months	21.89	44
>6 and ≤12 months	23.38	47
>12 and ≤24 months	27.86	56
>24 months	26.87	54

BMI = Body Mass Index; MIR-Q= Sport Readiness Questionnaire Focused on Musculoskeletal Injuries; VAS = Visual Analogue Scale; SD = Standard Deviation.

Regarding musculoskeletal injuries, 48.91% (n = 180) reported pain/injury in at least one body segment and 58.33% (n = 105) of the reports were from women. The most injured segments were shoulder (34.49%), knee (24.63%), lumbar (20.69%), wrist (3.94%), leg/calf (3.94%), elbow/arm (3.45%), foot (2.46%), ankle (1.98%). 41.66% (n = 75) of the 180 practitioners who responded positively to pain/injury practiced another sport and 48.33% (n = 87) reported having participated in a competition.

In this sample, it was found that 54.61% (n = 201) answered YES in at least one of the questions of MIR-Q, and 55.72% (n = 112) of those who answered were women. Question one was answered positively by 78 practitioners, question two by 40 practitioners, question three by 23 practitioners, question four by 96 practitioners, question five by 77 practitioners and question six by 29 practitioners. 41.79% (n = 84) of the 201 practitioners who responded positively to the MIR-Q practiced another sport and 43.28 (n = 87) have already participated in a competition.

In the results found, 32.88% (n = 121) responded positively to pain/injury and positively to MIR-Q. Those who responded positively to pain/injury were 2.76 more likely to have responded positively in at least one of the questions in

the MIRQ-Q (Table 2). In the same way, practitioners who reported pain/injury were 2.72 more likely to have responded positively to MIR-Q and practitioners who have already participated in a competition had a 50% lower chance of answering the questionnaire positively (Table 3).

Table 2. Association between the positive report for pain/injury and the characte ristics of the practitioners

	Pain/Injury		**Odds Ratio (IC95%)**	***p***
	Yes	**No**		
Age				
Mean (SD)	30.78 (7.2)	30.13 (6.4)	1.014 (0.983-1.046)	0.385
Gender				
Male (n=157)	75 (47.77%)	82 (52.33%)	0.974 (0.630-1.507)	0.906
Female (n=211)	105 (49.77%)	106 (50.23%)	1	
BMI				
Mean (SD)	24.8 (2.8)	25.02 (2.9)	1.001 (0.924-1.085)	0.977
Practice Time				
Mean (SD)	20.84 (17.16)	22.97 (18.91)	0.993 (0.981-1.006)	0.385
Practice Time				
≤6 months (n=68)	44 (64.71%)	24 (35.29%)	1	
>6 months and ≤12 months (n=85)	47 (55.30%)	38 (44.70%)	0.879 (0.464-1.663)	0.691
>12 months and ≤24 months (n=102)	56 (54.90%)	46 (45.10%)	1.020 (0.552-1.885)	0.950
>24 months (n=113)	54 (47.78%)	59 (52.22%)	0.776 (0.424-1.417)	0.808
Participation in competitions				
Yes (n=144)	75 (52.09%)	69 (47.91%)	1.175 (0.761-1.816)	0.467
No (n=224)	105 (46.87%)	119 (53.13%)	1	
MIR-Q Postive				
Yes (n=201)	121 (60.20%)	80 (39.80%)	2.769 (1.810-4.234)	0.000*
No (n=167)	59 (35.33%)	108 (64.67%)	1	
Practice of another modality				
Yes (n=144)	121 (60.20%)	80 (39.80%)	2.769 (1.810-4.234)	0.000*
No (n=167)	59 (35.33%)	108 (64.67%)	1	

SD = Standard Deviation; BMI = Body Mass Index; MIR-Q = Sport Readiness Questionnaire Focused on Musculoskeletal Inuries; * = p<0.005.

Table 3. Association between the positive report for the MIR-Q and the characteristics of the practitioners

	MIR-Q		*Odds Ratio* (IC95%)	*p*
	Yes	**No**		
Age				
Mean(SD)	30.78 (7.2)	30.13 (6.4)	1.013 (0.978-1.049)	0.462
Gender				
Male (n=157)	75 (47.77%)	82 (52.33%)	0.849 (0.530-1.362)	0.498
Female (n=211)	105 (49.77%)	106 (50.23%)	1	
BMI				
Mean (SD)	24.8 (2.8)	25.02 (2.9)	1.001 (0.924-1.085)	0.977
Practice Time				
Mean (SD)	20.84 (17.16)	22.97 (18.91)	0.998 (0.985-1.012)	0.825
Practice Time				
≤6 months (n=68)	44 (64.71%)	24 (35.29%)	1	
>6 months and ≤12 months (n=85)	47 (55.30%)	38 (44.70%)	0.736 (0.362-1.495)	0.396
>12 months and ≤24 months (n=102)	56 (54.90%)	46 (45.10%)	0.737 (0.356-1.524)	0.410
>24 months (n=113)	54 (47.78%)	59 (52.22%)	0.639 (0.305-1.336)	0.234
Participation in competitions				
Yes (n=144)	75 (52.09%)	69 (47.91%)	0.476 (0.294-0.771)	0.003*
No (n=224)	105 (46.87%)	119 (53.13%)	1	
Pain/Injury Positive				
Sim (n=180)	121 (60.20%)	80 (39.80%)	2.726 (1.758-4.227)	0.000*
Não (n=188)	59 (35.33%)	108 (64.67%)	1	
Practice of another modality				
Yes (n=144)	75 (52.09%)	69 (47.91%)	1.365 (0.865-2.154)	0.181
No (n=224)	105 (46.88%)	119 (53.12%)	1	

