Acute effect of benchmarck crosstrainig associated with physiological parameters and mental skills according to performance

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Research Article

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Abstract

Present study aimed to evaluate the acute effect of cross training benchmarck on the physiological parameters associated with mental abilities according to performance. Thirty-two practitioners were divided according to their performance, Elite Group (n = 07) Advanced Group (n = 10) and Beginner group (n = 15). This research compares groups and pre-WOD and post-WOD. Result showed significance concerning the performance in WOD Fran (E: 177.1±29.8s <A: 314.3±46.8s and I: 538.2±102.1s), total robustness (A: 50.20±5.24 > E: 43.86±7.47 and I: 43.47±5.81) and control (A: 22.20±3.36 > E: 20.14±3.93 and 19.07±3.65), lactate (E: 13.1±1.8mmol <A: 15.1±3.2mmol and I: 16.1±3.7mmol), heart rate (E : 188.0±6.6bpm > A: 174.1±16.1bpm and I: 185.1±8.9bpm), systolic blood pressure (E: 149.7±11.5mmHg <A: 151.0±9.2mmHg and I: 152.5±8.1mmHg), and diastolic blood pressure (E: 73.4±6.2mmHg > A: 72.8±9.6mmHg and I: 69.3±7.1mmHg). Significant correlations in the Elite group in lactate and appearance and systolic blood pressure and choice. Advanced Group significant correlations in WOD time and extroversion, lactate and confidence and heart rate and reading. Beginner Group significant correlations in WOD time and Achievement, lactate and constancy and lactate and flexibility. Present study concluded that about mental abilities, Advanced level athletes showed greater total strength than athletes from Elite and Beginner groups.

Keywords: Mental Resilience, Mental Robustness, Motivation, Cross training, physiological parameters

Introduction

Mental skills are one of the biggest reasons indicated by different sports agents to justify obtaining specific results (Souza & Decussatti, 2017). Mental skills are defined as techniques and strategies designed to teach or improve the skills and abilities that facilitate performance and a positive approach to success in the competition (Ong & Griva, 2017). This study chose to analyze the Mental Toughness, Resilience, and Motivation of cross training practitioners.

Mental toughness is an individuals' ability to handle or control pressure, stress, and adversity, overcome, and overcome failures, regardless of circumstances (Wall et al., 2019). Athletes with more robust mental capacities have the potential to remain calm, relaxed, and full of energy, as they have learned to improve two critical capacities: increased flow, which is a mental state of operation in which the person is immersed in what is doing and the ability to think and have the right attitudes towards deadlocks, pressure, mistakes, and competition (Fitzwater et al., 2018). Mental toughness today is more than a source of resistance that operates in adversity, making it possible to maintain an attentional and motivational focus when things are not going well (Liew et al., 2019).

Resilience, on the other hand, is the individual's ability to adapt to changes and withstand the pressure of adverse situations, finding strategic solutions to face and overcome obstacles (Souza & Decussatti, 2017). It is decision-making when someone is faced with a context between the tension of the environment and the will to win (Souza & Decussatti, 2017). In competitions, athletes face constant pressure and stress; resilience acts as protection, preventing external factors from causing damage (Fitzwater et al., 2018).

Finally, motivation is defined as energy, need, a desire that regulates the direction, intensity, and persistence of behavior, directed towards specific goals (Sibley & Bergman, 2018). Motivation has been one of the most cited concepts among the reasons that justify athletes' success (Sibley & Bergman, 2018). Besides, it is considered an essential element for the permanence and maintenance in a sports activity, being fundamental in the athlete's conduct, as it awakens and maintains adequate activation levels to regulate the performance-oriented behavior (Dominski et al., 2020).

Evidence (Beatty & Janelle, 2019) points out that mental responses affect cognitive functioning, physiological responses, and motor execution mechanisms implicit in performance in various sports fields. For our research, we chose to work with cross training, as it is a complex and varied activity, described as capable of improving aerobic and anaerobic performance (Glassman, 2007). Thus, it is believed that cross training, as it is variable, intense, and acts with functional movements, can bring benefits to mental abilities.

