Effect of Different Phases of the Menstrual Cycle on the Performance of Muscular Strength in 10RM

CLÍNICA MÉDICA DO EXERCÍCIO E DO ESPORTE

Original Article

Sheila Loureiro[1]
Ingrid Dias[2]
Dayane Sales[1]
Isabel Alessi[1]
Roberto Simão[2]
Rogério César Fermino[3,4]

1. Universidade Gama Filho (CEPAC).
2. Escola de Educação Física e Desportos, Universidade Federal do Rio de Janeiro (UFRJ).
3. Programa de Pós-Graduação em Educação Física, Universidade Federal do Paraná (UFPR).
4. Grupo de Pesquisa em Atividade Física e Qualidade de Vida, Pontifícia Universidade Católica do Paraná (GPAQ/PUCPR).

Correspondence address:
Rogério César Fermino
Pontifícia Universidade Católica do Paraná – PUCPR Centro de Ciências Biológicas e da Saúde, CCBS – Curso de Educação Física. Grupo de Pesquisa em Atividade Física e Qualidade de Vida – GPAQ
Rua Imaculada Conceição, 1155 – Prado Velho - 80215-901 – Curitiba – Paraná – Brasil
E-mail: rogeriofermino@hotmail.com

ABSTRACT

The aim of this study was to investigate the effect of the different phases of the menstrual cycle (MC) on muscular strength performance in resistance exercises. Nine healthy and physically active women, aged 27±7 yrs, body mass 58.2±5 kg, height 161.1±4.7 cm and BMI 20.4±2 kg/m2 participated in the study. All of them had regular MCs (28-31 days), used oral contraceptives and had been experienced in resistance exercises for at least eight months. Muscle strength was evaluated with a 10RM test in the following order: leg press 45º, bench press, leg extension and biceps curl. The tests were performed in the three phases of the MC: follicular (between the 3rd and 5th day of menses), ovulatory (between 9th and 10th days) and luteal (between 17th and 21th days). ANOVA for repeated measures was applied for statistical analysis, data were analyzed in the SPSS 15.0 and level of significance was set at 5% ($p<0.05$). No significant statistical differences were observed in the mobilized weight between the MC periods in those four exercises. Regarding the leg press exercise, a 5% increment in muscle strength was observed on the luteal phase. In the remaining exercises and phases these differences were not observed. In conclusion, the phases of the MC did not affect performance of muscular strength in resistance exercise, both single and multiple joint, for large or small muscle groups or in different body segments.

Keywords: menstrual cycle, hormonal alterations, muscle strength, 10RM test.

INTRODUCTION

Understanding about the menstrual cycle (MC) and its physiological mechanism is of great importance to the comprehension on the many biological alterations which occur at each new cycle and which globally reflect on women's body. Such alterations depend on the integrity and suitable action of the neuroendocrine system which, by the activity of its hormones, is responsible for these alterations[1]. The normal MC varies from 21 to 35 days, with mean of 28 days, and can be divided in three distinct phases: follicular, ovulatory and luteal[2,3].

The follicular phase is characterized by low levels of estradiol and progesterone, which make that the uterine filling degenerates and comes off during menstruation, marking the first day of the MC[1]. Increase in the luteinizing and follicle-stimulating hormone levels signal the beginning of the ovulatory phase, in which the estradiol level reaches its peak and progesterone increases. In the luteal phase the luteinizing and follicle-stimulating hormones decrease, the follicle closes after releasing from the ovule and makes the luteal body, which segregates progesterone[2]. If the ovule is not fertilized, the luteal body degenerates and stops producing progesterone, the estradiol level decreases and a new MC begins[1].

