Association between depressive symptoms and episodes of musculoskeletal injuries in Brazilian athletes during crisis time

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Abstract The crisis time generated negative impacts in sports. This study aimed to investigate the main psychological symptoms and the resilience profile of Brazilian athletes during the COVID-19 pandemic. A cross-sectional observational study was conducted, involving 474 athletes from different sports, who completed an online self-reported questionnaire about their sociodemographic and sports profile, COVID-19 clinical profile, life and health habits, profile psychological and resilience. A total of the 441 athletes (93%) reported some impairment of mental health: 81% concern, 68% stress, 63% mood change, 61% anxiety, 50% insomnia, 48% pessimism, 47% fear, 40% sadness, 13% depression, and 7% panic. The lower family income was associated with concern (p=0.02), insomnia (p=0.05), fear (p=0.05) and sadness (p=0.05). The depression was associated with lower family income (OR=3.7 CI95%=1.4-9.5), changes in financial income (OR=2 CI95%=1.1-3.8), not able to adapt training (OR=2.8 CI95%=1.5-5.0), and musculoskeletal injuries (OR=2.6 CI95%=1.1-3.8). The mean resilience score in all athletes was 130±14 points and the group with a low resilience score (up to 125 points) showed more anxiety, pessimism, concern, depression, fear, insomnia, mood change, panic, sadness, and stress. The score decreased by 1.6 points according to the cumulative psychological outcome (p<0.01). The years of sports practice and weekly training hours were associated with higher resilience scores (above 140 points). The identification of factors associated with the presence of negative psychological symptoms and the resilience of athletes can help monitor post-pandemic mental health, promoting the well-being and quality of life of these individuals, optimizing sports performance, and mitigating the occurrence of injuries.

Keywords: athlete, depression, musculoskeletal injury, mental health, COVID-19.

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1. Introduction

The COVID-19 pandemic has severely affected humanity, impacting individuals in various ways, including generating stressful life events and pathophysiological outcomes, such as depression or anxiety [1,2]. It has also changed individuals' resilience levels, which refer to their psychosocial capacity to adapt to adversity [3]. In the sports world, in addition to the risk of infection, athletes have had to deal with numerous challenges, including disruptions to their regular training, limited support from fans and media, reduced financial income, uncertainty regarding resumption to play, isolation, and musculoskeletal injuries (MSK-I) [4]. These effects have become stressors, impacting athletes' mental health, leading to a loss of motivation and performance, consequently impacting their careers [5,6,7,8]. As if that were not enough, 2020 was a year of high expectations for the Olympics. However, almost all competitions, including the Summer Olympic Games, were postponed [9,10].

Injuries have long been a major concern for athletes, and the prevalence of MSK-I among athletes was already high before the COVID-19 pandemic. Goes et al. (2020), reported a prevalence of 76% of MSK-I in a

cross-sectional observational study involving 627 athletes from rugby, soccer, combat sports, handball, and water polo. More recently, a study conducted between August to November 2020 observed that almost 20% (in a cohort of 414) of athletes reported MSK-I during the pandemic [4]. This highlights the ongoing importance of injury prevention and management in sports, even during a global health crisis.

While the focus of athlete management during the pandemic has been on physical health [11,12], the previous factors may have contributed to compromising athletes' mental health, affecting their physical fitness, and increasing the risk of orthopedic injuries [5]. The case of the American gymnast at the Tokyo Olympics Games – who voluntarily withdrew from the competition due to mental health issues – highlights the close relationship between high-intensity physical activity to achieve competition-driven performance, associated with injury and negative psychological impact [13]. These and other cases of mental distress in elite athletes reinforce the need for studies on the pandemic impact on mental health.

This study aimed to describe the psychological effects experienced by Brazilian athletes during the COVID-19 pandemic, including anxiety, pessimism, concern, depression, fear, insomnia, mood change, panic, sadness, and stress. Also, the study aimed to determine the epidemiological, athletic profiles, life and health habits, and clinical conditions associated with these psychological outcomes.