Given the fundamental and complex importance of mental skills in optimal performance (Beatty & Janelle, 2019) is important understand mental skills (toughness, resilience, and motivation) in cross training practice. We believe that inferences can It will be able to provide professionals with various strategies psychological preparation to obtain excellent performance and keeping participants motivated and focused on their training, which can impact their performance. The current literature has not yet found the acute effect of a cross training benchmark on the physiological parameters associated with mental skills according to performance. The present study aimed to evaluate the acute effect of WOD cross training Fran on physiological parameters associated with mental skills (i.e., mental toughness, resilience, and motivation) according to performance.

Materials and methods

Experimental Design

This research is pre-experimental, interdisciplinary, and descriptive (Gil, 2002). We proceeded with an intervention in which the participants were submitted to anthropometric assessments, mental skills, and pre-WOD physiological parameters, and after the practice of the WOD Fran benchmark, the post-WOD physiological parameters were reevaluated. Then, individuals were allocated into groups based on the distribution of performance time in the benchmark. The pre-intervention values were used as a control for the post-intervention values, compared and paired between groups (anthropometric assessments and mental skills) and moments (physiological parameters).

Sample Characterization

A sample of 32 participant's compoused the present study, inhabitants of the city of Governador Valadares (Minas Gerais, Brazil). The groups were divided into Elite (E; n = 07; age: 28.8 years; body mass: 80.0 kg; height: 1.72 cm; practice time: 47.00 months), Advanced (A; n = 10; age: 33.4 years; body mass: 71.7 kg; height: 1.70 cm; practice time: 27.60 months) and Beginner (B; n = 15; age: 30.6 years; body mass: 72.3 kg; height: 1.70 cm; practice time: 22.76 months).

The participants were divided according to their performance in the benchmark execution time as follows: the first group was formed by athletes who performed WOD Fran in up to 239 seconds, being classified as an Elite group; the second group consisted of athletes who

performed the WOD between 240 to 393 seconds, and considered an Advanced group; the third group, formed by athletes who performed the WOD over 394 seconds, being considered a Beginner.

Inclusion criteria for participants: belonging to the age group between 20 and 40 years; regular training routine (minimum three times a week), with at least 12 months of continuous experience; female participant being under hormonal control (use of contraceptive method). Exclusion criteria for participants: People who reported using substances that may alter psychophysiological characteristics in the last three months. The list of substances considered doping by the World Anti-Doping Agency was used; failing to complete one of the proposed tests; be participating in two or more physical activity programs simultaneously.

Instruments and procedures

The research was carried out in the participants' affiliation box, in a separate and organized place for the intervention. All evaluations were performed at night. For the execution of the WOD, the practitioners were instructed to reach the condition of exhaustion, continuous monitoring of the heart rate was carried out and encouragement of voice as modulation of behavior to motivate the participant to execute the WOD.

Avoiding interference from uncontrolled variables during the execution of the WOD, all practitioners were instructed to maintain their usual lifestyle and regular diet before and during the study, and women to maintain hormonal control.

A single evaluator was used per parameter, carrying out training and alignment. Anamnesis and a sociodemographic questionnaire were applied for the evaluations in order to characterize the sample, using the questionnaire containing questions related to age, sex, education, profession, practice time of joining cross training, training frequency/week/day, reasons for choosing the cross training modality (appearance, conditioning, diversion, health, and performance), the reason for staying in the modality (appearance, competition, conditioning, social interaction, diversion, health, and performance), presence of chronic disease, and medication use.

