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HEALTH SCIENCES

Changes in athlete training patterns due to COVID-19 pandemic among Brazilian athletes

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Abstract: In sports, training needs to be done according to various training patterns to optimize performance. However, this has been a major challenge to athletes due to the COVID-19 pandemic, therefore describing the impacts of lockdown caused by the COVID-19 pandemic on the athlete's training routine is necessary. 52 Brazilian athletes (Age: 31.5±10.3 years; Body Mass Index: 23.9±3.5 kg/m²), Olympic and Paralympic sports practitioners (professional and recreational) answered an online questionnaire [frequency, duration and intensity (subjective perception of effort) of training sessions], before and during lockdown (July to November/2020). The weekly training frequency (sessions/week) reduced by 48.1% (n=25) and was significantly higher among those who performed more than eight sessions before the pandemic (75% of them, p<0.000). The duration of the sessions (hours/day) decreased by 55.8% (n=29) and was significantly higher in athletes who performed training lasting more than one hour/day [75.9% of them (n=22)] and 24.1% (n= 7) performed training for more than two hours/day (p=0.132). The subjective perception of effort significantly decreased by 56%, from 8.4±1.2 to 5.5±1.7 (p=0.001). Because of the lockdown, athletes have suffered a reduction in the frequency, volume and intensity of their training sessions, but only in those with higher pre-pandemic training loads.

Key words: COVID-19, physical exercise, lockdown, training.

INTRODUCTION

The coronavirus 2019 (COVID-19) caused by Sars-Cov-2 quickly spread across the world in 2020, and consequently, declared a pandemic by the World Health Organization (WHO) on March 11, 2020. As a result, measures of social isolation and confinement (i.e., lockdown) were enforced across the world (Trabelsi et al. 2021, Romdhani et al. 2021). One of the consequences was that several regional and international sporting competitions and events (e.g., Euro 2020, Tokyo Olympic Games and Formula 1 Grand Prix) had to be postponed (Nicola et al. 2020).

Before the pandemic, athletes were exposed to training with high intensities, with specific mechanical and metabolic demands for each sport (Gamble 2006). With the imposition of lockdown, athletes had to adapt their training, having to perform them often in their home environments and often lacking specific equipment for their sport.

Ammar et al. (2020) conducted an online survey with 1047 people and found that the lockdown adopted to prevent the spread of Sars-Cov-2 decreased the intensity levels of physical activities, the number of days of physical activity and increased the time spent sitting per day. However, this study was carried out with 97%

of people from Europe, Asia and Africa and only 3% from other continents. Furthermore, this study was carried out with people with different occupations and does not represent a population of athletes, for whom a reduction in the training load has an important impact on their performance. In a more recent study, Washif et al. (2022) were able to expressively represent the population of athletes around the world when evaluating 12,526 athletes from 142 countries and six continents. They concluded that COVID-19-related lockdowns had marked reductions in physical training specificity, intensity, frequency, and duration, with notable differences within the sample (by athlete classification).

Several other studies have been conducted to examine the impacts of lockdown on athletes (Mon-López et al. 2020a, b, Jagim et al. 2020, Pillay et al. 2020, Zinner et al. 2020, Peña et al. 2021, Hermassi et al. 2021, Washif et al. 2021, 2022). All bring the same information in common, that athletes had a significant reduction in the intensity, duration and frequency of training during the lockdown. However, these studies do not include a sample of Brazilian athletes and some of them did not present diversity in the analyzed sports modalities. Mon-López et al. (2020a) and Hermassi et al. (2021) conducted a survey of handball athletes, Mon-López et al. (2020a) conducted a survey of football athletes, Zinner et al. (2020) conducted a survey of highly trained German kayakers and canoeists. Pillay et al. (2020) and Jagim et al. (2020) conducted a survey of South African and United States athletes respectively from various sports modalities. Only three of these studies brought results from athletes from different modalities and from several countries around the world (Peña et al. 2021, Washif et al. 2021, 2022).

Therefore, the objective of this work was to describe the impacts of lockdown on the training routine (intensity and weekly frequency) among professional and recreational athletes from several Olympic and Paralympic sports in Brazil. We hypothesize that athletes' training routines will be severely impacted by the lockdown, causing a significant reduction in the intensity, duration and frequency of training sessions.