2. Methods

2.1. Population and Study Design

This cross-sectional observational study was approved by the Human Ethics Committee of the *Fundação Oswaldo Cruz* (#4.180.668). The athletes were invited to participate in this study from August 2020 to August 2021, via the laboratory website (https://lapesfuezo.wixsite.com/website), Instagram (@lapesf.jamila.perini), or dissemination of sports clubs/federations, when appropriate and possible. The inclusion criteria were professional or amateur athletes participating in state, municipal, or international competitions of any sport modality, and the exclusion criteria were athletes under 18 years old. All participants provided written consent and answered an online questionnaire (*https://forms.gle/zSEr3C9QQUFi4W2b8*), as described in a previous study [4].

2.2. Questionnaire

The first section was dedicated to sociodemographic characteristics, such as age, sex, number of residents in the housing, and family income. The value of 5 minimum wages corresponds to U$ 966.33 (R$ 5,183.30) a month and U$ 11,595.96 per year, according to the classification scheme of the Brazilian official census (*Instituto Brasileiro de Geografia e Estatística* – IBGE).

The second section was about sports and training characteristics, such as competition level, sport modality, adapted sport (for parathletes), wage as an athlete, weekly training hours (number of weekly training periods and duration in hours of each training period), and years of practice in the sport.

The next section inquired about COVID-19 health issues: diagnosis and characteristic symptoms. The COVID-19 characteristic symptoms reported were headache, sneezing, coryza, sore throat, cough, body ache, fever, diarrhea, loss of taste, loss of smell, difficulty breathing, nausea, and respiratory insufficiency. In addition, the repercussions of socioeconomic changes, training during the pandemic and episodes of musculoskeletal injuries (e.g., muscle and joint injuries, and/or tendinopathy) during the pandemic were/was inquired. Finally, the last section inquired about the repercussions of psychological and resilience aspects during the pandemic.

2.3. Assessment of Psychological Symptoms

The athletes completed a self-reported questionnaire to assess the psychological symptoms and disorders during the pandemic, including anxiety, pessimism, concern, depression, fear, insomnia, mood change, panic, sadness, and stress, adapted from [14]. Each symptom was assessed using a four-point Likert scale (never, rarely, sometimes, and always), which was then categorized into two groups: absence (never and rarely) or presence (sometimes and always), based on the participant's response. The prevalence of each psychological outcome was calculated by dividing the number of athletes who reported the presence of that effect by the total number of participants.

2.4. Assessment of Scale Resilience

The resilience scale used was the cross-cultural adaptation to Portuguese developed by Pesce et al. (2005) and measures levels of positive psychosocial adaptation in the face of significant life events. The scale consists of 25 items and uses a 7-point Likert scale [1 = strongly disagree to 7 = strongly agree]. The entire scale has high internal consistency, with a Cronbach's α of 0.80. The questionnaire has good psychometric properties, with a regular to moderate kappa between the two points in time (0.21-0.53) and an intraclass correlation coefficient of 0.75 [15]. Scale scores range from 25 to 175, with scores up to 125 indicating low resilience, scores between 125 and 145 indicating average resilience, and scores above 145 indicating high resilience [16].

2.5. Statistical Analysis

The virtual snowball was the sampling method used for the greatest dissemination of the online questionnaire for Brazilian athletes. Virtual snowball sampling is a method of online participant recruitment through referrals. Initial participants are recruited through social media or email and asked to refer others who might be interested in the study. The referred individuals are contacted and asked to participate, and the process continues until the desired sample size is achieved. This approach was an interesting strategy during the COVID-19 pandemic to investigate the changes in lifestyles and health conditions of the Brazilian population [17]. The data distribution was verified by the Shapiro-Wilk test. The comparisons made were between the groups with and without psychological symptoms.

Continuous variables were reported as mean ± standard deviation (SD) and analyzed by independent t Student test. In addition, according to their normal distribution, for the analysis, the age, years of practice in sport, and weekly training hours variables were divided into the median. Categorical data were shown in ratio and differences using the chi-squared (χ2) statistic test or Fisher's exact test, when applicable.