Some studies have assessed the effect of the hormonal oscillations derived from the MC on physical performance[2,4-7]. However, the literature presents controversial results[5,7]. While some evidence demonstrates there are not significant differences in physiological aspects (O_2 consumption, lactate threshold, plasmatic volume, hemoglobin concentration and ventilation) in the three phases of the MC [2], other studies[4,8-10] have verified differences in the hormonal concentrations, with no alteration in muscle strength between phases. Dias ***et al.***[11] assessed strength in two multiarticular resisted exercises for large muscular groups and did not find significant differences between the different phases of the MC. On the other hand, Simão ***et al.***[12] assessed the saem exercises and verified that in the follicular phase the women presented significant reduction in strength in one of the exercises. Petrofsky ***et al.***[13] observed alterations in the isometric strength and correlated such findings with cyclic variation of muscular temperature and straight effects of the MC on the circulation and musculature.

The studies related to strength alterations and MC present clashing results. Research which assessed muscle strength approaching some variables of resisted exercises, such as the number of joints and muscle mass involved, has not been identified. The aim of this study was to verify the effect of different phases of the MC in muscle strength performance in mono and multiarticular resisted exercises, for large and small muscular groups and in different body segments.

MATERIAL AND METHODS

Participants

Nine healthy and physically active women, mean age of 27 ± 7 years, body mass 58.2 ± 5kg, stature 161.1 ± 4.7cm and BMI 20.4 ± 2kg/m^2 participated in this study. All of them presented regular MC (28 to 31 days), use of oral contraception for at least two years and eight months of experience in resisted exercises. Women who reported disorders related to the MC, use of food supplements or ergogenic substances were excluded from the study. The individuals, after having been previously clarified on the aims of the investigation and procedures through which they would be submitted to, agreed to voluntarily participate in the study and signed a Free and Clarified Consent Form according to rules in the Resolution 196/96 of the National Health Board on research involving humans.

Muscle strength evaluation in 10RM

The 10 repetition maximum test (10RM) application was chosen for presenting high correlation with the muscle strength assessed in 1RM[14]. The test was applied in alternation by segment in the following order: leg press 45º, bench press, leg extension and biceps curl. The exercises were selected due to their dissemination in training centers and for their easy performance, and all participants have performed the exercises in their training routines for at least three months.

The 10RM test was performed following the protocol proposed by Baechle and Earle[15], and initial load was estimated according to the usual weight from individual training routines. The test was interrupted at the moment the volunteers were unable to perform the complete movement or when voluntarily concentric flaws occurred in 10RM. The following strategies were adopted to reduce the error gap in the tests: a) standard instructions were given before the test so that the volunteer was aware of the entire routine which involved the data collection; b) the volunteer was instructed on the exercise performance; c) the evaluator was aware of the position adopted by the practitioner at the moment of the test, since slight variations in the positioning of the joints involved in the movement could trigger other muscles, leading to misinterpretation of the obtained scores; d) the subjects were verbally encouraged with the purpose to keep their motivation level high; e) the additional load used in the study was previously measured on a precision scale. Intervals between trials in each exercise during the 10RM test were set between three and five minutes. Intervals not shorter than 10 minutes were given after the load in a given exercise was obtained, before the following exercise performance.

The volunteers were oriented not to ingest any stimulating substance (caffeine or alcohol) and not to perform physical activity on the previous day or on the day of the tests.

Experimental protocol

The participants paid four visits to the tests' location. On day one, the following procedures were performed: a) anamnesis and PAR-Q questionnaire application[16] to identify possible restrictions to the tests performance; b) information compilation on the sue of oral contraceptives, menstrual flow regularity and days (collected to determine the period of the muscle strength assessment); c) body mass (Filizola scale®, precision of 100g) and stature measurement (Cardiomed® stadiometer, precision of 1mm); d) familiarization and adaptation to the 10RM test. The tests were performed in the four exercises in which the muscle strength was going to be subsequently assessed. All procedures were explained to the participants and the possible doubts clarified.

On the second, third and fourth days of the visit for collection, the volunteers performed the 10RM tests on specific days due to the different phases of the MC: follicular (first to seventh day of menstrual cycle), ovulatory (eight to 14th day) and luteal (15th to 28th day). Specific days for the tests application were established to reduce possible fluctuations in strength. During the follicular phase, the tests were performed between the third and fifth days of the menstrual cycle; ovulatory phase between the ninth and 10th day and in the luteal phase, between the 17th and 21st day.