SD = Standard Deviation; BMI = Body Mass Index; MIR-Q = Sport Readiness Questionnaire Focused on Musculoskeletal Injuries; * = p<0.005.

The results found a low and positive correlation between the positive result on MIR-Q and BMI (r = 0.139, p = 0.008), a low and negative correlation between a positive result on MIR-Q and a positive result for having participated in a competition (r = -0.153, p = 0.003) and low and positive correlation between positive result on MIR-Q and positive for injury/pain (r = 0.248, p = 0.000).

DISCUSSION

The aim of this study was to determine the prevalence of injuries, evaluate the profile of these practitioners and a screening of injuries associated with ECPs, being the first to use an instrument to screen these injuries. More than half of practitioners responded positively to at least one of the six questions, indicating the need for medical consultation, preferably with an orthopedics specialist.

It reinforces the fact that it is the first study found that used this questionnaire to assess sports injuries. Other questionnaires were applied in different modalities and were made in specific ways for soccer[17] and athletes with disabilities[18]. Therefore, more studies are needed with the use of this

questionnaire, to analyze its reliability and application in different modalities.

Two reviews with ECPs practitioners indicated that injury rate in these practitioners varies between 5 to 73.5%[19] and 19 to 74%[20], respectively, which is in line with the rate of 48.91% found in practitioners of this sample. In this study, higher rates were found than other studies with the Brazilian population, with rates of 31.0%[21] and 36%[22]. This difference may be due to different concepts about injuries, with no consensus in studies on the subject.

Although almost half of the sample respond positively, injuries reported by practitioners do not seem to disturb their daily practice of the modality, which was observed in the low average value reported in VAS (3.96) and the small amount of positive answers in question number six of MIR-Q.

Data obtained in this study showed that about 19% of the sample that reported pain/injury and about 21% of the sample that answered positive on MIR-Q had up to six months of practicing in the modality, values close to other studies that found similar rates, 19.4%, 26.2% and 22.3% respectively[23-25], suggesting that these practitioners already started the practice with some previous injury.

For this reason, practitioners with less than 12 months of experience should be careful when participating in sport events, with appropriate training to their fitness and experience in sport[26]. Professionals should be careful with these "beginners" and promote programs that enable a progression in training, especially in the first year of practice to minimize risk of injury[27].

As a consequence, the need for professionals to pay attention to anamnesis and screening of practitioners in the places where ECPs are practiced is highlighted, with the objective of knowing previous injuries and preventing the recurrence of these injuries[19]. The places with the highest incidence of these injuries in these practitioners are shoulders, lumbar and knees[9,23-25,27-29]. In this study, the places corroborate with the literature, the same ones being most cited by practitioners.

In comparison to sports that are included in ECPs, the same predominance of injured body sites is found: practitioners of weight training (body building, strongman, weightlifting) injure their shoulders, lower back and knees[30] more frequently, gymnasts injure the shoulder[31]; and joggers injure their knees[32].

The positive answer in question four may show scoliosis, a common and complex spinal deformity in adults that leads to frontal curves, spinal rotations and flattening of sagittal physiological curves[33], with low back pain being a common symptom in those who have scoliosis[34], which can be the result of fatigue and muscle spasm on the convexity of the curvature[35], which could explain lower back as one of the most affected places in these practitioners.

Fatigue in this region can impede an adequate movement and technique with each repetition, exercises such as squats and

deadlifts require a neutral alignment throughout the training[36]. Heavy axial loads and high number of repetitions and a small error in execution, can lead to an increase inside the disc and risk of herniation[28,36]. Practitioners with scoliosis present greater risk factors for these conditions[37].

Several studies have shown that a greater amount of weekly hours dedicated, in addition to a longer exposure time, and the male gender were risk factors for a higher injury rate[19,25,28,29,38,39], which was not confirmed in this study sample, in which none of these variables influenced the number of injuries. No relationship was found between the variables pain / injury and time of practice, weekly frequency, age, sex, which is in consent with another study in the Brazilian population[40]. Thus, the need for physical examination by a trained professional is reiterated.

