Physiological and Psychological Tests Involving a Professional CrossFit Athlete: A Case Report

Arthur M. Zecchin-Oliveira[1*], Luis Armando Gomes Alesse da Costa[2], Enrico F. Puggina[1,3]

[1]Ribeirao Preto Medical School, University of Sao Paulo, Brazil
[2]Strength and Conditioning Coach, CrossFit Ribeirao Preto, Ribeirao Preto, Brazil
[3]School of Physical Education and Sport of Ribeirao Preto, University of Sao Paulo, Brazil

Corresponding author: Arthur M. Zecchin-Oliveira, Ribeirao Preto Medical School, University of Sao Paulo, Brazil. E-mail: arthurmzo@hotmail.com

Introduction

CrossFit is a high intensity training program designed to improve performance and health [1,2]. Although the popularity of CrossFit training and the increase of studies involving physiological and psychological parameters in CrossFit practitioners, case reports CrossFit regarding high level athletes still scarce. Most of the studies involving CrossFit athletes were devoted to understand injury indexes [3-9].

Recently, Martínez-Gómez et al. [10], investigated performance in multiple workout trainings. The physiological parameters were correlated and the researchers found high correlation between VO_{2max} and workout performance ($R^2 = 81.7\%$, p = 0.001). These physiological results can be useful as a test for predict CrossFit performance. The importance of evaluating athletes before competitions is fundamental in training prescription and adjustments. Here is reported a case of a elite master athlete and the physiological and psychological parameters in the specific preparation phase (2º phase of the training program), preceding an international competition.

Case Report

Miss Ferreira, 42 years old, 64kg, 160cm, married and daily training routine of 2 hours, including weekends. At the moment of data collection she was healthy, without any injury or physiological impairment. And a regular 28-30 day menstrual cycle. Additionally, she was the winner of 2018 Brazil CrossFit Tournament (the main CrossFit competition in Brazil) and she classified to the Regionals, that leads to CrossFit Games, an international competition in 2019.

First, the participant wore light clothing and removed all jewelry to undergo whole-body DXA scanning (GE-Lunar iDXA, GE Healthcare, Madison, WI). GE-Lunar enCORE™ software (version 15) was used to determine body fat percentage, lean tissue mass, bone density, waist-hip index, relative skeletal muscle index, resting metabolic rate and visceral fat mass [11].

After 24 hours, she performed an incremental cycling test in the specific CrossFit cycle ergometer. The test basically comprehends of a warm up at low intensity for 5 minutes, after the warm up, the 30 seconds sprint all out is done, then recovery of 8 minutes and then incremental cycle starts at 150w, and every three minutes 25 watts is implemented until the failure. This test aimed to find the maximal lactate steady state (MLSS) through the glycemic curve using glycemic minimum test (Figure 1). This test was validated before [12,13]. Capillary blood samples (25μl) was extracted from the aseptic earlobe and collected in the G-Tech analyzer (G-Tech Free lite, Korea).
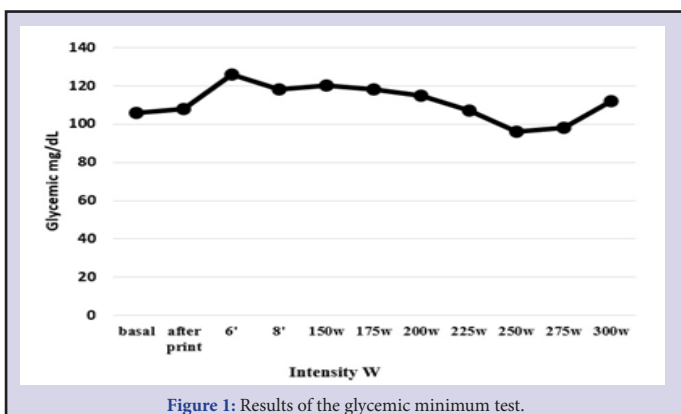

Figure 1: Results of the glycemic minimum test.

Note: Glycemic concentration was taken in basal state, before the warm up and after the first measure, then the participant cycled 5min in cadence of 3 in Rating Perceived Exertion (RPE). After the warm up, the participant performed 30 seconds of all out sprint, right after the performance finished, glycemic sample was taken. The participant kept sited quietly for 8min, in the 6th and 8th min the glycemic sample was taken. after 8min, the participant started the incremental protocol, beginning the cycle using 150w, increasing 25 watts every 3 minutes until the exhaustion. At the end of each stage the glycemic samples were taken. The minimum glycemic level found was considered the MLSS.

After 48 hours, the participant performed the 1RM test for back squat using the Fleck & Kraemer protocol [14].