For anthropometric assessment, we used body mass measurement (portable digital electronic scale - Líder P150M®, Araçatuba - Brazil), height (Alturaexata®, Belo Horizonte-Brazil), waist and hip ratio (using a tape measure), skin folds (chest, tricipital, subscapular, suprailiac, middle axillary, abdominal and thigh; measured with the CESCORF adipometer, BRA), and body mass index (Calculated by dividing body mass by square height) (Sheill, 2018).

To assess mental skills, we used the Mental Resilience Scale (Wagnild & Young, 1993) to identify the degree of individual resilience, considering it a personality characteristic that allows psychosocial adaptation to adversity (Codonhato et al., 2018). The calculation of the sample's internal consistency in the research reached a Cronbach's alpha of 0.82.

Mental Toughness Questionnaire (Sheard et al., 2009) refers to mental toughness as the individual's ability to overcome adversity, including self-confidence, commitment, perseverance, and emotions management (Liew et al., 2019; Sheard et al., 2009). The sample's internal consistency in the survey was calculated and found a Cronbach's alpha of 0.88.

Motivation Questionnaires (Frederick & Ryan, 1993) has been applied to identify the reasons for the practice's adherence to physical activity (Gonçalves & Alchieri, 2010). The sample's internal consistency in the survey was calculated and found a Cronbach's alpha of 0.88.

To assess the Physiological parameters, we used Heart Rate measurements using Polar ProTrainer 5, USA (Leal et al., 2019); for Blood Pressure, we used the auscultatory method and using the aneroid sphygmomanometer with the Premium device, Duque de Caxias - Brazil (Leal et al., 2019; Malachias et al., 2016), and Blood Lactate were measured with the Accutrend analyzer® GC / GCT, the USA, in a blood sample from the finger (Zebrowska et al., 2019). All physiological parameters were obtained before and after the intervention of the WOD Fran. An acute intervention was proposed using a WOD Fran benchmark, which is a three-round workout with the repetition scheme, with the general goal of completing the prescribed exercises and repetitions as quickly as possible (Glassman, 2015). The total load used in the Thruster exercise was 43kg for men and 29 kg for women (Glassman, 2015). There was a standardized 5-minute warm-up, which consisted of running around the box and simulating movements at low intensities (~ 60% of HRmax). After 5 minutes of rest, the execution of WOD Fran began.

Statistical analysis

The Shapiro-Wilk and Levene test was applied to verify the normality and homogeneity of the data variance, respectively. The Mauchly test verified the sphericity hypothesis, and when violated, the degrees of freedom were corrected by the Greenhouse-Geisser estimates.

The statistical analysis performed used ANOVA with an independent factor for the mental skills questionnaires, and the range (R) value was included, which is the difference between the lowest and the highest number observed in the mental skills tests. Repeated measures ANOVA (pre-WOD and post WOD) were applied, conducted to compare executive functions and physiological parameters, between moments.

Pearson's coefficient was used to assess interdependence between the variables: personality, mental skills, executive and physiological functions. Correlations were classified as weak ($r = 0.10$ to 0.30); moderate ($r = 0.40$ to 0.60); or strong ($r = 0.70$ to 1) (Paranhos et al., 2014). To assess the questionnaires' internal consistency, Cronbach's alpha was estimated (Gliem & Gliem, 2003).

The data are described as mean (M) and standard deviation (SD). The p-value $\leq$ of 0.05 was adopted as the significance criterion. All analyzes were applied using the Statistical Package for Social Sciences (SPSS 22.0) for Windows.

Results

This research evaluated 32 individuals (62.5% men) who practice cross training. The reasons that led them to practice the sport were: 31.3% health, 28.1% body appearance concern, 21.9% fun, 9.4% physical conditioning, and 9.3% performance. However, to remain in the sport, the goals were: 37.5% funn, 21.9% health, 12.5% social interaction, 9.4% performance, 9.3% competition, 6.3% fitness, and 3.1% body appearance concern.

The Elite group was composed of 21.9% of the participants; the Advanced group 31.3%, and the Beginner group 46.8% of cross training practitioners in the present study.