Statistical analysis

Values distribution normality was verified by the Shapiro-Wilk test and after normality was confirmed, parametric procedures were adopted. Results were described through descriptive statistics (mean ± standard deviation) and to test possible differences in muscle strength in 10RM due to the MC phases, ANOVA of repeated measurements was applied. The data were assessed in the SPSS 15.0 software and the significance level kept in 5% ($p < 0.05$).

RESULTS

Figure 1 presents muscle strength performance in 10RM in the different phases of the MC for the leg press 45º, leg extension, bench press and biceps curl exercises. Statistically significant differences have not been identified between the periods on the MC in any of the four exercises assessed ($p > 0.05$). In the leg press 45º increment of 5% in strength was verified comparing the luteal phase to the follicular phase and ovulatory phase. In the remaining phases and exercises these differences were not observed.

DISCUSSION

The present study assessed the behavior of muscle strength in a 10RM test, using resisted mono and multiarticular exercises for large and small muscular groups and in different body segments, during the three phases of the MC. Trained, eumenorrheic women with use of oral contraceptives for at least two years were selected to the be subjects of the experiment. Significant differences were not observed in strength in any of the assessed exercises.

The literature reports that the female physiology is affected by the hormonal alterations derived from the MC[2,3,6]. Nevertheless, it is still controversial whether the endocrine oscillations affect performance during

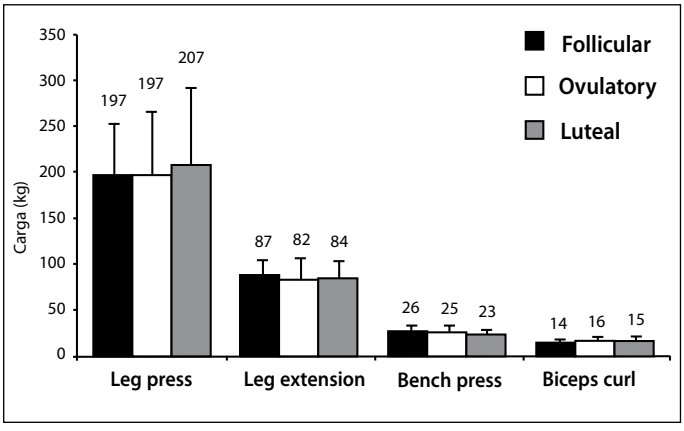

Figure 1. Muscle strength behavior in 10RM in the different phases of the menstrual cycle. Significant differences have not been verified.

exercises. While some studies show that alterations in estrogen/progesterone serum concentrations are not sufficient to affect physical performance[17,18], other experiments demonstrate better performance in some phases of the MC[12,13]. The findings of the present study could not observe differences in muscle strength during 10RM tests performance in the different phases of the MC.

Redman and Weatherby[6] verified reduction in anaerobic performance in the luteal phase (pre-menstrual) in women who did not make use of oral contraceptives, while in the group which used the ovarian steroids significant differences have not been reported. The authors attributed the results to the hormonal control derived from the contraceptives. Since the participants in the present study were oral contraceptive users and variations in strength were not verified, we may corroborate the speculation of the authors mentioned above. Conversely, Giacomoni ***et al.***[19] did not observe oscillations in anaerobic performance during the MC, regardless of the use of oral contraception, suggesting hence that the absence or presence of pre-menstrual symptoms or dysmenorrheal could affect performance. Such symptoms are derived from the oscillations of estrogen/progesterone during the MC. In the pre-menstrual phase, increase of the progesterone concentrations is observed, and it is suggested that this hormone may negatively influence performance. The post-menstrual phase is characterized by high levels of estrogen and higher noradrenalin secretion and is related to performance improvement [1]. However, it is worth mentioning that the physiological functions and sports specialization are highly individual [20].