Logistic regression analyses were performed to identify the possible factors associated with depression during social isolation in this athlete, which was estimated by the odds ratio (OR) with a 95% confidence interval (95%CI). Univariate characteristics with biological importance or p-value less than 0.25 were included in the multivariable logistic regression analysis. In addition, a linear regression analysis was performed separately for the resilience score (dependent variable) concerning age, years of practice in sport, and weekly training hours (independent variables). This analysis allows us to evaluate the variation in resilience score in dependence on the proposed independent variables. All analyses were performed using IBM SPSS 20.0 Statistics for Windows (SPSS Inc., Chicago, IL, USA) and the level of statistical significance was set at a p-value <0.05.

3. Results

A total of 474 athletes were eligible for inclusion in the study. Their mean age was 28.0 ± 8.9 years old, 329 (69.4%) participated in team sports modalities, 177 (37.3%) received wages as an athlete, and the proportion between males and females in the study population was 1.5-fold. The average time of sports practice and weekly training was 14.7 ± 9.2 years and 14.5 ± 9.4 hours, respectively. Of the 91 athletes who reported MSK-I during the period of social isolation, 58 (63.7%) had muscle injuries, 36 (39.6%) had joint injuries, and 17 (18.7%) had tendinopathies. In addition, 16 (17.6%) athletes reported multiple injuries. Table 1 shows the epidemiological, athletic profiles, and pandemic characteristics of the studied athletes.

The main problems reported by athletes to manage their sports career during the period of social isolation were keeping motivated (69.1%), effective training at home (68.5%), and mental health management (53.3%). The distribution frequency of the psychological symptoms during the COVID-19 pandemic according to the 4-point Likert scale is demonstrated in Figure 1.

The frequency of athletes who self-reported the feeling (sometimes or always) of anxiety, pessimism, concern, depression, fear, insomnia, mood change, panic, sadness, and stress was available according to the subgroups of financial income (amount and change), training, and episodes of MSK-I. The depression was significantly different between the 4 groups. The feelings of insomnia, fear, and sadness also were significantly different between changes in financial income groups; and panic between adapted training groups (Figure 2). In addition, the athletes who reported episodes of MSK-I during social isolation presented a 1.76-fold (CI 95% = 1.10 – 2.84) higher chance of their feeling at least 6 psychological outcomes compared to athletes with up to 5 outcomes. There was no association between the number of psychological outcomes and the socioeconomic changes or adapted training (data not shown). However, there was a higher chance of depression among athletes who had lower family income, changes in financial income, were not able to adapt to training and had MSK-I (Table 2).

Table 1. Description of the epidemiological, athletic profiles, and pandemic characteristics of the studied athletes (n = 474).

Athletes characteristics	n (%)	Sports modalities	n (%)
Demographic profile		Handball	69 (14.6)
Age ≥ 25 years old[a]	263 (55.5)	Rugby	68 (14.3)
Male sex	282 (59.5)	Combat sports	67 (14.1)
Living alone	62 (13.0)	Soccer	53 (11.2)
Family income ≤ U$12,000[b]	357 (75.3)	Basketball	35 (7.4)
		Volleyball	35 (7.4)
Sports and training profiles		Football	28 (5.9)
Federated athletes	405 (85.4)	Athletics	25 (5.3)
International competition	247 (52.1)	Water polo	18 (3.8)
Parathletes	24 (5.1)	Swimming	13 (2.7)
Salary as athlete	177 (37.3)	Hockey	11 (2.3)
Weekly training ≤ 12 hours[a]	265 (55.9)	Synchronized swimming	10 (2.1)
Sports practice ≤ 13 years[a]	256 (54.0)	Canoeing	8 (1.7)
		Cycling	7 (1.5)
Pandemic effects		CrossFit	6 (1.3)
Positive COVID-19	57 (12.0)	Table tennis	5 (1.1)
Symptoms (>3)	140 (29.5)	Rowing	3 (0.6)
Change in financial income	305 (64.3)	Tennis	3 (0.6)
Contract suspended or changed	60 (12.0)	Artistic gymnastics	2 (0.4)
Training during the pandemic	350 (74.0)	Other	8 (1.7)
MSK-I during the pandemic	91 (19.2)		