After 48 hours the previous test the participant performed the training section called "Cindy", which is very popular between CrossFit practitioners [15]. The workout consists of 20 minutes of rounds of five pull-ups, ten push-ups and fifteen body weight squats. The score is quantified by the number of reps performed in 20 minutes. The Counter Movement Jump (CMJ) was used to analyze power and fatigue 5min before and 5min after the training section. The CMJ was performed using an optical mat and the software Jumpsystem Pro® (CEFISE, Rio Claro, Brazil), proposed by Bosco et al., [16].

The well-being questionnaire was conducted 1 hour before the protocol. This questionnaire was used to monitor the psychological aspects of daily life and it is widely used by strength and conditioning coaches [17]. There are five questions about the athlete's life in the questionnaire, the possible answer for each question ranges from 1 to 5. As low is the sum of the answers, more stressed is the athlete (indicating non-functional overreaching).

Results

The aim of this case report was to observe physiological and psychological parameters in a CrossFit athlete, in the 2º phase of the training program. The main finding is exposed below.

The athlete provided written informed consent, and the study methods and protocols were approved in advance by the Research Ethics Committee of the School of Physical Education and Sport of Ribeirão Preto/USP (CAAE: 13353719.4.0000.5659). All the experiments are according with the current legislation (Helsinke declaration).

The results of the Well-being questionnaire indicated possible psychological stress (the sum of the score reported was 9).

All the tests were performed in the second week of February 2021, during 1 week. The results are showed in table 1 and 2.

Table 1: Anthropometric characteristic.

Anthropometric data	
BMI (Kg/m²)	24
Body Fat (%)	18.6
Bone Density (g/cm²)	1.498
Waist-Hip Index (waist (cm)/hip (cm))	0.58
Relative Skeletal Muscle Index (kg/m²)	9.27
Resting Metabolic Rate (cal/day)	1467
BMI: Body Mass Index.	

Table 2: Physiological results.

Tests	Results		Interpretation
Glycemic minimum test, MLSS (watts)	250		250w corresponds to 4mmol/L of lactate (lactate threshold)
1RM (kg)	160		Maximum weight lifted using legs in back squat
1RM relative (1RM/ Body weight in Kg)	2.5		-
Workout training (repetition)	703		Total of repetitions performed in 20 minutes
CMJ (cm)	Pre: 33.92	Post: 34.18	There was no loss of performance in the lower limbs after the workout training

Discussion

The overall results showed that the athlete was considered strong for back squat repetition maximum, since her results was considered very good when compared with a study evaluating 1RM in CrossFit athletes [18].

The intensity obtained at MLSS through glycemic minimum test in the athlete was considered good as much as our investigated group researched other women athletes, and them reported lower values using the same protocol (data not published). We can infer that the participant reached very good values (250w) compared to professional cyclists using the same protocol (there is no studies using this method in CrossFit participants), demonstrating that the anaerobic threshold is good enough to the international competition [19]. Although this result, the air assault bike used to cycle in CrossFit is different in multiple ways when it is compared with cycle ergometer.

The reached workout training score obtained was 703 repetitions which is considered above a previous study involving CrossFit athletes [20]. The CMJ achieved was not high considering the athletic level of the participant, but the results did not show any impairment comparing power in pre- and post-training session. The athlete was not used to do this test protocol, so there is the motor learning effect that must be said here. It was found higher values of CMJ after the workout, probably due the post-activation potentiation. The continued muscle contraction in the workout session influenced the mechanical performance positively.

There were two tests that must have attention:

1. The body fat was considered "high" considering the athlete level, according previous study [18]. Although this value, the iDXA is considered the gold standard to evaluate body composition, and this equipment can evaluate even intra tissue fat. Due this fact 18% can be considered valid for the athlete.

2. The well-being questionnaire demonstrated high values of psychological stress [21]. This probably occurred due the hard training routine with high training load. Training load must be reduced for positive adaptations to occur.

Conclusion

We can infer that in general the participant presented good parameters of functional development through the physiological tests. These results are similar with international CrossFit athletes. Body fat was considered good, considering the iDXA precision, for the phase of the training program (2º phase), and it must be fixed until the tapering phase. Moreover, the well-being questionnaire demonstrated high levels of stress, that is more common in this phase of training, but it is essential that the strength and conditioning coach manipulate the training variables to do not lead the athlete to a possible overtraining, that could threaten the competition program. Strength and conditioning coaches must have physiologists working together to develop tests in certain periods, aiming to analyze how the athletes are developing their abilities.

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Citation: Zecchin-Oliveira AM, Alesse da Costa LAG, Puggina EF (2021) Physiological and Psychological Tests Involving a Professional CrossFit Athlete: A Case Report. Open J Case Rep 2: 128

Page 2 of 2

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