

Comparison between mood states, stress and recovery in CrossFit® competitors and non-competitors.

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Abstract:

Currently, there is an increase in the demand for sports and physical exercises, which are the most effective way to promote health, self-esteem and prevent bad habits. In this context, the practice of CrossFit® attracts new practitioners every day, given the expectation of the challenge linked to the practice due to high intensity training, in this sense still, many feel attracted to competitions in the modality. However, high training loads associated with demands can bring changes in the level of stress associated with abrupt changes in mood. Thus, the present study aims to identify and analyze levels of stress and recovery, and the mood of CrossFit® competitors and non-competitors. The BRUMS instrument was used to measure the mood level and the RESTQ 76 to determine the levels of stress and recovery. The results demonstrate that there was a difference between the pre-competitive and competitive periods for the group of competitors for the variables tension ($48.27 \pm 36.36\%$, $p = 0.05$) and post-competition ($79.31 \pm 20.45\%$, $p = 0.002$), intergroup difference during the competitive period for depression [$1380 \pm 180.64\%$, $X^2(2) = 3.961$, $p = 0.05$]; changes in anger were observed during pre-competitive and competitive periods ($247.93 \pm 33.14\%$, $p = 0.041$) for the competitive group, and during the recovery period ($43.38 \pm 27.64\%$, $p = 0.048$), in addition, difference between the analysis groups [$109.45 \pm 34.83\%$, $X^2(2) = 3.116$, $p = 0.043$], vigor showed a significant reduction for the competitor group, and, intergroup difference during the study [$X^2(2) = 4.685$; $p = 0.03$], in addition, there was a difference between groups for confusion ($406.97 \pm 25.98\%$, $f = 4.707$, $p = 0.041$); in the stress analysis, the specific stress showed a difference for the competitor group ($31.15 \pm 15.78\%$, $p = 0.021$), in addition to demonstrating a difference in the analysis between groups ($39.94 \pm 25.54\%$, $f = 7.321$, $p = 0.019$), the global stress in turn, it showed a difference between the groups ($43.77 \pm 36\%$, $f = 5.068$, $p = 0.44$). The data therefore demonstrate that CrossFit practitioners submitted to periods of competition have changes in their mood profile and stress levels when compared to non-competitive individuals submitted to the same training routines.

Key Words: - Mood States; Stress; Recovery; CrossFit; Competitor

Introduction

Currently, there has been a significant increase in people looking for sports and physical exercise practices, as the practice of physical exercise is an effective way to promote health, being also of fundamental importance for the improvement of self-esteem, in addition to be a valuable resource in the prevention of bad habits and in the fight against pathologies related to a sedentary lifestyle (Mandolesi et al., 2018; Tikac et al., 2021).

Within this context, a growing modality is Crossfit®, which has attracted new practitioners every day, as they are short and high-intensity workouts, in addition to being constantly varied, they instigate the practitioner to improve more with each workout, involving different movements and stimuli (Bellar et al., 2015; Wagener et al., 2020). For De Souza et al. (2017), CrossFit® as an activity has been attracting more and more athletes interested in competitions, generally seduced by the adrenaline that the events provide and the discovery of talents combined with the skills developed, in addition to learning self-control and self-confidence.

Current studies demonstrate that a training session is capable of significantly modifying the body functionality process, reducing blood pressure and improving the practitioner's body profile (Barbieri et al., 2019; Gianzina & Kassotaki, 2019), these benefits are derived from high level of physical demand, recruiting the individual's physical capacities close to their maximum performance (Conde et al., 2022; Fernández et al., 2015), due to the design and proposal of the training, where during the session (Workout of a day [WOD]) metabolic movements are required, Olympic weightlifting, and movements similar to everyday life (<https://www.crossfit.com/>). In addition, the regular practice of CrossFit® is associated with positive changes in the subject's behavioral profile, bringing considerable improvements in terms of self-motivation and group interaction, which the practice makes possible (Davies et al., 2016; Dominski et al., 2021).

