Do the different menstrual cycle phases influence CrossFit® performance?

Hiohana Rilary Moraes Sacon
State University of Maringá-PR

Cecília Segabinazi Peserico (ceciliapeserico@gmail.com)
State University of Maringá-PR

Fabiana Andrade Machado
State University of Maringá-PR

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Abstract

Aim- The aim of this study was to verify the effects of the menstrual cycle (MC) phases on CrossFit® performance during three benchmark workouts: CrossFit Total, Jerry, and Fran in the three MC phases: Follicular (FP), Ovulatory (OP), and Luteal (LP). Methods: Eight physically active women (26.2±1.9 years; 56.3±1.6 kg; 159.0±0.0 cm; 29.5±4.9% of fat) took place in this pilot study. All the participants were evaluated in the CrossFit Total, Jerry, and Fran workouts in the three MC phases: Follicular (FP), Ovulatory (OP), and Luteal (LP). Results: There were significant differences between the MC phases for the CrossFit Total (FP= 188.8 ± 26.4 kg; OP= 194.2 ± 25.6 kg; LP= 202.9 ± 27.2 kg), Fran (FP= 9.1 ± 1.6 min; OP= 8.4 ± 1.0 min; LP= 7.2 ± 0.8 min), sources of stress (FP= 2.6 ± 1.2; OP= 0.7 ± 0.7; LP= 1.0 ± 0.5), and symptoms of stress (FP= 9.5 ± 3.0; OP= 4.4 ± 1.1; LP= 3.1 ± 1.8); there was no significant difference for Jerry performances between MC phases. Conclusion: In conclusion, the MC phases changed the performances of CrossFit Total and Fran workouts, with better results in the LP compared to OP and FP. *OBSERVATION: This abstract not appears in your manuscript file because the article is a short communication and the instructions for authors for this type of article ask that you do not have an abstract in the main document.

Introduction

CrossFit® is a high intensity functional training performed through metabolic conditioning, gymnastic movements, and weightlifting exercises [1]. Recently, CrossFit® training has been shown to improve aspects associated with health and performance, such as body fat, muscle mass, strength, and both aerobic and anaerobic performances. As a result, the number of people doing such modality has been increasing exponentially [2].

Concerning the physical training for women, some particularities must be considered, such as hormonal fluctuations during the menstrual cycle (MC) phases, which can affect performance [3]. Studies have reported the influence of the MC phases on strength [3,4] and maximal resistance⁵, revealing that performance tends to be better during the luteal phase (LP) [4]. However, no study has examined the association between the MC and CrossFit® performance.

Thus, this study aimed to verify the effects of the MC phases on CrossFit® performance during three benchmark workouts. Our hypothesis is that different MC phases can influence workouts performance.

Methods

Participants

Eight physically active women, who signed the Physical Activity Readiness Questionnaire (PAR-Q) were eligible for inclusion, took part in this pilot study (26.2 ±1.9 years; 56.3 ± 1.6 kg; 159 ± 0.04 cm; 29.5 ± 4.9 % fat). The training characteristics required were: one to two years of experience in CrossFit®, three to five...
of training frequency and being familiar with the 3 previously mentioned benchmark workouts, namely CrossFit total, Jerry and Fran. The participants self-reported regular MC (between 28 and 31 days), with no history of disorders related to the endocrine system and/or MC. They did not use ergogenic substances and did not have any limitations that would prevent the tests performance. The participants were informed of the benefits and risks of the investigation prior to signing the informed consent document to participate in the study. The experimental protocol was approved by the Local Human Research Ethics Committee (#4177256/2020).

**Experimental Design**

The entire experimental protocol lasted four weeks, a period in which the participants performed evaluation sessions on nine different occasions, between 4:00 pm and 10:00 pm. All participants were familiarized with the tests and procedures. All three benchmark workouts (CrossFit® Total, Jerry, and Fran) were repeated in each MC phase on fixed days: Follicular (FP), Ovulatory (OP), and Luteal (LP). The evaluations comprised: 1ª) maximum strength performance obtained from CrossFit® total workout; 2ª) aerobic performance achieved in Jerry workout; 3ª) high intensity exercise in Fran workout. The evaluation sessions followed the MC phases, in which specific days were fixed for the workouts, so that the participants had enough time to recover between the evaluations. Thus, the three benchmark workouts (CrossFit Total, Jerry and Fran) were repeated in the three MC phases. During the FP, days three, five and seven were, respectively, scheduled for CrossFit Total, Jerry and Fran. On days 10, 12 and 14, during the OP, the participants performed CrossFit Total, Jerry and Fran, respectively. Finally, during the LP, day 19 was chosen for CrossFit Total, day 21 for Jerry, and day 23 for Fran.

All evaluation sessions were performed in a CrossFit® affiliated Box under the supervision of a level-one coach in order to ensure that standard movements were met.

At the end of each MC phase, the participants answered the Daily Analysis of Life Demands in Athletes (DALDA) [6] for monitoring sources and symptoms of stress. Furthermore, after each workout, the session rating of perceived exertion (sRPE) was registered using the CR-10 scale [7,8].