The description of anthropometric variables: time of execution of WOD Fran, time of practice, and the weekly volume of training for cross training practitioners, is made in means and standard deviation. The variables are stratified by groups, as shown in Table 1.

Table 1 near here

The statistical analysis showed that there is a significant difference in relation to the execution time of WOD Fran ($F_{(2, 29)} = 7.30$; $p \leq 0.001$; $\eta p^2 = 0.802$), in the time of practice of cross training ($F_{(2, 29)} = 8.86$; $p \leq 0.001$; $\eta p^2 = 0.98$) and in the weekly training volume ($F_{(2, 29)} = 6.06$; $p = 0.006$; $\eta p^2 = 0.86$). The Elite group had a better average in the time of execution of the WOD, time of practice of cross training, and the weekly volume of training, in relation to the groups Advanced and Beginner. The results did not reveal significant differences between groups when comparing anthropometric measurements ($p \geq 0.05$ for all other comparisons). In the description in Table 2, we present the assessment of mental skills between the groups, through the questionnaires of toughness, mental resilience and motivation, described in average, standard deviation and range.

Table 2 near here

The statistical analysis showed that there is a significant difference in relation to the dimensions of mental skills, in the total aspects of mental toughness ($F_{(2, 29)} = 4.13$; $p = 0.003$; $\eta p^2 = 0.22$), and in the control dimension ($F_{(2, 29)} = 3.75$; $p = 0.004$; $\eta p^2 = 0.14$). The Advanced group had a better average in the total mental robustness and the constancy factor's dimension compared to the Elite and Beginner groups. The statistical analysis showed no significant difference in the comparison between the groups for the other factors ($p \leq 0.05$ for all other comparisons). However, despite not being significant, we observed that the groups have a high mental control rate, medium constancy, and low confidence concerning toughness. As for resilience, the groups have low mental resilience. According to the motivation, the groups point to the diversion factor and the competition factor to be at cross training.

Table 3 presents the groups' physiological parameters, according to performance, described in mean and standard deviation.

Table 3 near here

The statistical analysis identified a difference in the comparison between the pre and post measurements in all groups for: heart rate ($F_{(1, 29)} = 1091.07$; $p \leq 0.001$; $\eta p^2 = 0.97$), systolic blood pressure ($F_{(1, 29)} = 138.47$; $p \leq 0.001$; $\eta p^2 = 0.83$), diastolic blood pressure ($F_{(1, 29)} = 31.35$; $p \leq 0.001$; $\eta p^2 = 0.52$), and blood lactate ($F_{(1, 29)} = 318.19$; $p \geq 0.001$; $\eta p^2 = 0.92$).

In Table 4, we present the correlations of the physiological parameters associated with the cross training participants' mental skills according to performance.

Table 4 near here

There was a significant correlation between mental skills associated with physiological parameters in the Elite group. The associations were strong and positive for competition factor and systolic blood pressure ($p = 0.03$), appearance factor, and blood lactate ($p \leq 0.001$); proved to be strong and negative for social factor and WOD execution time ($p = 0.02$), constancy factor and systolic blood pressure, constancy factor and diastolic blood pressure ($p = 0.04$). The other variables, when associated, did not show significant correlations ($p \leq 0.05$).

There was a significant correlation between mental skills associated with physiological parameters in the Advanced group. Concerning the Advanced group, there was a strong and negative correlation in the factors confidence and blood lactate ($p = 0.02$); moderate and positive correlation in the total resilience and in the execution time of the WOD ($p \leq 0.001$). For the other variables, there were no significant correlations ($p \leq 0.05$).

There was a significant correlation between mental skillss associated with physiological parameters in the Beginner group. The group showed a strong and negative significant association for constancy and lactate ($p = 0.04$). There was a negative and moderate correlation in total robustness and lactate ($p \leq 0.001$), total motivation and lactate ($p = 0.04$), competition factor and lactate ($p = 0.03$, health factor and lactate ($p = 0.04$), social factor and lactate ($p = 0.03$). For the other variables, there were no significant correlations ($p \leq 0.05$).