[a]The variables were categorized by median according to the distribution among the athletes recruited. [b]The value corresponds to the value for the year.
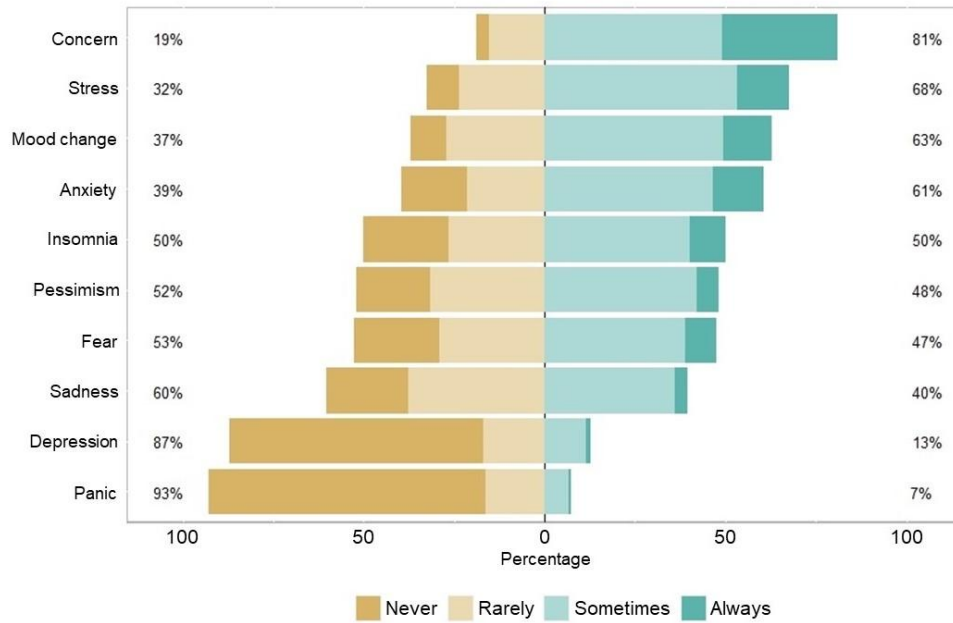Note: MSK-I = self-reported musculoskeletal injuries during the pandemic.

Figure 1. Distribution of the self-reported questions regarding psychological effects during the COVID-19 pandemic on the athletes.
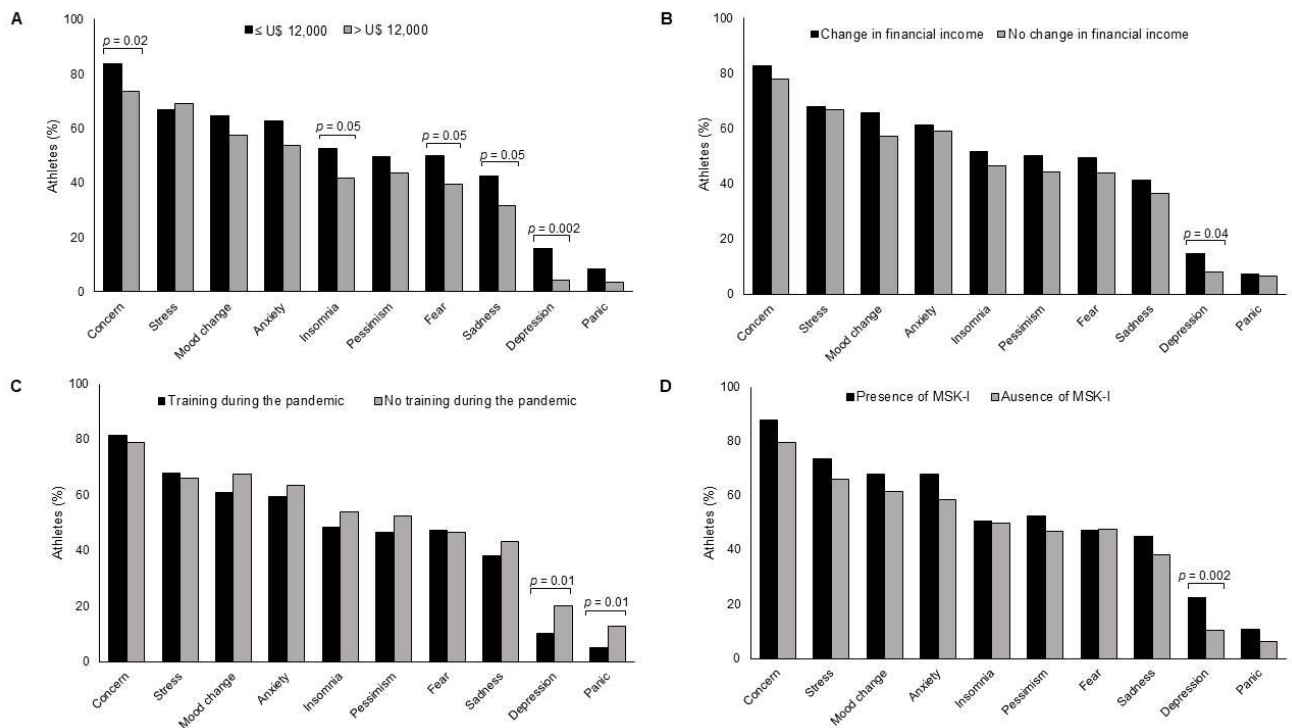

