06 - LEVELS OF BLOOD LACTATE AND VO2MAX IN CROSSFIT ATHLETES

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INTRODUCTION

Currently, a considerable part of the population has included physical exercise in their daily activities, this is notorious in academies, sport centers, clubs and even in public squares, people in search of a healthier life (Silva et al., 2017). Studies have also shown that regular physical training improves the physical and psychological conditions of an individual, such as reducing body fat and the risk of cardiovascular disease, glycemic control and elevating self-esteem (KHAWALI, ANDRIOLO; FERREIRA, 2003).

According to a study done by Lima and Silva (2017) in the city of Curitiba-PR, among the exercises most practiced, there are walking, bodybuilding, soccer and cycling. However, the modality called Crossfit has been practiced in gyms or in open air places where group exercises are carried out, making this practice effective due to the collective aspect as it is performed, contributing to a better development through the environment and motivation of participants (SCIENTIFIC CULTURAL INTERINSTITUTIONAL MEETING, 2014).

In order to improve the performance of its practitioners, the CF was created in 1995 by Greg Glassman, a method of physical training that works with high intensity, seeking to prepare the practitioners of this modality for any type of physical activity, with varied and high intensity functional movements. The trainings used in this modality were initially developed for the preparation of military personnel, police and firefighters, who need good physical fitness and muscular strength (RIOS, 2018). Subsequently, this method became popular in obese, sedentary and athletes of different modalities (GLASSMAN, 2007). According to the author, the exercises applied in the CF develop gymnastic movements that improve the control of the body in movement and statically. Emphasis is also given to the Olympic weightlifting by developing power and motor control. Glassman (2003) further states that in this method there is the possibility of improving VO2max performance, lactate threshold, body composition, strength and flexibility.

An example of training used in CF it´s “Filthy Fifty”, which consists of performing 50 repetitions of 10 different exercises in the shortest possible time. This type of training requires the athlete to have good aerobic, anaerobic and muscular conditioning (BUTCHER et al., 2015). Mcardle et al. (2015), states that athletes practicing aerobic modalities generally reach values of VO2max almost twice from those of sedentary people.

VO2max and the production or accumulation of blood lactate levels are metabolic alterations that occur during the practice of high intensity exercises and are essential in the evaluation of the performance of an athlete. For a long time, it was believed that the accumulation of lactate in the blood was responsible for muscle fatigue, but recent studies state that part of the lactate produced by the muscle in action can be retained by this muscle and used as energy metabolite (MILLER, 2015; POWERS; HOWLEY, 2014).

For Silva (2011), lactate is the result of the metabolism produced during the process of glucose or glycogen breakdown, and that part of the lactate produced by the active muscle is used as energy source and the rest that is not used in the muscles, is diffused into the bloodstream, and can be dosed in several ways.

One of the tests that is widely used by researchers to verify the VO2max is the Cooper test of 12 minutes, it is practical and cost-free, the evaluated must walk or run for 12 minutes without interruption (COSTA et al., 2007). The individual's VO2max is a reproducible measure of the cardiovascular system's ability to carry oxygenated blood into the large muscle masses involved in dynamic work (POWERS; HOWLEY, 2014).

In this sense, the objective of this study was to investigate the immediate acute responses of blood lactate and VO2max of CF athletes, in view of the fact that this modality has gained space in large urban centers, it is up to us, researchers, to clarify how our organism reacts to a training of high intensity.

METHODOLOGY

The sample of this study was formed by seven adults apparently healthy, between 18 and 35 years of age, being four males and three females, all practicing the Crossfit modality in the city of Foz do Iguaçu-PR, with at least one year of practice and frequency least five training sessions per week. All participants were instructed to fill out an anamnesis form prepared by the researchers, who were informed of the characteristics and purpose of the study and the Free and Informed Consent Term. Were excluded from the study sample, individuals that had any type of lesions, any disease that could compromise health during the test, or missed any stage of the study.

Initially, an anthropometric evaluation was performed to obtain weight and height. On two non-consecutive days, subjects were submitted to the Workout of the Day (WOD), a specific Crossfit training called "Filthy Fifty", it was held at the participant's home branch, under the supervision of a Level 1 CrossFit instructor, to ensure that the patterns of movement and training were fulfilled. All participants perfomed the prescribed exercises without modification or scales. This training consisted of performing 50 repetitions of each of the 10 movements in the shortest possible time, according to table 1.