Although the literature demonstrates the benefits of regular CrossFit® practice, it is exposed that individuals submitted to prolonged high intensity, arising from training, would be more susceptible to harmful conditions (Meyer et al., 2021; Montalvo et al., 2017). And, although it is well described in the literature that high training loads are capable of modifying emotional aspects such as levels of anxiety, stress and mood profile (Selmi et al., 2018; Zanini et al., 2018) there is a lack of evidence related to this for individuals competing in the CrossFit® modality.

The relationship between mood states and sports performance is exposed in the literature, athletes who present a mood state with great changes, may not be able to achieve the best sports performance (Zanini et al., 2018). After the moments of competition, the energetic and emotional demands intrinsic to it tend to change, in primacy to levels lower than the beginning of the competitive period, thus, it is expected that there will be a change in the levels of mood and perception of these athletes, in addition to a considerable increase in fatigue (De Wet et al., 2022; Zanini et al., 2018). Thus, in a study conducted with professional swimmers, it was found that the level of competitive demand associated with training loads, as well as the intrinsic demands of competition, led athletes to a worsening in their behavioral patterns, as well as a significant increase in their stress levels associated with poor recovery (Zanini et al., 2018). In a study carried out with Olympic athletes, it was found that most athletes were in a condition of exhaustion, and that the determinant for the winner would be the ability to control emotional (Brandt et al., 2011). In addition, in a study carried out with dancers, it was observed that the high demand for training during the preparation phases associated with performances were able to modify the dancers' stress levels over time (De Wet et al., 2022). Thus, there is a lack of evidence in the literature that seeks to relate exposure to intense training in competitors of the modality. Thus, the present study aims to verify the effect of the training routine associated with the competitive period in competitors when compared to non-competitors.

Material & methods

Participants

The sample of this study consisted of athletes who perform specific training worksheets aimed at competitions and non-athletes, who do daily and conventional training in the CrossFit® modality, of both sexes, aged between 25 and 40 years, of modalities individual and/or collective. Demographic data can be seen in table 1.

Table 1. Participants demographics.

	General (N=14)	Competitor (N=5)	Non-Competitor (N=9)
Age	36,14 ± 4,6	33,4 ± 4,33	37,67 ± 4,21
Male. (n)	7	1	6
Fem. (n)	7	4	3
Practice Prime (years)	5,41 ± 1,21	6,76 ± 2,54	4,81 ± 0,99

Legend – N – sample size for the variable; male. – male audience; Fem. - female public.

Procedure

Individuals who agreed to participate in the research signed a Free and Informed Consent Term (FICT) which aimed to explain all stages of the study, as well as control with collected data. Practitioners were evaluated individually and objectively, meeting the criteria established in the research, through interviews, with direct questions, mentioned above.

Data collection was carried out over 26 weeks, and the questionnaires were applied every 2 weeks, totaling 13 collections. After obtaining the data, they were allocated according to the period provided for in the calendar, being divided into Period 1 (pre-competitive phase), Period 2 (competitive phase) and Period 3 (post-competition phase). Thus, the averages of the period could be observed, and the data condensed, allowing a better comprehension of the real results obtained.

Instruments

Brunel's Mood Scale (BRUMS)

The Brunel Mood Scale (BRUMS) is an abbreviated version of the Profile of Mood States (POMS) questionnaire (McNair et al., 1971), is composed of 24 indicators that assess mood, such as anger, disposition, nervousness and dissatisfaction. The 24 items are shown in six subscales: anger, confusion, depression, fatigue, tension and vigor, which generate scores between 0 and 16, which are measured on a 5-point scale where 0 = not at all and 4 = extremely. As the questionnaire was validated and translated into Brazil by Rohlf's (Rohlf's et al., 2005).

Recovery-Stress Questionnaire for Athletes (RESTQ 76 Sport)

Composed of statements that indicate the mental, emotional and physical well-being of athletes, the questionnaire was developed to measure the frequency of recovery activities associated with the frequency of the current state of stress, therefore, it evaluates stressful events and recovery phases. with its subjective consequences of the last three days (M Kellmann et al., 2009; Michael Kellmann, 2012). Responses are

represented on a scale of 0 (Never); 1 (Very few times); 2 (Few times); 3 (Half of the time); 4 (Often); 5 (Many times); 6. (Always).