Discussion

To date, there are no studies that address the acute effect of a cross training benchmark about the physiological parameters associated with mental skills (Dominski, Serafim, et al., 2019). Understanding the importance of these mental skills for performance is one more component of preparing the high-performance athlete (Fletcher & Sarka, 2016). Therefore, the present study verified WOD cross training Fran's acute effect on physiological parameters associated with mental skills according to performance. Regarding the reasons that led practitioners to join cross training, we found in the sociodemographic questionnaire data that indicate health as the main reason (31.3%), followed by body appearance concern (28.1%) and fun (21.9%). A study like the one by Sibley and Bergman (2018) affirms that the adherence and motivation to practice the cross training modality include individuals from different groups such as obese, healthy, and athletes, and the number of people as a limitation to the practice of this modality for each group compared.

However, the reason for staying at cross training indicated that 37.5% of the practitioners aim for more fun activities, 21.9% seek to improve health, and 12.5% practice the modality for social interaction. The data presented corroborate those of previous authors (Tibana et al., 2015; Dominski et al., 2020), which point to a relationship between the challenging character and the motivation for staying and adhering to the modality - with higher levels of social relations, satisfaction, and behavioral regulation. These findings indicate that professionals seek strategies to increase practitioners' adherence and permanence in the cross training modality.

The grouping of participants, occurring according to the performance time in WOD Fran, the Elite group (177 sec) concluded the benchmark with a shorter time than the Advanced group (314 sec) and Beginner group (538 sec). This difference could be associated with technical performance and physical fitness, developed with practicing the modality, which consequently improves your training's final time (Glassman, 2015).

Regarding mental toughness, the Advanced group showed a difference concerning the Elite and Beginner groups and the control factor when compared between groups. We believe that the Advanced group was more motivated in the sport at that time, concerning the change of level, aiming to achieve a better classification, becoming mentally stronger and controlled. We found that the Advanced group was more focused on executing the WOD with precision, already Elite just accomplished the task without much effort. We observed that individuals who have a significant increase in mental toughness are more likely to perform well in the sport they practice (Ong & Griva, 2017).

When correcting the questionnaire, we found a high index of mental control, moderate constancy, and low confidence, corroborating the systematic review that found mental toughness as one of the best-classified psychological characteristics in the performance of more successful athletes (Liew et al., 2019). Hence, the need to improve mental robustness, incorporating it as an essential element in training to obtain higher sport performance levels in cross training.

A fact to note is that all groups showed low mental resilience. We understand the importance of mental resilience in the sports context, as athletes must use and optimize various mental skills to withstand the pressures they experience (Fletcher & Sarkar, 2016). In this research, taking into account the data collected, we suggest that athletes with low mental resilience carry out a systematic training program to develop it to succeed.

Regarding motivation between groups, we can see in Table 7 that there was no difference between them. The three groups' profiles indicated that motivational interests are linked to factors such as diversion and competition. It is well known that a cross training activity presents these reasons in their daily workouts, which corroborates the study by Dominski et al. (2019), who describe cross training as general physical conditioning, with characteristics that favor motivation and the permanence of its practitioners in this modality.

Present results suggest that professionals should pay attention to the perceptions of the motivational climate and group exercises' objectives. These differences can motivate, encourage, and instruct cross training practitioners more effectively, particularly in what they do. It is about setting goals that more effectively address your stay at cross training.

The physiological parameters data showed differences in the pre and post-WOD comparisons between the three groups. There was a difference in the heart rate variable before and after WOD, with an increase of approximately 95% of HRmax. Studies report that the response to stress results in reactions that occur the interaction of the endocrine, immune and nervous systems through chemical mediators. The Sympathetic Autonomic Nervous System is the adrenergic or excitatory, releases adrenaline and norepinephrine that act in receptors and are mediators of adrenaline and norepinephrine stimulatory action on smooth muscle. A receptors promote vasoconstriction while β promote vasodilation and increase heart rate (Fonseca et al., 2015).