In this study, a low and significant correlation was found ($r = 0.248$, $p < 0.000$) between those who answered positive in one of MIR-Q questions and between those who reported at least one pain / injury, and who reported at least one pain / injury, was 2.7 more likely to respond positively to the questionnaire, thus indicating the potential of the questionnaire to screen practitioners, at least in ECPs practitioners.

Still, in this study, there is a contradiction between a positive answer in question five, where the practice of the modality showed positive improvements in levels of anxiety, interpersonal relationships, eating habits and sleep, perhaps it may not present the need for a medical consultation, thus requiring prior experience and common sense in application of the questionnaire so that there are no errors in interpretation.

For a better interpretation of the results of the questionnaire and its ability to screen for musculoskeletal injuries, different weights may be necessary in each question, so that each report by the practitioners, is treated and/or forwarded in a specific way.

An important consideration is that 41.66% of practitioners who reported pain/injury, also reported performing other sports in addition to ECPs, thus there may be a risk of bias, as it would be impossible to assume that all injuries were caused by only one modality sport.

The present study has limitations, as the questionnaire was also distributed electronically, with the aim of reaching a larger audience, which can generate a selection bias, as we were dependent on practitioners to interpret their pain/injury, and the late muscle pain can be misinterpreted as an injury.

CONCLUSION

The injury rate (48.91%) found among the participants was similar to the injury rate in other studies with the same population. The shoulder, lumbar and knees appear as the most affected sites and more than half of the sample requires consultation with a specialist, based on the adopted screening method.

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Appendix 1. Sport Readiness Questionnaire focused on musculoskeletal injuries (MIR-Q).

Questionário de Prontidão para esporte com foco nas lesões musculoesqueléticas (MIR-Q).

Esta ferramenta foi elaborada por **Especialistas em Medicina do Exercício e do Esporte** para que um profissional do esporte a aplique nos atletas sob seus cuidados, em qualquer momento do calendário esportivo. Caso você tenha um médico em seu ambiente de treinamento, convém consultá-lo antes de iniciar o treinamento físico com seu(s) atleta(s). Não existindo esta possibilidade, este questionário procura então selecionar atletas que necessitem de avaliação médica para uma possível lesão musculoesquelética ou fatores predisponentes. Estas questões abaixo devem ser respondidas com muita sinceridade por parte dos atletas, pois podem auxiliar no diagnóstico precoce e posterior tratamento de uma alteração muscular ou óssea, evitando seu agravamento e impactando em um melhor desempenho físico.

Apresenta dor nos treinos e jogos (competições) que prejudica a sua performance ou rendimento esportivo? Em que local do corpo? ( ) SIM ( ) NÃO
Tem queixa de instabilidade articular (folga na junta, falseio na articulação)? Em qual articulação (junta)? ( ) SIM ( ) NÃO
Você apresenta sinais visíveis de lesões (edema-inchaço, calor local, vermelhidão, mancha escurecida, deformidade, bloqueio ou travamento articular)? Em que local do corpo? ( ) SIM ( ) NÃO
Algum médico já lhe disse que você tem desvio da coluna vertebral ou você já percebeu diferença na altura dos ombros, no alinhamento ou comprimento dos braços ou pernas? ( ) SIM ( ) NÃO
Tem percebido alterações no humor, no relacionamento com pessoas próximas, no hábito alimentar (apetite), no sono ou aparecimento frequente de infecções respiratórias relacionado aos treinamentos nos últimos 6 meses? ( ) SIM ( ) NÃO
Nos últimos 6 meses você notou uma queda de rendimento esportivo (performance) associado ou não às queixas ou sintomas relatados nas perguntas anteriores? ( ) SIM ( ) NÃO

Se o atleta responder **SIM**

A pelo menos uma questão, há necessidade de uma consulta médica, preferencialmente com o especialista em ortopedia ou médico do esporte, para avaliar a sua condição muscular e esquelética.

Se o atleta responder **NÃO** com sinceridade a todas as questões, existe um estado de razoável segurança quanto à sua condição muscular e óssea

Mas lembre-se: este questionário não substitui a avaliação médica quando esta for possível. Mesmo tendo respondido **NÃO** a todas as questões anteriores, atletas de nível competitivo tem indicações para uma avaliação chamada de pré-participação, onde os sintomas cardiovasculares, que não são perguntados neste questionário, serão também investigados

Importante: De acordo com o Colégio Americano de Medicina Esportiva, qualquer desconforto muscular ou articular associado ao exercício ou agravado por ele deve ser identificado. Assim, caso os sintomas ou sinais aqui perguntados venham aparecer em qualquer momento de prática esportiva dos atletas, este questionário poderá confirmar a necessidade de encaminhamento para avaliação médica. Em caso de dúvida quanto a honestidade das respostas, opte pelo encaminhamento ao médico especialista. Esta conduta procura garantir um estado seguro para a pratica esportiva