Figure 2. Distribution of psychological symptoms self-reported by athletes stratified by socioeconomic, sports and training factors. (A) Family income with a cutoff point of U$ 966.33 (R$ 5,183.30) a month, (B) change in income financial due to the pandemic, (C) Carrying out adapted training, and (D) the episode of musculoskeletal injuries during social isolation

The mean resilience score in the study population was 130.0 ± 13.7 points, which athletes with low resilience (score up to 125 points) self-declared more frequent psychological outcomes than individuals with high resilience (score above 140 points). There was a significant difference for all outcomes among individuals with low, medium, and high resilience scores (Figure 3A). The athletes with up to 3 outcomes had a mean resilience score of 135.3 ± 13.7 points, while the athletes who reported between 4-5 or ≥ 6 outcomes had 129.8 ± 13.6 and 124.3 ± 13.7 points, respectively. In

addition, the resilience score means decreased by 1.62 points according to the amount of cumulative psychological outcome (p<0.01) (Figure 3B). Residual analysis of the linear regression model showed normal distribution, homoscedasticity, and absence of influential points between the score resilience and related independent variables (age, years of sports practice, and weekly training hours). The years of sports practice contributed 1.4-fold more than weekly training hours to increase the resilience score. There was no correlation between age and the resilience score in the linear regression model (Table 3).

Table 2. Association between depression and financial income, training, and injury in the study population (n=474)

Variables	No depression (n = 413)	Depression (n = 61)	*p*-value[a]	OR (CI 95%)[b]
		n (%)		
Family income[d]				
> U$12,000	112 (27.1)	5 (8.2)	<0.01	1[c]
≤ U$12,000	301 (72.9)	56 (91.8)		3.67 (1.41 – 9.52)
Change in financial income				
No	155 (37.5)	14 (22.9)	0.04	1[c]
Yes	258 (62.5)	47 (77.1)		2.00 (1.04 – 3.83)
Adapted training				
Presence	314 (76.0)	36 (59.0)	<0.01	1[c]
Absence	99 (24.0)	25 (41.0)		2.75 (1.50 – 5.04)
Musculoskeletal injury				
No	343 (83.1)	40 (65.6)	<0.01	1[c]
Yes	70 (16.9)	21 (34.4)		2.57 (1.04 – 3.83)