Table 01. WOD *“Filthy Fifty”*

50 BOX JUMPS (60cm man/50cm woman)
50 JUMPING PULL-UPS
50 Kettlebell Swings (16kg man/12kg woman)
50 Walking Lunges
50 Knees-to-Elbows
50 Push Press (20kg man/15kg woman)
50 Back Extensions
50 WALL BALLS (9kg man/6kg woman)
50 Burpees
50 Double-Unders

Source: Mens Journal, 2018

To evaluate the efficiency of the cardiopulmonary and vascular system, or VO2max, the Cooper's 12-minute test (COSTA et al., 2007) was used. For the time control a chronometer (model CronobioSW2018, Brazil) was used. The test was applied by the researchers themselves in an official athletics track, previously marked with a cone and bounded every 20 meters of distance (occupying the entire track), where after a brief warm up the individual ran for 12 minutes interruptions.
Lactate dosage was performed in duplicate by one of the researchers, through the collection of a drop of blood by digital pulp (ring finger), punctiform puncture using lancets (Accu-Chek Safe-T-Pro Uno Roche) and a standardized lactometer (Accutr Plus Roche), revealing the athlete's ability to perform anaerobic exercise.
For the collection of anthropometric data, the subjects had their total body mass evaluated by a scale (model Omrom HBF-514C) with capacity up to 150 kg. Stature through a 210 cm compact stadiometer (model Wiso, Brazil).

RESULTS AND DISCUSSION

As we can observe in table 2, we have represented the profile of the variables of the athletes who participated in the present study:
Table 2. Profile of Athletes Practicing the CF Modality

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Variables	Men (n = 4)	Women (n = 3)
Age (years)	25,5 ± 6,45	29,66 ± 5,13
Stature (cm)	174,5 ± 10,6	172 ± 8,88
Weight (kg)	73,25 ± 9,94	66,2 ± 3,9
Practicing Time CF modality (years)	2,27 ± 0,86	2,66 ± 1,3

Results expressed as mean ± standard deviation; Significance level p ≤ 0.05.

Table 3, shows the mean lactate concentration levels before and after the WOD, we can analyze that there was a high concentration of lactate after the training. A similar study by Deminice et al. (2007), found a similar result in his study, where the tolerance of acidosis was determined in swimmers at intervals of 100 meters, 200 meters and 400 meters, in which the mean blood lactate concentration was 13.5 mmol / l.

Table 3. Levels of Lactate (mmol / l) Pre and Post WOD "Filthy Fifty", Cooper Test and VO2Max

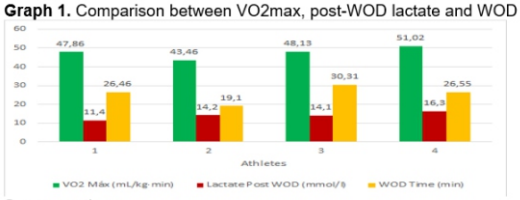
Variables	Men (n = 4)	Women (n = 3)
Pre WOD Lactate	3,35 ± 0,55	2,5 ± 0,5
Post WOD Lactate	14 ± 2	12,1 ± 3
Cooper Test (meters)	2647 ± 140,27	2484,3 ± 286,7
VO2Max (mL/kg·min)	47,61 ± 3,12	44 ± 6,37

Results expressed as mean ± standard deviation; Significance level p ≤ 0.05.

Analyzing the results of graph 1, on the aerobic test and comparing with the table of aerobic capacity level of Cooper, it can be stated that the men obtained an excellent performance, since, the table establishes as excellent results comprised in the interval between 2650 and 2830 for men aged between 20 and 29 years.

Now, looking at graph 1 we can analyze the results of VO2max, lactate post WOD and the time spent in training of the male segment:

Graph 1. Comparison between VO2max, post-WOD lactate and WOD runtime (Men)



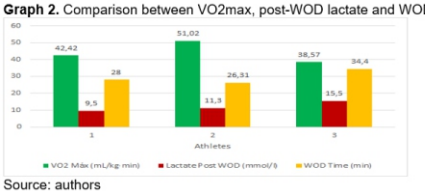
Source: authors

Observing the values obtained in this table, the VO2Máx of the athletes was not significantly different when compared to each other, however there was a considerable discrepancy in relation to the execution time of the WOD.