Statistical analysis

To perform statistical analysis, the statistical software SPSS 17.0 for Windows (SPSS Inc., Chicago, IL, USA) was used. The Shapiro-Wilk and Levene test were used to test for normality and homoscedasticity, respectively. Parametric and nonparametric variables are expressed as mean $\pm$ standard deviation and median (interquartile range), respectively. Two-way ANOVA with repeated measures was used to indicate intragroup differences in parametric data. Bonferroni's post hoc test will be used to identify significant data indicated by two-way ANOVA. The Kruskal-Wallis test was used to indicate intragroup differences in nonparametric data. Dunn's post hoc test was used to identify significant indicated by Kruskal-Wallis. Results whose descriptive levels (P values) were less than or equal to 0.05 were considered significant.

Results

The present study aimed to verify, evaluate and compare the stress and recovery scores, mood variation in non-athlete and athlete CrossFit® practitioners during different phases of the competitive period. The study was initially carried out with 22 participants, between men and women aged 25 to 40 years, with a sample loss of 8 participants, as they did not complete all the evaluation phases at the end of the collections, with 14 participants being considered for the final study, of these, 7 men, 6 non-competitors and 1 competitor and 7 women, 4 competitors and 1 non-competitor, as shown in Table 1.

The data obtained about the mood profile are displayed in table 2, the analysis showed that there were changes in tension during the study period, for intragroup (competitor) analysis, between period 1 and period 2 ($48.27 \pm 36.36\%$, $p = 0.05$), and between period 1 and 3 ($79.31 \pm 20.45\%$, $p = 0.002$), no differences in tension were observed in the non-competitive group during the study periods. Intragroup analysis showed no significant changes for depression between study groups, however Kruskal Wallis test showed intergroup difference in period 3 [$1380 \pm 180,64\%$, $X^2 (2) = 3,961$, $p = 0,05$].

When analyzing the data obtained on anger, an intragroup difference was observed for the competitor sample, which showed a reduction in the means between period 1 and 2 ($266.08 \pm 27.28\%$, $p = 0.004$), and period 1 and 3 ($247.93 \pm 33.14\%$, $p = 0.041$), and, for non-competitors, increase in means between period 1 and 2 ($43.38 \pm 27.64\%$, $p = 0.048$), in addition, the Kruskal Wallis test showed an intergroup difference in period 1 [$109,45 \pm 34,83\%$, $X^2 (2) = 3,116$, $p = 0,043$].

In vigor, there was a significant reduction in the means of competitors between period 1 and period 2 ($30.11 \pm 66.32\%$, $p = 0.038$), and between period 2 and 3 ($21.79 \pm 20.96\%$, $p = 0.047$), and, for the non-competitive group, there was an increase in the means between period 1 and 2 ($25.58 \pm 16.5\%$, $p = 0.044$) and between period 1 and 3 ($23.80 \pm 75.01\%$, $p = 0.049$). The Kruskal Wallis test showed that there was a significant difference in the intragroup analysis for vigor during period 2 (competitive phase) between the competitive and non-competitive groups [$X^2 (2) = 4.685$; $p = 0.03$].

There were no intragroup statistical differences for fatigue, although for the competitors the average increased, and in the group of non-competitors there was a reduction in the averages. However, there was an intergroup difference in period 2 ($406.97 \pm 25.98\%$, $f = 4.707$, $p = 0.041$), and in period 3 ($376.88 \pm 24.79\%$, $f = 9.148$, $p = 0.011$).

Table 2. Mood Profile Variables between groups over time.