MATERIALS AND METHODS

Study participants and ethical issues

Study conducted with 52 athletes (Age: 31.5±10.3 years; Body mass index (BMI): 23.9±3.5 kg/m^2) of Olympic and Paralympic sports (sports modalities are included in Table I), of both genders (male and female), professional (competition level, high level, registered in sports federations, received salary and represent the country internationally) (Loland 2020) and recreational (training with purpose maximizing performance, but not as a profession, but as a hobby) (Pazin et al. 2008). The inclusion criteria adopted were: being at least 18 years old, having been training for at least one year before the start of the pandemic (March/2020); having been in constant training for at least three uninterrupted months prior to quarantine, be a regular participant in competitions. In addition, the athlete should have a body mass verification procedure already established by their club and have a means of verifying their body mass during the period of lockdown. The information from the completed forms was analyzed so that the research inclusion criteria were applied. Forms that did not meet the inclusion criteria or those that were incompletely filled out were not included in the survey.

This study was approved by the Research Ethics Committee of the Health Sciences Center of the Federal University of Paraíba under protocol number 4.102.802. There was no physical contact between the researchers and the athletes and the research did not encourage

Table I. Demographic characteristics of athletes.

VARIABLES		(%)
AGE (years)	31,5±10,3	
BMI (kg/m²)	23,9±3,5	
ATHLETE LEVEL		
	Professional	42,3%
	Recreational (amateur)	57,7%
MODALITY		
	Running, Jumping, Shooting or Throwing	25%
	Road running	21%
	Soccer, Futsal or Beach Soccer	19%
	Triathlon	15%
	Cycling	8%
	Bodybuilding	4%
	Handball or Beach Handball	4%
	Crossfit	2%
	Combat sports	2%
SPORTS CLASSIFICATION		
	Olympic	73%
	Paralympic	27%
BRAZIL REGION		
	Northeast	96%
	Southeast	2%
	South	2%

BMI: body mass index.

any activity that would reduce lockdown. The collection was carried out using a Google form (Developed by Google Corporation, USA, 2018) and the form's first window was the text of the Informed Consent Form (FICF), which was read and accepted by the athletes, in accordance with resolution 466/12 of the National Council of Health. The data of this study are available from the corresponding author upon reasonable request.

Recruitment

The recruitment of participants was carried out through the dissemination of an online form on social networks (Instagram, Facebook and WhatsApp). Athletes, coaches, physical education teachers and sports nutritionists known to the researchers were marked in the publications and asked to disseminate information among their athletes on their social networks, since there was a considerable national network of contacts between researchers and these professionals.

Procedures

The form had questions about general data [Full name, body mass (Kg) and height (m)], whether they were Olympic or Paralympic athletes, professional or recreational, the modality in which they competed, their city, the competition that obtained the best performance in the last

two years and how he kept his training routine or it was changed during the period of lockdown, as per the attached file.

Statistical analysis

Data are presented as mean and standard deviation of the mean. Initially, data were tested for normality and homogeneity using the Shapiro-Wilk and Levene tests, respectively. Responses were categorized as the percentage of athletes who remained, decreased or increased training variables. To test differences between these categorical groups, the chi-square test was used (to verify changes in weekly frequency and duration of training sessions) and to test the difference between continuous data (means) the paired t-test was used (to verify changes in the athletes' subjective perception of effort). The Statistical Package for the Social Sciences software (IBM SPSS statistics 27, Inc, Chicago, IL, USA) was used and a 5% significance level was adopted.

RESULTS

Fifty-two athletes [41 men (78,85%) and 11 women (21,15%)], young adults and eutrophic (BMI within normal limits) participated in this study. They were athletes professionals (22 athletes) and recreational (30 athletes) from different Olympic (38 athletes) and Paralympic (14 athletes) modalities from the Northeast, Southeast and South regions of Brazil. Details of the characterization of these athletes are presented in Table I. The answers were carried out between the months between July and November/2020.

At the time of data collection, the lockdown in Brazil had already lasted for several months, so they had been training at home for at least 5 months. All athletes reported that they trained in specialized environments and with the use of equipment available only in training environments before the lockdown, so that when they had to train at home, they had to make adaptations. As a result, most athletes decreased their weekly training frequency, as shown in Table II. Although a small number of athletes increased their weekly training frequency, the percentage of athletes who decreased their training frequency was significantly higher (Table II). Also in Table II, it is possible to observe that the percentage of athletes who reduced the frequency of training was statistically higher among those who practiced a greater number of weekly sessions before lockdown.