According to Weineck (2003), in the training process, in addition to progress in physical performance factors, technical competence is also required. Thus, the lack of development of the technique may affect the evolution of the physical potential, preventing the athlete from reaching its potential for performance. As observed in graph 1, the second athlete presented the lowest aerobic performance in the Cooper test, concluding with the VO2max of 43.46 mL / kg.min. In the WOD "Filthy Fifty", he was the first to finish the training with a reasonably large difference of 7.36 minutes for the second positioned. n hypothesis, it can be affirmed that the athlete 2, presents a deficiency in the technical quality of race.

Analyzing graph 2, we can observe that the women presented a result that is classified as superior when compared to the Cooper aerobic table, because the average reached is greater than 2330m for the age group of 20 to 29 years. Regarding WOD time and blood lactate accumulation, when compared to each other, it can be observed that Athlete 3 had a higher concentration of blood lactate and a lower perfomance level when performing the WOD as compared to the other athletes.

Graph 2. Comparison between VO2max, post-WOD lactate and WOD runtime (Women)



Source: authors

Also, it is observed that Athlete 3 of figure 2, used much more the anaerobic energy system, reporting a higher level of intensity when compared to the other athletes. Thus, the blood lactate concentration (which may be high or low) becomes an indication of how each energy system is used (TEODORO, 2013).

CONCLUSION

In the present study, acute responses at rest, immediately after WOD and the Cooper test were analyzed. According to the results, it was evident that after WOD there is a significant increase in blood lactate levels, this high concentration of lactate means that they accumulated a great amount of energy produced by the anaerobic system, since the training for the most part used the anaerobic glycolytic pathways.

In relation to the VO2Máx level, we can conclude that the practitioners of this modality, under these conditions, have an excellent aerobic capacity when compared to the Cooper aerobic conditioning table.

Therefore, future studies are needed to demonstrate more findings of acute physiological responses in high-intensity workouts such as the CF, analyzing a larger sample, comparing training time, and verifying the subjective perception of effort.

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SUMMARY

The Crossfit® is a model of physical training that works with high intensity and involves several muscle groups during the variety of its exercises, so, the objective of this research was to evaluate the performance of athletes of (CF) after the "Workout of the Day" (WOD) specific of the method, through the levels of lactate pre and post-training and maximum oxygen volume (VO2max). The research consisted of seven athletes aged between 18 and 35 years, CF practitioners for at least twelve months, with a training frequency of at least five times a week. The research methodology was based on the collection of anthropometric measurements, such as weight and height, and the Cooper test. The WOD was the "Filthy Fifty" and the dosage of lactate obtained in duplicate by one of the researchers, through the collection of a drop of blood from the digital pulp of the ring finger revealing the athlete's ability to perform a physical exercise anaerobically. Analyzing the results of the Cooper test, we found that men achieved excellent aerobic performance, and women superior. As for lactate there was no significant difference compared to each other, but when compared to other sports, such as swimming for example, in the WOD, lactate concentration was higher. Due to the mentioned facts, we can conclude that the athletes accumulated a great amount of energy produced by the anaerobic system in the training. And in relation to VO2max, it was verified that they have an excellent aerobic fitness when their results were compared with the Cooper table.

Keywords: VO2; Lactate; Crossfit

RÉSUMÉ

Crossfit® est un modèle d'entraînement physique qui fonctionne avec une intensité élevée et implique plusieurs groupes de muscles au cours de la variété de vos exercices, étant ainsi, l'objectif de cette recherche était d'évaluer la performance d'athlètes de (CF) après un entraînement "Workout of the day" (WOD) spécifique à la méthode, par les niveaux de lactatepré et post-entraînement et le volume maximal d'oxygène (VO2max). La recherche portait sur sept athlètes âgés de 18 à 35 ans et des praticiens des CF depuis au moins douze mois, avec une fréquence d'entraînement d'au moins cinq fois par semaine. La méthodologie de recherche reposait sur la collecte de mesures anthropométriques, telles que le poids et la taille, et le test de Cooper. Le WOD appliqué était le "FilthyFifty" et le dosage de lactate obtenu en double par l'un des chercheurs, grâce à la collecte d'une goutte de sang de la pulpe digitale du doigt afin de révéler la capacité de l'athlète à effectuer un exercice anaérobie. En analysant les résultats du test de Cooper, nous avons constaté que les hommes obtenaient d'excellentes performances aérobiques et les femmes supérieures. En ce qui concerne le lactate, il n'y avait pas de différence significative les uns par rapport aux autres, mais par rapport à d'autres sports tels que la natation, par exemple, dans le WOD, la concentration en lactate était plus élevée. En raison des faits mentionnés, nous pouvons conclure que les athlètes ont accumulé une grande quantité d'énergie produite par le système anaérobie pendant l'entraînement. Et par rapport à VO2max, il a été vérifié qu'ils avaient une excellente capacité aérobique lorsque leurs résultats étaient comparés à ceux de la table de Cooper.