	Group	Period 1	Period 2	Period 3
Tension	Competitor	5,0 (3 – 11) * **	2,0 (0 – 8)	1,0 (0 – 3) †
	Non-Competitor	2,0 (0 – 7)	1,0 (0 – 11)	3,55 $\pm$ 0,78
Depression	Competitor	2,11 $\pm$ 0,91	2,3 $\pm$ 0,84	3 (0 – 7) †
	Non-Competitor	1,08 $\pm$ 0,86	0,3 $\pm$ 0,61	0,2 $\pm$ 0,62
Anger	Competitor	4,0 (2 – 7) * ** †	1,0 (0 – 4)	1,0 (0 – 5)
	Non-Competitor	2,0 (0 – 8) *	3,0 (0 – 10)	2,0 (0 – 13)
Vigor	Competitor	13,0 (5 – 14) *	14,0 (8 – 16) *** †	13,0 (10 – 16)
	Non-Competitor	10,0 (4 – 16) * **	9,0 (6 – 11)	11,0 (5 – 15)
Fadigue	Competitor	3,61 $\pm$ 0,89	6,54 $\pm$ 1,31 †	5,77 $\pm$ 0,91 †
	Non-Competitor	3,88 $\pm$ 0,63	1,29 $\pm$ 1,77	1,21 $\pm$ 1,21
Confusion	Competitor	2,0 (0 – 3)	1,0 (0 – 4)	0,0 (0)
	Non-Competitor	1,0 (0 – 7)	1,0 (0 – 7)	1,0 (0 – 7)
TMD	Competitor	105 $\pm$ 10,3	93,8 $\pm$ 3,96	90,98 $\pm$ 8,7
	Non-Competitor	102,32 $\pm$ 11,3	108,9 $\pm$ 6,41	105,67 $\pm$ 7,94

Legend – TMD – Total mood disorder; * - Denotes significant difference between Period 1 and Period 2; ** - Denotes significant difference between Period 1 and Period 3; *** - Denotes significant difference between Period 2 and Period 3; † - Denotes significant difference between groups (Competitor/Non-Competitor).

Figure 1 shows the curve of the iceberg profile for the non-competitive group, it is found to be within the ideal at all periods of the study, with low variation. In figure 2, the iceberg profile of the competitor group is observed, in period 1, the curve close to the ideal is observed, with only a slight increase in tension, in period 2, there is a large reduction in vigor, and, the tendency of the other variables to rise, which would demonstrate the tendency of an inversion of the curve over time, however, it is verified that during period 3 the curve recovers, increasing the vigor indices, reducing the other variables, keeping high just fatigue.

Figure 1. Iceberg Profile Over-time – Non-competitor Group

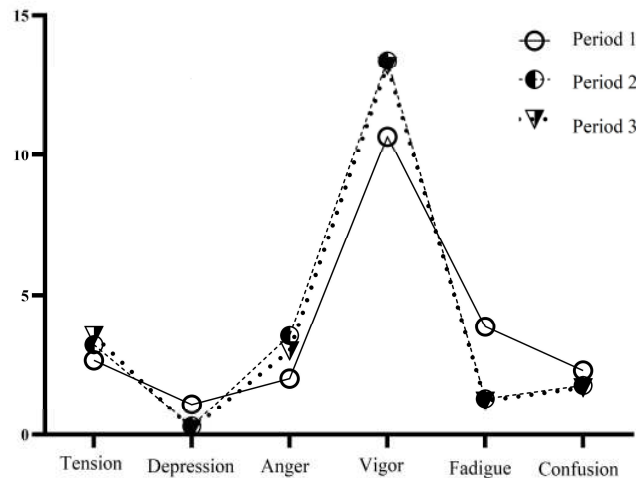
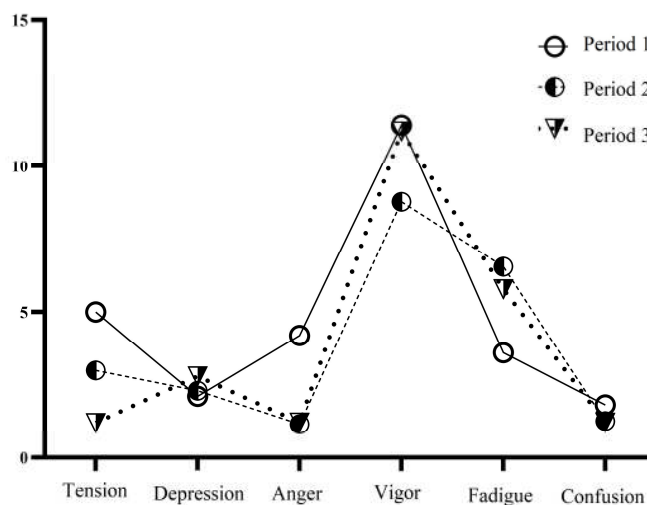