[a]*p*-value was obtained by Chi-square test. [b]OR adjusted by age, sex, family income, adapted training, and musculoskeletal injuries. [c]Reference value. [d]The value corresponds to the value for the year. Note: OR = odds ratio; CI = confidence interval.
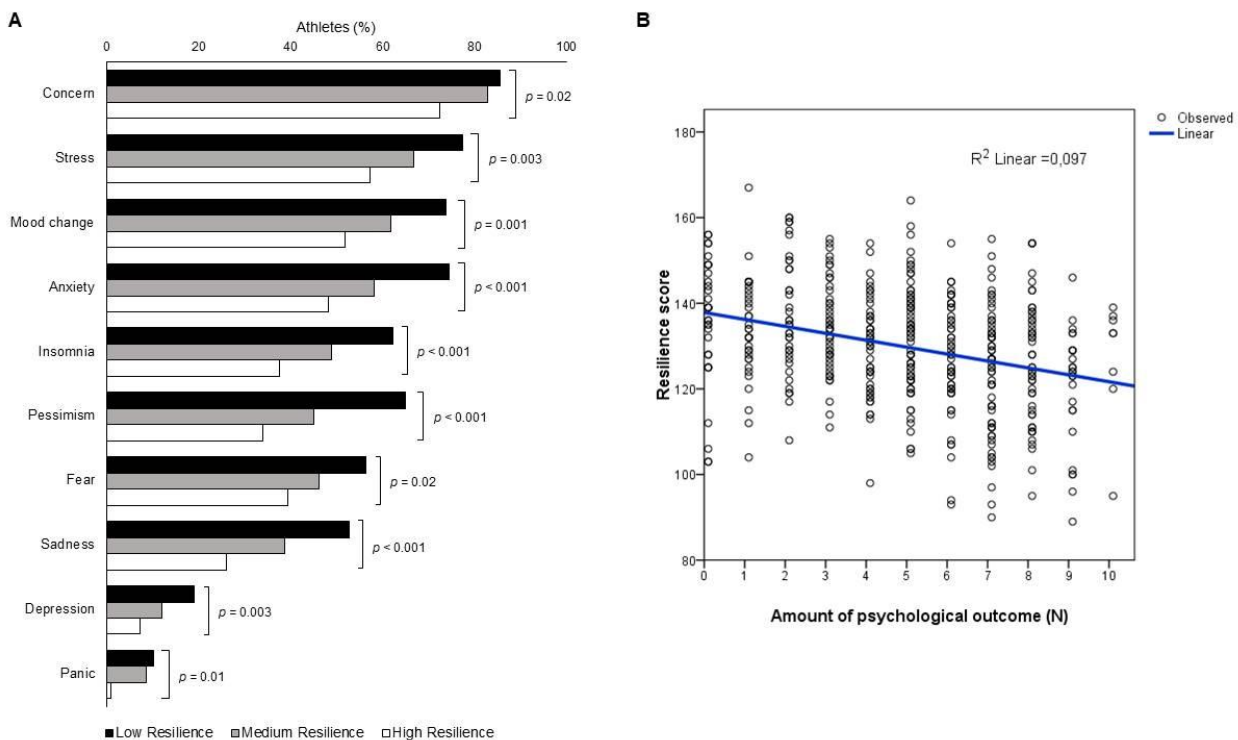

Figure 3. Resilience profile of the athletes in the study (n = 474). (A) Frequency of psychological symptoms in the population according to the resilience score (low resilience ≤ 125, average resilience between 125 and 145, and high resilience > 145 points). (B) Correlation between the resilience score and the amount of self-reported psychological symptoms by each athlete.

Table 3. Linear regression model between the resilience scale with age, years of sports practice and weekly training hours of the athletes in the study (n = 474).

Variables	Unstandardized coefficient	Standardized coefficient	*p*[a]	CI 95%
		Resilience score		
Age	-0.03	-0.02	0.73	-0.24 – 0.17
Sports practice[b]	0.23	0.15	0.02	0.04 – 0.42
Weekly training[c]	0.16	0.11	0.02	0.02 – 0.29
r[2] adjusted		0.20	<0.001	

[a]*p*-value from ANOVA to compare the resilience scale with related independent variables (age, years of sports practice and weekly training hours) in the linear regression model. [b]Sports practice in years. [c]Weekly training in hours.

4. Discussion

The COVID-19 pandemic had several biopsychosocial effects on athletes, affecting their physical and mental health [1,10,18,19]. In the current study, almost 70% of 474 Brazilian athletes self-reported to experienced difficulties in maintaining motivation for their sports career and effective training at home; and over 90% of the athletes reported some impairment of mental health, including serious outcomes, such as depression.

These findings corroborated with recent studies in which, 79% of the 399 Australian elite and sub-elite athletes disrupted their athletic training practice during the lockdown, and the decrease in training load was associated with increased reports of depression, anxiety, and stress [18]. In addition, the National Collegiate Athletic Association reported that 40% of the 37,000 student-athletes lacked motivation, and over 20% reported mental stress during the COVID-19 restrictions [20].