In Table III, it is possible to observe that most athletes decreased the duration of their training sessions, a part remained with the same duration and a small part increased, however, the percentage of athletes who decreased the duration of the training sessions was not significant, but the percentage of athletes who reduced the duration of the sessions was statistically higher among those who practiced sessions lasting longer than one hour before the pandemic ($p<0.05$).

About 56% of athletes reduced the intensity of training sessions, 21% maintained and 23% increased. Figure 1 shows the graph referring to the subjective perception of effort before lockdown and during this lockdown. It is possible to observe that the perceived exertion significantly reduced during the lockdown, going from 8.0±1.4 in the pre-lockdown moment to 6.8±2.3 during lockdown ($p=0.001$). When considering only the athletes who reduced the intensity of their sessions, it was noticed that the subjective perception of effort reduced from 8.4±1.2 to 5.5±1.7 ($p<0.05$) (Figure 1b).

Table II. Weekly frequency of athletes training sessions.

Modification in the frequency of sessions	Weekly training sessions before social isolation			p
	Up to 4 sessions	5 to 8 sessions	9 or more sessions	
Remained	5 (20,0%)	16 (64,0%)	4 (16,0%)	0,000
Decreased	0 (0,0%)	13 (52,0%)	12 (48,0%)	
Increased	2 (100,0%)	0 (0,0%)	0 (0,0%)	

Data are presented as frequencies. Acronyms: p value indicates the result of the chi-square test that compared differences in the modification of the frequency of sessions.

Table III. Frequency of duration of the athletes training sessions.

Modification in duration frequency	Duration of training per session before social isolation			p
	Up to one hour	More than one hour	More than two hours	
Remained	4 (19,0%)	13 (61,9%)	4 (19,0%)	0,132
Decreased	0 (0,0%)	22 (75,9%)	7 (24,1%)	
Increased	0 (0,0%)	2 (100,0%)	0 (0,0%)	

Data are presented as frequencies. Acronyms: p value indicates the result of the chi-square test that compared differences in the frequency of duration of sessions between moments before and during social isolation in athletes who decreased.

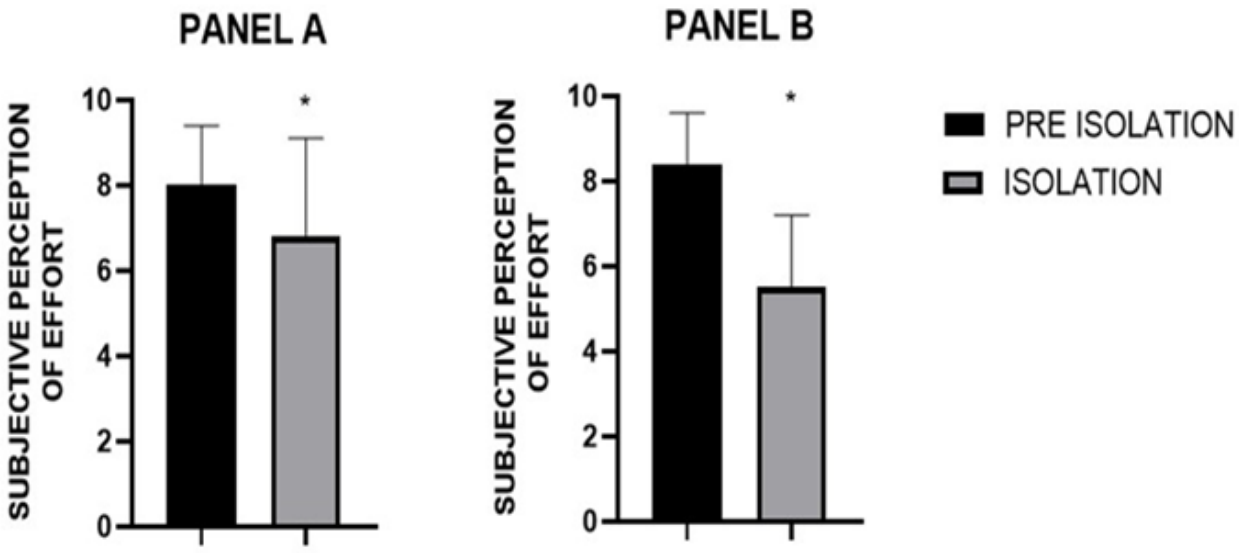

Figure 1. Subjective Perception of Effort (SPE). Data are presented as mean and standard deviation of the mean. *Statistical difference between pre-isolation and isolation moments. Panel **a)** general data; Panel **b)** data only from athletes who reduced training intensity.