Blood lactate had an increase above 100%, which may be related to satisfaction in carrying out the activity or reaching the goals, thus ignoring the high level of lactate and fatigue common among athletes. In the study by (Perciavalle et al., 2016), we can see who reports that, during an exhaustive exercise, there is an increase in blood lactate, an expression of performance intensity instead of muscle fatigue.

There was a significant increase in systolic blood pressure and a decrease in diastolic blood pressure. Due to the increase in the SNS and the need to increase cardiac output to perform the task that involves large muscle groups and oxygen demand, much research has been done in the literature about physical exercises and their impact on the physiological mechanisms that regulate blood pressure, such as, baroreflex, autonomic actions on heart rate, stroke volume, peripheral vascular resistance, cardiac output, due to changes in cardiac muscle contraction, with a resulting increase in systemic vascular conductance with the possibility of extending this reduction for up to 24 hours (Materko et al., 2020).

Taking into account the mental skills, the Elite group stood out from the others, presenting a strong and negative correlation between the time of execution of the WOD about the characteristics of the social factor, indicating that they are more socially dependent and with tendencies to judgment, who seek excellence in its results. The strong and negative association with SBP and DBP before and after WOD with a characteristic of the constancy factor, revealing that emotionally constant people tend to have lower BP in the pre and post-exercise; they cope better with stressful situations. A strong relationship in the pre SBP with the competition factor is characteristic of more competitive people and tends to present symptoms that increase BP, using the stressful situation in their favor as a propelling spring.

Kaiseler et al. (2019) indicated that athletes mentally more resistant tend to report stressors as less intense and perceive more significant control over the stressors. Activities that demand high levels of mental stress and attentional processing can reduce parasympathetic tone and homeostatic changes (Kim, 2015). These results corroborate investigations in which complex interactions between the sympathetic-parasympathetic systems occur when participants perform tests that demand states of attention and acute psychological stress.

We found in the Elite group an association between lactate and appearance factor after WOD, pointing out that individuals concerned with appearance probably have more resistance to pain; reach their extreme to achieve their goals related to the body. As we have not found studies on the appearance and dependence of exercises in intensity and volume, we indicate future studies' theme.

On the other hand, the Advanced group showed a strong association in the execution time of the WOD with a character in the total resilience, suggesting that resilient people develop the execution of WOD with a longer duration. There was also a correlation with high lactate and the characteristics of the low confidence factor, indicating the need for prescription of mental training to increase the athlete's confidence, as highlighted by a study by Fortes et al. (2017), on the effectiveness of the associated mental practice physical training.

Finally, the Beginner group showed a negative and moderate correlation in pre-WOD lactate and total toughness, total motivation, competition, health, and social factors. The athletes' success depends on the combination of physical, tactical, technical, and psychological factors. The psychological factor is usually the determinant that differentiates a winner (Codonhato et al., 2018).

Conclusion

Regarding mental skills, Advanced level athletes showed greater total strength than Elite and Beginner athletes. There was no difference between groups in resilience and motivation. However, studying the cross training athlete's mental skills is essential to understand and develop strategies and techniques to improve their sports performance. Thus, we infer that implementing mental training with a focus on toughness, resilience, and motivation is indicated for a better performance of athletes, expanding confidence (toughness), the ability to recover after failures (resilience), persistence or refusal in give up and stay focused (motivation) in the face of potential distractions.

The research stands out for physical training when it finds that the physiological effects of mental skills help in the construction and knowledge of the athlete's training profile. Thinking about the individual in its entirety proposes work in conjunction with physiological and psychological issues to affect the athlete's performance. These data can be used to know a little more about the athlete and rethink skills to train and increase performance.

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