The studies which are closest to the present research concerning methodology were developed by Dias ***et al.***[11] and Simão ***et al.***[12]. Dias ***et al.***[11] verified the effect of the different phases of the MC over strength performance in a 10RM test. Eight trained women with regular use of oral contraceptive were assessed. The results demonstrated that for the biceps curl exercise significant differences in strength have not been found when the three phases of the MC were compared. In the leg press exercise, variations were observed, with no significant differences in the interphase loads though, especially between the first and third measurements (follicular and luteal phases, respectively). In conclusion, this study also reports that there are not variations in muscle strength during the phases of the MC.

On the other hand, Simão ***et al.***[12] when assessed strength performance in 8RM in the same exercises in 19 trained women, demonstrated results different from the ones found by Dias ***et al.***[11], as well as what was found in the present research. In this study[12] the results in the leg press exercise evidenced that in the first phase (menstrual) performance decrease was observed when compared to the remaining phases. In the biceps curl exercise significant differences have not been identified between phases. The authors suggest that factors such as adaptation to the test during collection, motivation level, increase in strength and muscle mass involved in the movement performance, may have influenced on the results. It is worth stressing that in this study four measurements were performed during the MC and the women did not use oral contraception.

The possible variation in performance in the different phases of the MC is normally explained by hormonal issues. The catabolic hormones (progesterone and cortisol) present higher plasma concentrations in the luteal phase, while testosterone remains steady during almost the entire MC [20]. Thus, the variations in the hormonal concentrations would provide better performance in the follicular phase. Nevertheless, the evidence does not support this statement [4,8-10,17,19].

Reviewing the literature, it is observed that the issue of strength performance concerning the different phases of the MC still remains controverse[2,5,7]. It is important to highlight that, this fact can be partly explained by the lack of suitable experimental controls as well as the wide variation in the kinds of methods used to determine the CM phase (body temperature ***vs.*** hormonal exams) and in the regulation of the time of the tests (menstruation ***vs.*** next and/or mean, follicular phase ***vs.*** ovulatory phase ***vs.*** mean and /or u next luteal phase during the MC)[12]. Other authors even speculate that the selection criteria of the requisites in some studies is not clearly defined (age, physical aptitude, MC history and degree, gynecologic problems, etc) and, sometimes the standardization and classification of the pre-exercise, including ingestion of a controlled diet as well as the level of activity, has been limited [6,21,22].

The findings of this research present practical implications in training programs performed in gyms, health clubs or centers. Since there is not alteration in muscle strength, it is suggested that there is not need to alter the training characteristics (volume and intensity) due to the MC of women who present similar profiles. Moreover, the application of load tests to control and/or follow-up the training evolution may be performed with no phase distinction in the MC.

Some limitations should be considered to extrapolate the results. Subsequently to the establishment of the inclusion criteria, 20 women volunteered to participate in the study; however, as the collections were carried out, sample loss of 55% took place and the experiment was ended with nine women. Nevertheless, it is important to highlight that the majority of studies reviewed used a reduced number of participants [4,10,11,13,17,19]. Another important limitation was the definition of the beginning and end of each phase of the MC. Sharper accuracy in determination of the cycle by the measurement of the serum levels of the estrogen/progesterone ratio in urine or blood [8,23], would allow a more suitable interpretation of the results. Time of collection should also be considered, since the data were collected in a single MC, and according to the literature, variations in the duration of the cycle may occur among women or even with the same woman [1,24].

Further studies with higher number of subjects and better methodological control should be carried out. Additionally, the interaction between the different phases of the MC, strength performance and other variables of resisted exercises (interval, performance velocity, etc) should also be explored.

CONCLUSION

The phases of the MC do not influence on muscle strength performance in resisted exercises, either mono or multiarticular, for large or small muscular groups or in different body segments.

All authors have declared there is not any potential conflict of interests concerning this article.

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