DISCUSSION

As expected, the data from this study showed that all athletes had to give up their training sites and start training at home. This change in the training environment was accompanied by a decrease in the weekly frequency of training, duration of sessions and the perceived exertion for most athletes.

The impact of the lockdown on training sessions has been amply recorded. Several of published studies are with non-athlete populations (Abouzid et al. 2021, Ammar et al. 2020, Carroll et al. 2020, Castañeda-Babarro et al. 2020, Chopra et al. 2020, Ferrante et al. 2020, Górnicka et al. 2020, Husain & Ashkanani 2020, Rossinot et al. 2020), however, several studies have also been performed in athletes (Mon-López et al. 2020a, b, Jagim et al. 2020, Pillay et al. 2020, Zinner et al. 2020, Peña et al. 2021, Hermassi et al. 2021, Washif et al. 2021, 2022), and all bring the same information in common, that athletes had a significant reduction in the intensity, duration and frequency of training during the lockdown. However, studies carried out on athletes do not include a sample of Brazilian athletes and some of them did not present diversity in the analyzed sports modalities. These gaps are filled with the present study.

Regarding the training volume, the study by Mon-López et al. (2020b) showed that this variable was also affected by lockdown, causing athletes to reduce the frequency of their sessions from 4.8±1.1 (before lockdown) to 4.2±1.6 days (during lockdown). In the study by Mon-López et al. (2020a) carried out with football athletes, a reduction in the frequency of training sessions was also observed, with the frequency in the pre-lockdown period being 5.1±1 and rising to 4.9±1.4 days. The study by Hermassi et al. (2021) showed that the number of days that the athletes performed vigorous physical activities reduced from 4.6±1 (before lockdown) to 2.3±0.9 days (during lockdown), the same was observed for the activities moderate. Muriel et al. (2020) evaluated 18 professional cyclists and observed that during lockdown the total training volume decreased by 33.9%. Weekly volumes by standardized zones decreased between 25.8% and 52.2%. There were large reductions in 5 minutes best performance and 20 minutes best performance with losses between 1% and 19% in all cyclists. Once again, the data from these four studies corroborate those of the present study, wherein in the present study about 48.1% of the athletes had to reduce their weekly training frequency.

Among the studies that were carried out with a single sport, Mon-López et al. (2020b) showed that lockdown due to Sars-Cov-2 negatively affected the training intensity, which significantly affected the training and recovery conditions of handball athletes. The reduction in intensity presented in this study was 2.2 in the perceived exertion (Likert scale 1–10). Another study by Mon-López et al. (2020a), carried out with professional and non-professional football athletes, also showed that lockdown affected the training load, causing the subjective perception of effort during lockdown (4.7±2.4) was lower than in pre lockdown training (6.0±2.8). Zinner et al. (2020) showed that highly trained German kayakers and canoeists had a reduction in overall weekly training time and mean duration of each training session during lockdown by 27.6% and 15.4%, respectively. At the same time, the number of sessions involving specific (i.e. canoeing and kayaking) and non-specific (i.e. running, cycling) training, respectively, did not change. All this data corroborates those of the present study, since we also found reductions in the intensity of training, with the subjective

perception of effort being 8.0±1.4 in the pre-lockdown moment and rising to 6.8±2.3 during the lockdown.

Among the studies that investigated different sports modalities, Pillay et al. (2020) sought to describe the perceptions and fitness maintenance of 692 elite and semi-elite South African athletes from 15 sports on their return to training. Most athletes trained alone (61%), daily (61%) at moderate intensity (58%) and for 30–60 min (72%). These data corroborate the data of our study, in that they are similar in frequency and intensity of training, except duration, which in our study most athletes trained between 1 and 2 hours. In this study, the authors also verified that the athletes trained alone, without the support of the technical committees, which is an interesting data, but that was not collected in our study.