Mots-clés: VO2; Lactate; Crossfit

RESUMEN

El Crossfit® es un modelo de entrenamiento físico que trabaja con alta intensidad e involucra a varios grupos musculares durante la variedad de sus ejercicios, siendo así, objetivo de esta investigación fue evaluar el desempeño de atletas de (CF) después de un entrenamiento “Workout of the day” (WOD) específico del método, a través de los niveles de lactato pre y post-entrenamiento y volumen de oxígeno máximo (VO2Máx). La investigación consistió de siete atletas de edad entre 18 y 35 años, practicantes de CF por al menos doce meses, con una frecuencia de entrenamiento de al menos cinco veces por semana. La metodología de la investigación fue basada en la recolección de medidas antropométricas, como peso y altura, y la realización de la prueba de Cooper. El WOD aplicado fue el "FilthyFifty" y la dosificación de lactato fue realizada en duplicado por uno de los investigadores, a través de la recolección de una gota de sangre de la pulpa digital del dedo anelar revelando la capacidad del atleta en realizar un ejercicio físico de manera anaerobia. Analizando los resultados de la prueba de Cooper, verificamos que los hombres obtuvieron un desempeño aeróbico excelente, y las mujeres superior. En cuanto al lactato no hubo diferencia significativa si se comparan entre ellos, pero cuando comparado con otros deportes, como la natación por ejemplo, en el WOD la concentración de lactato fue mayor. En virtud de los hechos mencionados, podemos concluir que los atletas acumularon una gran cantidad de energía producida por el sistema anaeróbico en el entrenamiento. Y en relación al VO2Máx, se verificó que poseen una aptitud aeróbica excelente cuando sus resultados fueron comparados con la tabla de Cooper.

Palabras claves: VO2; lactato; Crossfit

RESUMO
O Crossfit® é um modelo de treinamento físico que trabalha com alta intensidade e envolve vários grupos musculares durante a variedade de seus exercícios, sendo assim, objetivo desta pesquisa foi avaliar a performance de atletas de (CF) após um treino "Workout of the day" (WOD) específico do método, através dos níveis de lactato pré e pós-treino e volume de oxigênio máximo (VO2Máx). A pesquisa consistiu-se de sete atletas com idade entre 18 e 35 anos, praticantes de CF no mínimo doze meses, com uma frequência de treino de pelo menos cinco vezes por semana. A metodologia da pesquisa foi baseada na coleta das medidas antropométricas, como peso e altura, e a realização do teste de Cooper. O WOD aplicado foi o "Filthy Fifty" e a dosagem de lactato foi realizada em duplicata por um dos pesquisadores, através da coleta de uma gota de sangue da polpa digital do dedo anelar revelando a capacidade do atleta em realizar um exercício físico de maneira anaeróbia. Analisando os resultados do teste de Cooper, verificamos que os homens obtiveram um desempenho aeróbico excelente, e as mulheres superior. Quanto aos níveis de lactato não houve diferença significativa se comparados entre eles, mas quando comparado com outros esportes a concentração de lactato foi maior no WOD em relação a natação por exemplo. Em virtude dos fatos mencionados, podemos concluir que os atletas acumularam uma grande quantidade de energia produzida pelo sistema anaeróbico no treino. E em relação ao VO2Máx, foi verificado que eles possuem uma aptidão aeróbica excelente quando seus resultados foram comparados com a tabela de Cooper.
Palavras-chaves: Crossfit ; VO2; Lactato