Excessive training loads, social pressure, and sacrifices demanded by high sports performance can often be abusive to the physical and mental health of athletes, as observed in cases such as Carey Price, Michael Phelps, and Simone Biles [13,21]. And the pandemic period has created additional stressors for the mental health of athletes, such as career disruption and the inability to engage in specific training [1,7]. Here, 13% of Brazilian athletes reported depressive symptoms, in agreement with elite athletes' study during the lockdown, who showed moderate or severe depression in 10% of rugby players [19]. The depression also was more frequent (risk of ~2-4-fold) among Brazilian athletes who had lower family income, changes in financial income, was not able to adapt to training and was injured during the pandemic. In this sense, it was also observed that professional male Turkish football players who experienced a higher reduction in income reported more feelings of depression [1]. The lower family income was the most risk (~4-fold) of depression in Brazilian athletes. Financial conditions should be considered a severe stressor with a significant negative impact on the psychological state of athletes.

In addition, the MSK-I has always been frequent and it has a serious problem in sports, leading to high economic costs and can decrease athletic performance [22]. A cross-sectional observational study observed 76% of MSK-I confirmed by physical or image exam in 627 Brazilian athletes during their sports life career [11]. Only during the COVID-19 pandemic period, almost 20% of 414 Brazilian athletes self-report MSK-I [4]. In the current study, MSK-I was associated with the risk (~3-fold) of depression in Brazilian athletes. Recently, the MSK-I was also associated with lower sports performance and lower training intensity in Swiss elite athletes [23]. The high training load and poor quality of mental health may be impaired athletic performance and increase the risk of MSK-I [1,23,24], and this scenario was potentially impaired by the direct and indirect of the COVID-19 pandemic effects [4].

The psychological symptoms and disorders during the pandemic also contributed to the resilience score in Brazilian athletes. The low resilience score was more frequent in athletes who felt anxiety, pessimism, concern, depression, fear, insomnia, mood swing, panic, sadness, and stress during the pandemic period. Moreover, the resilience score decreased by almost 2 points according to the amount of cumulative psychological outcome. Resilience is an essential trait for athletes to overcome stressors following adverse experiences [25,26]. Here, the athletes with more years of sports career and training hours had a higher resilience score. Many Olympic champions reported that overcoming stressors was a key factor in their gold medal-winning careers [27]. The difficulty in staying motivated, and the loss of sports and training opportunities were the main adversities faced by athletes during the pandemic lockdown [3]. Therefore, continuous psychological support for athletes to develop coping strategies is crucial to managing adverse situations, such as it happened the COVID-19 pandemic, which until today still spreading out devastating effects in the sports environment [3,25].

This study provides valuable insights into the psychological symptoms and resilience of Brazilian athletes during the COVID-19 pandemic. However, some limitations need to be addressed. For instance, the risk of recall bias cannot be ignored; the questionnaire did not provide explanations for any questions, meaning that the athletes' perception of each symptom was self-reported. However, the data collection method through a self-explanatory online form avoids typing and conference errors. Furthermore, there was adequate sample size ensured sufficient statistical power to detect significant differences. Overall, the findings from this study can be used to develop protocols that prioritize the well-being and quality of life of athletes, thereby optimizing sports performance, increasing the athlete's resilience, and even reducing the incidence of MSK-I. These findings reinforce the importance of mental care, in addition to the physical preparation of athletes.

5. Conclusion

The COVID-19 pandemic has had negative repercussions on the mental health of athletes. Almost 70% reported having trouble maintaining motivation for their sports career and effective training at home, and over 90% reported some impairment of mental health. Athletes with lower family income, changes in financial income, and those who were not able to adapt to training and suffered from MSK-I had a higher risk of depression. The resilience score decreased significantly according to the number of psychological outcomes. Additionally, years of a sports career and more weekly training hours were associated with higher resilience scores in facing the COVID-19 pandemic. These results highlight the importance of addressing mental health issues among athletes and providing psychological support, especially during times of crisis.

Acknowledgments

Conflict of Interest Declaration

The authors report no conflicts of interest.

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