The study with the largest sample size found was that of Washif et al. (2022), which evaluated 12,526 athletes of several sports modalities in worldwide proportions (13% world class, 21% international, 36% national, 24% state and 6% recreational). Despite the global scope of the study, Brazilian athletes were not evaluated. In this study, a reduction in the frequency of several training modalities was also observed: only 40% were able to maintain sport-specific training (eg, long resistance [39%], interval training [35%], weight lifting [33%], plyometric exercise [30%]). Corroborating with our data, compared with pre-lockdown, most athletes reported reduced training frequency (between five and seven sessions per week to four or less), shorter training sessions (from ≥60 to <60 min), and lower exercise-specific intensity. sport (~38% reduction), regardless of the athlete's classification. Therefore, the present study that was carried out at a more localized level (of a certain region of a single country) shows similar results to studies that had an international/global scope.

Likewise, other studies with similar characteristics to the present study in terms of region and sample size maintained the same trend. Jagim et al. (2020) examined 105 non-elite athletes from 10 sports from the United States of America. There was a significant decrease in self-reported participation time for strength training (−1.65 ± 4.32 h/week^{-1}), endurance (−1.47 ± 3.93 h/week^{-1}) and mobility (−1.09 ± 2.24 h/week^{-1}), with the greatest reduction coming from the time of participation in specific sports activities (−6.44 ± 6.28 h/week^{-1}). In our study, there was no similar evasion of the practice of the sport, since the interviewees kept practicing their training, but only with a reduction in frequency, volume and intensity among those who practiced greater training loads pre lockdown.

Washif et al. (2021) did a different investigation compared to previous studies, because they investigated the training routine of 76 elite Malaysian athletes, who were training at home, but were summoned to a training camp isolated from the population. The athletes were predominantly (~80%) representatives of Olympic/Paralympic and/or world championships of six Olympic and nine Paralympics sports. Compared to the lockdown, the "quarantine" camp revealed improvements in access to sport-specific training (28.6%), recovery facilities (22,2%), nutritional choices (17.5%), mental (12.4%) and emotional health (11.4%); training motivation (20.0%); and perceived stress (7.4%). These data confirm the deleterious effects that the lockdown brought to the athletes' preparation routine.

The important practical implication of the data from our study and the previous studies that evaluated the impact of the lockdown on the physical training of athletes is that the reduction in the training load may have affected

both sports performance and increased the probability of injury, especially in the return to competitions. In this sense, Radzimiński et al. (2021) observed that professional football players of the Polish league Ekstraklasa showed a decrease in the total distance covered and the distance of high-intensity running after the 81-day block due to COVID-19. An increase in the number of injuries was also observed in professional football athletes from the Premier League (Mannino et al. 2021) and the Bundesliga (Seshadri et al. 2021). Furthermore, studies have also analyzed the mood state and sleep quality (Mon-López et al. 2020a, b, Romdhani et al. 2021, Washif et al. 2021), which are variables that influence sports performance, so that this information is added to better configure the impact of reducing training loads those athletes suffered during the COVID-19 pandemic.

Although this is the first study on the effects of the COVID-19 lockdown on the training of Brazilian athletes, as far as we know, some limitations should be mentioned. The unprecedented social and sports context in which the research was carried out and the lockdown situation was new in relation to the sports training process and additional data would be needed. In addition, the final sample of the study consisted of 52 athletes, which limited the statistical power, interpretations and discussions of this work. In this sense, the results should be considered with caution, mainly due to the sample imbalance that cannot be considered representative of the Brazilian population.

As future perspectives, study designs could consider including more variables in relation to demographic characteristics (level of study, place of residence, social status, etc.), training and recovery conditions (available space, training machines, etc.), mood (motivations, etc.), athletes' sleep quality and diet. On the other hand, an improvement in the systems for monitoring the quantity and quality of training would be desirable to draw more precise conclusions. Furthermore, conducting a longitudinal study covering the pre-, during and post-lockdown periods through various measures could provide information on how such a long period of detraining influences athletes' habits. Finally, larger sample sizes with representative samples of populations would be pertinent.

CONCLUSIONS

The lockdown caused by the COVID-19 pandemic caused a reduction in the weekly frequency of training, volume and intensity of athletes' training sessions, but only in those with higher pre-lockdown training loads. These data are very similar to several others carried out in different countries and with different sample sizes, indicating that the phenomenon observed in Brazilian athletes was the same throughout the world population.

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