Figure 2. Iceberg Profile Over-time – Competitor Group



In table 3, the athletes' stress and recovery scores are described, the general stress did not show intragroup difference during the study period, in the same way, no significant difference was observed during the intergroup analysis, however, there is a tendency to decrease during the study period. In the specific stress, there is a significant increase in intragroup averages for the competitive group between the period 2 and period 3 ($31.15 \pm 15.78\%$, $p = 0.021$),

In addition to the intergroup analysis, the ANOVA test showed a significant difference between the period 2 (competitive moment) ($39.94 \pm 25.54\%$, $f = 7.321$, $p = 0.019$). In terms of global stress, there was an intergroup difference during the competitive period ($43.77 \pm 36\%$, $f = 5.068$, $p = 0.44$), with no intragroup differences being observed. In the general recovery factor, there was no significant intragroup or intergroup difference, although the means showed reductions during the study period. In the specific recovery, the competitive group showed lower averages when compared to the non-competitive group, especially during the competitive period ($50 \pm 32.14\%$, $f = 4.898$, $p = 0.47$), no significant difference was observed. in the intragroup analysis.

Table 3. Stress and Recovery Scores during Study Periods.

	Group	Period 1	Period 2	Period 3
General Stress	Competitor	2,83 ± 0,21	2,13 ± 0,25	2,45 ± 0,21
	Non-Competitor	2,77 ± 0,28	2,57 ± 0,34	2,23 ± 0,28
Specific Stress	Competitor	2,94 ± 0,38	2,21 ± 0,32 *** †	3,21 ± 0,38
	Non-Competitor	3,95 ± 0,51	3,68 ± 0,43	3,53 ± 0,51
Global Stress	Competitor	2,89 ± 0,23	2,17 ± 0,25 †	2,83 ± 0,26
	Non-Competitor	3,36 ± 0,31	3,12 ± 0,34	2,88 ± 0,35
General Recovery	Competitor	2,75 ± 0,23	2,3 ± 0,28	2,64 ± 0,26
	Non-Competitor	2,77 ± 0,31	2,46 ± 0,37	2,07 ± 0,35
Specific Recovery	Competitor	2,58 ± 0,23	2,1 ± 0,28 †	2,62 ± 0,36
	Non-Competitor	3,18 ± 0,31	3,15 ± 0,37	3,12 ± 0,48
Global Recovery	Competitor	2,66 ± 0,21	2,21 ± 0,23	2,63 ± 0,25
	Non-Competitor	2,97 ± 0,27	2,8 ± 0,31	2,59 ± 0,34

Legend -*** - Denotes significant difference between period 2 and period 3; † - Denotes significant difference between groups (Competitor/Non-Competitor).

Discussion

It is noted that the results found and evaluated by the present study showed significant changes between mood, stress and recovery in the periods evaluated. One of the results that calls our attention is the state of tension in the competitive period of competitors and non-competitors. Thus, it is exposed in the literature that there is a direct relationship between the mood state and the athlete's performance during competitive periods (Brandt et al., 2011; Zanini et al., 2018), one of the main aspects related to this statement focuses on the high energy demands and emotional factors intrinsic to the competitive period (Langan-Evans et al., 2020; Moore et al., 2022).