**CrossFit Total Workout**

The CrossFit Total benchmark workout is used to assess maximal strength. It consisted of determining the 1-repetition maximum (1RM) of three exercises: back squat, strict shoulder-press, and deadlift. For this, before each exercise, there was a specific 10-minute warm-up with approximately 50% of 1RM for each participant. After warm-up, they had three attempts to determine 1RM, with 3-5 min of rest between the attempts in each exercise. Total duration of the workout was 90 min, and 1RM loads (kg) of each exercise were added to determine the individual score [1].

**Jerry Workout**
Jerry was the benchmark workout used to determine aerobic performance, in which each participant ran one mile (1609.34 m), followed by two kilometers of exercise on the rowing simulator ergometer and, finally, another mile running. At the end, the total time to perform the three exercises (running, rowing, running) was computed (min), and recorded by a manual stopwatch.

**Fran Workout**

The benchmark Fran workout consisted of a high intensity exercise. Participants completed 21-15-9 repetitions of thrusters and pull-ups, where thrusters were performed with 29.5 kg. The entire workout consisted of completing 21 thrusters, then 21 pull-ups, 15 thrusters and 15 pull-ups, nine thrusters, and nine pull-ups at a time. The time to complete all repetitions was recorded with a manual stopwatch.

**Sources and symptoms of stress**

To evaluate the sources and symptoms of stress, the Daily Analysis of Life Demands in Athletes (DALDA) questionnaire was filled out at the end of each MC phase. The DALDA is divided into parts A (9 questions) and B (25 questions), which represents the sources and symptoms of stress. The response options available for each item are ‘better than normal’, ‘normal’ and ‘worse than normal’. The sum of the scores marked as “worse than normal” was recorded for analysis.

**Statistical analysis**

The data were analyzed using the Statistical Package for the Social Sciences software (SPSS® Inc., USA). Shapiro-Wilk test was used to check the normality of the data distribution, and is presented as mean ± standard deviation (SD). The analysis of variance (ANOVA) with repeated measures was used to compare the MC phases for all variables. The sphericity assumption was checked by Mauchly’s test and, where violations occurred, degrees of freedom were corrected using Greenhouse-Geisser (epsilon ≤ 0.75) or Huynd-Feldt (epsilon > 0.75) estimates of sphericity. Bonferroni post hoc was performed for multiple comparisons. Statistical significance was set at $P < 0.05$.

**Results**

Table 1 shows the results for CrossFit Total, Jerry and Fran workouts in the different MC phases. Concerning the CrossFit Total, performance was significantly higher in the LP compared to FP ($P = 0.020$) and OP ($P = 0.046$). For the Jerry performance, there were no significant differences during the different MC phases. The results related to Fran showed a significant better performance in the LP compared to FP ($P = 0.024$). In addition, the sRPE values were not significantly different between the MC phases in all CrossFit workouts.
Table 1
Performance results for the workouts CrossFit Total, Jerry, and Fran in the different menstrual cycle phases.

<table>
<thead>
<tr>
<th>Variables</th>
<th>FP</th>
<th>OP</th>
<th>LP</th>
</tr>
</thead>
<tbody>
<tr>
<td>CrossFit Total (kg)</td>
<td>188.8 ± 26.4</td>
<td>194.2 ± 25.6</td>
<td>202.9 ± 27.2*#</td>
</tr>
<tr>
<td>sRPE – CrossFit Total (AU)</td>
<td>4.6 ± 1.7</td>
<td>4.7 ± 1.5</td>
<td>5.0 ± 1.9</td>
</tr>
<tr>
<td>Jerry (min)</td>
<td>32.2 ± 3.0</td>
<td>31.6 ± 2.8</td>
<td>32.2 ± 3.8</td>
</tr>
<tr>
<td>sRPE - Jerry (AU)</td>
<td>7.0 ± 1.1</td>
<td>6.2 ± 1.2</td>
<td>6.0 ± 1.9</td>
</tr>
<tr>
<td>Fran (min)</td>
<td>9.1 ± 1.6</td>
<td>8.4 ± 1.0</td>
<td>7.2 ± 0.8*</td>
</tr>
<tr>
<td>sRPE – Fran (AU)</td>
<td>8.1 ± 1.7</td>
<td>7.0 ± 1.5</td>
<td>6.5 ± 1.7</td>
</tr>
</tbody>
</table>

Note: n = 8; sRPE = session rating of perceived exertion; AU = Arbitrary units; FO: Follicular phase; OP: Ovulatory phase; FL: Luteal phase.

* P < 0.05 compared to FP;
# P < 0.05 compared to OP.

DALDA scores indicating the number of ‘worse than normal’ responses are shown in the Table 2. The sources of stress were significantly higher in the FP compared to OP (P = 0.043) and LP (P = 0.041). Similarly, the symptoms of stress were higher in the FP (P = 0.003 compared to OP and P = 0.001 compared to LP).

Table 2
DALDA scores indicating the number of responses “worse than normal” to sources of stress and symptoms of stress in the different menstrual cycle phases.