In addition, other variables such as sleep, rest and rest can influence athletes' vigor and fatigue levels (Doherty et al., 2019; Kölling et al., 2019), thus, the deficient rest associated with high tension can interfere with the athlete's motor control, physically harming him during competition (Schinka & Velicer, 2013). The changes in relation to stress and recovery seen in this study could also be observed in a study carried out with athletes and non-athletes practicing CrossFit®, which evaluated changes in stress levels and mood states in the pre-competitive period (de Oliveira Costa et al., 2017).

However, when analyzing and correlating the results of the tests applied with the literature, it is noted that, if there is a drop, even if imperceptible, in vigor, it leads to a change in fatigue, causing it to rise too much, causing changes in mood. and consequent drop in sports performance. Thus, there must be a balance, regarding the training demands and the general recovery factor, which must be equivalent to the intensity and volume of the work performed, if it is stronger than the previous one, it generates supercompensation, leading to an improvement in performance (Lochbaum et al., 2021; Zanini et al., 2018). In the specific recovery, the competitive group showed lower averages when compared to the non-competitive group, especially during the competitive period, no significant difference was observed in the intragroup analysis. It may thus be related to the rhythm of training and competitions, associated with insufficient recovery, exceeding the athlete's tolerance (Grandou et al., 2020; Oliver-López et al., 2022).

For Caputo et al (2017), in pre-competition periods, high levels of stress can cause recuperative changes, such as sleep impairment, resulting in a reduction in the athlete's performance. Taking these aspects into account, the control and monitoring of load and psychological, emotional and social support could lead all competing and non-competitive athletes to control all the demands characterized as negative, and thus maintain the positive aspects presented in the profile of iceberg of both groups (Zanini et al., 2018).

Thus, it is observed that the findings of this study about the emotional behavior of the competitors are in direct agreement with the findings in the classic study of Jürimäe et al. (2004), who verified the relationship between the increase in training and performance in rowers during competition periods, observed that the increase in training volume, accompanied by a reduction in performance, was correlated with increases in the scores of the stress and reductions in recovery scales. found that there was a reduction in performance in the face of modification of stress-recovery. that is, during the training phases characterized by high loads and long periods of sports charging, the athlete may not correctly meet the necessary demands.

Therefore, since CrossFit is a set of training techniques, and that during its competitions, there is a great level of physical demand, such as strength, muscle power, in addition to a great cardiovascular demand, it becomes essential to control the training loads during the competitive period (Popovych et al., 2022; Tarasova et al., 2020). In this sense, one of the main pillars on which CrossFit focuses are the movements and techniques of Olympic weightlifting, specific studies carried out with weightlifting athletes demonstrate that load control

during the main phases of training are essential for good performance. in competitions due to the high demands that practice brings to the athlete (Popovych et al., 2022; Tarasova et al., 2020).

In our findings we could observe something similar with the assumptions of the literature, there is a direct relationship between the period of competition and the behavioral level of the sample of competitors when compared to non-competitors (Grandou et al., 2020; Zanini et al., 2018). However, it appears that there is a scarcity of studies that directly report the emotional aspect in CrossFit practitioners during a period of competition, therefore, it is necessary to monitor and follow the training load within the modality. In view of this, we attest with our results the need to control the state of mood and stress about the competition. In addition, new studies should emerge in this sense, observing a longer period of follow-up, as well as with larger sample groups, in the most diverse contexts in order to understand the various aspects that can lead to the success or failure of CrossFit® practice, whether for the improvement of the quality of life, as well as in the competitive context.

Conclusions

The findings of the study demonstrated that there was a change in the profile of mood, stress and recovery of the competitors, whereas for the non-competitors, these changes were not observed. These findings demonstrate that although the requirement of training loads are the same for both, when associated with the demands of competition there is a tendency to a worsening of the mood profiles, and an increase in stress, thus, it becomes necessary that the loads of training in this period are better evaluated and adjusted to the reality of the competitor. In addition, new studies must advance in order to understand the best load control, as well as long-term evidence for the competitive and training demands of crossfit competitors, seeking to minimize the effects of the energetic and emotional demands of individuals inserted in competitive contexts.

Conflicts of interest - If the authors have any conflicts of interest to declare.

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