<table>
<thead>
<tr>
<th>Variables</th>
<th>FP</th>
<th>OP</th>
<th>LP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sources of stress de estresse</td>
<td>2.6 ± 1.2</td>
<td>1.0 ± 0.7</td>
<td>0.7 ± 0.5*#</td>
</tr>
<tr>
<td>Symptoms of stress</td>
<td>9.5 ± 3.0</td>
<td>4.4 ± 1.1</td>
<td>3.1 ± 1.8*#</td>
</tr>
</tbody>
</table>

Note: n = 8; FO: Follicular phase; OP: Ovulatory phase; FL: Luteal phase.

* P < 0.05 compared to FP;
# P < 0.05 compared to OP.

The individual results for the three workouts in the MC phases are presented in Fig. 1. Concerning CrossFit Total and Fran, seven participants had better performances in the LP, and only one in the FP. For Jerry, four participants achieved better results in the OP, three in the LP and one in the FP.
Discussion

The aim of this study was to verify the effects of the MC phases on CrossFit® performance during three benchmark workouts. The main finding was that the participants had a significantly better performance in the LP for CrossFit Total and Fran; however, the performance during Jerry was not affected by the MC phases, partially confirming the previously formulated hypothesis.

In the present study, the changes in muscle strength levels verified in the CrossFit Total workout throughout the MC were similar to those shown by previous studies [4, 9]. Weidauer et al. [9] with fifty physically active participants evaluated isokinetic peak torque at the knee and grip force measured using a handheld dynamometer. The results showed that muscular performance is reduced during the FP, which is in line with our findings. Furthermore, the results provided by the systematic review and metaanalysis of McNulty et al. [4] indicated that exercise performance might be trivially reduced during the FP phase of the MC compared to the other phases.

Differently, Loureiro et al. [3] in a study with nine young women who used oral contraceptives and were engaged in strength training for at least six consecutive months, found that there were no significant variations in muscle strength (e.g., 10 RM test) during the MC phases. Nevertheless, it is important to emphasize that these results must be analyzed with caution due to aspects related to premenstrual symptoms, hormonal fluctuations, definition of MC phases and small sample sizes.

To evaluate aerobic performance, in this pilot study we chose the Jerry workout, in which there was no significant difference between the MC phases concerning the test duration. Concerning Fran, which was performed to evaluate high intensity exercise performance, there were differences between the MC phases with a significantly better result in the FP. Julian et al. [5] evaluated nine sub-elite soccer players who performed a series of performance tests, including the Yo-Yo Intermittent Endurance Test (Yo-Yo IET). The researchers found a reduction in the athletes’ Yo-Yo IET performance during the FP, which was different compared to the findings of our study.

In a systematic review, Carmichael et al. [10] showed that anaerobic performance is not influenced by the MC phases and that the differences between the MC phases seem to have been influenced by motivation or other extrinsic practice-related factors. Therefore, Carmichael et al. [10] suggest that studies examining anaerobic, aerobic or strength performance tests have not been able to report clear and consistent effects of the potential impact of MC phases on physical performance.

It is noteworthy that there are no studies with Crossfit® verifying the effects of CM phases, which makes it difficult to directly compare our results with those of other studies. Given the contradictory findings in the literature, in our study, differences between the MC phases for strength (e.g., CrossFit Total) and high-intensity exercise (e.g., Fran) performances can be related to intrinsic factors perceived by the participants during the MC, such as the sources and symptoms of stress evaluated by the DALDA [6]. Our findings showed differences between the MC phases for the sources and symptoms of stress, in which
the scores for ‘worse than normal’ was higher in the FP and lower in the LP. These results may have influenced the performance of the participants in the workouts.

It is also suggested that performance during the MC varies from woman to woman, and that each organism reacts differently during this period. Therefore, it is important for coaches to know how their practitioners adapt and periodize their training according to individual needs. This study has some limitations that should be considered for future research, such as the small sample size and the impossibility to perform hormonal tests (due to the high financial costs) that could better demarcate the MC phases.

**Conclusions**

In conclusion, the MC phases changed the performances of CrossFit Total and Fran workouts, with better results in the LP compared to OP and FP. Considering this, the MC must be taken into account for the prescription of CrossFit® training, but more research to investigating the influence of MC on CrossFit® with a larger number of participants should be carried out.

**Declarations**

**Acknowledgments**

We would like to thank Luis Augusto R. Sordi for providing the space and materials to carry out the evaluations; we also thank the participants who were part of this pilot study.

**Declarations**

**Funding.** Not applicable

**Conflict of interest/ Competing interests.** The authors declare that they have no conflict of interest.

**Ethical approval.** This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Local Human Research Ethics Committee of State University of Maringá (#4177256/2020)

**Consent to participate.** Informed consent was obtained from all individual participants included in the study.

**Authors’ contributions.** All authors contributed to the study conception and design, participated to acquisition of the data, analysis and interpretation of the data and writing the text. All authors have read and approved the final version of the manuscript.

**References**


**Figures**

**Figure 1**
Individual results for the workouts *CrossFit Total* (A) *Jerry* (B) and *Fran* (C) during the menstrual cycle phases.