

STUDY OF EMG DURING MAXIMAL ISOMETRIC CONTRACTION OF THE LEG EXTENSION EXERCISE DURING PHASES OF THE MENSTRUAL CYCLE

¹Poliana de Lima Costa, ¹Gislaine Cristina de Souza, ¹Renata Cristina da Silva Oliveira, ¹Francielle Pereira Santos, ¹Cintia Campolina Duarte Rocha and ¹Sandro Fernandes da Silva.

¹Grupo de Estudo e Pesquisa em Respostas Neuromusculares - Núcleo de Estudos do Movimento Humano – Departamento de Educação Física, Universidade Federal de Lavras (UFLA), Lavras – Minas Gerais - Brasil;
e-mail: poli.edf@hotmail.com

Financial Support: Fundação de Amparo à Pesquisa do Estado de Minas Gerais - FAPEMIG

SUMMARY

This study aims to evaluate the activation electromyographic (EMG) and isometric maximum voluntary contraction (CVIM) of the quadriceps femoris (QF) in the different phases of the menstrual cycle (MC). The EMG activations and CVIM muscles that make up the QF - rectus femoris (RF), vastus lateralis (VL) and vastus medialis (VM) - were evaluated in nine physically active women with CM regularly and not using oral or vaginal contraceptives, through three sets of five seconds after the completion of training (RT), three times a week for two months. The results revealed a significant difference of CVIM the muscles of the QF between the 1st and 3rd phase of CM, while the EMG activation, there was a significant difference in the 1st and 2nd phase of CM, between muscles RF and VM, no change in 3rd phase. It is believed that the high concentration of estrogen can result in muscle strength improved in the luteal phase compared to the MC follicular phase. Still, there is a chance of occurring neural adaptations to justify the increased muscle strength and EMG activation. This can be explained by the improvement in fiber recruitment and decreased energy expenditure. According to the results, it is concluded that the CM affects the performance of the strength of QF and neural adaptations, TP due to guarantee an improvement in the performance.

INTRODUCTION

In recent years, the number of women seeking physical exercise using the strength training (ST) is increasing [1]. Studies on the CM are made increasingly necessary due to this peculiarity female can influence the recruitment of muscle fibers, muscle strength and neural adaptations that occur during ST. Thus, the CM is divided into three phases characterized by different hormone levels: follicular (1st to 7th day), ovulatory (8 to 14 days) and luteal (15th to 28th day). [2] Given the lack of studies on the subject, this study aims to evaluate the EMG activation and CVIM in the muscles of the QF in physically active women.

METHODS

Participated in the experiment nine women healthy volunteers, with a mean age of 20.6 ± 0.70 years, body mass of 59.6 ± 6.85 kg, and height of 1.59 ± 0.062 meters, with CM regularly and not using oral or vaginal contraceptives. The participants were informed about the nature and procedures of the study and agreed to participate voluntarily in the experiment, signing a consent form (ICF), in accordance with Resolution 196/96 of the National Health Council, referring to research involving human subjects. The study was approved by the Ethics Committee on Human Research of University of Lavras, with CAAE 01565412.0.0000.5148.

At the first moments, the participants signed an informed consent form, and then were referred to a physical assessment (weighing, measuring height and measurement of body fat estimated using a tetrapolar bioimpedance apparatus Quantum BIA-II ®). In the second moment, we performed a ST with three weekly sessions in a period of two months preceding the first day of testing and EMG CVIM to familiarize the same. Finally, there were certain phases of CM, the performance of bioimpedance earlier each day of testing and the collection of EMG and CVIM QF muscle, performed at the following times: follicular phase (between the 3rd and 5th day), ovulatory phase (between the 9th and 10th days) and luteal phase (between 17 and 21 days) [2].

On the test day, and prior to its implementation, the participants underwent the process of shaving and cleaning the skin with alcohol, for the attachment of electrodes in the QF muscle portions, which are: RF, VL and VM. The electrodes used were 3M ® brand and were fixed according to the points established in the literature [3].

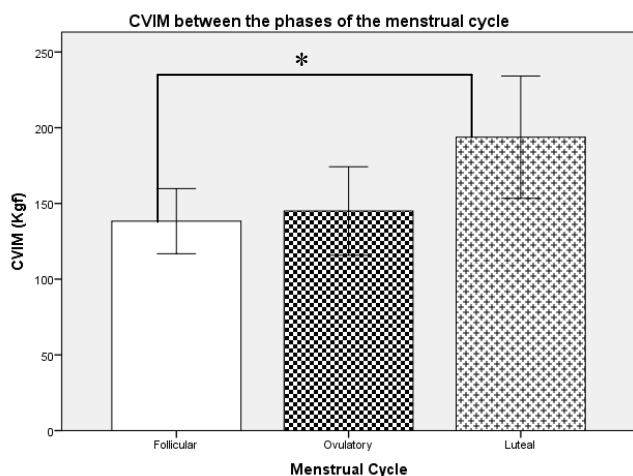
Then, the subjects underwent a series of 15 replications the leg extension (LE) and specific warm, with a charge calculated by the formula whose body weight (kg) x 0.5 results in the total heat load [4]. After heating, was given a recovery interval of two minutes, to thereby be initiated

assessments consisting of three sets of five seconds maximum isometric, in the LE with knee flexion at an angle of 90° to 110°, in which we analyzed the electromyographic signal through an EMG ® Miotool 400 of MIOTEC and data CVIM peak, with the load cell 500kgf. The signals collected were filtered through filter 5th order Butterworth-type band-pass with a cutoff frequency of 20-500 Hz. The amplitude of the EMG signal was calculated on the mantle RMS (Root Mean Square). For purposes of data collection, analysis of results was observed an average of three attempts.

Data analysis was performed with statistical comparison of averages and standard deviations. To investigate the distribution of the sample was used the Shapiro-Wilk. As the distribution was normal, we used the Anova Two-Way and analysis of evidence adopted the post Hock Tukey. For statistical evidence adopted was $p < 0.05$.

RESULTS AND DISCUSSION

The results revealed significant difference in the CVIM muscles of the QF between the follicular and Luteal phase of the CM (Figure 1). Regarding the EMG activation, there is a significant difference in the Follicular and Ovulatory phase of CM between the RF and VM muscles, no change in the Luteal phase (Table 1).



* $p < 0.05$ significance difference of the Follicular and Luteal

Figure 1- CVIM between phases of the Menstrual Cycle

Increased muscle strength, as assessed by CVIM, can be justified by changes in hormone levels during different stages of the CM. Whereas in the Luteal phase concentrations of estrogen are high, and this hormone is highly related to increased performance, it can result in muscle strength improved in the luteal phase compared with the follicular phase, and the peak of the hormone progesterone does not influence the outcome of same [5,6].

Another hypothesis to be considered would be the occurrence of neural adaptations from strength training for beginners, hypertrophy that even without a notable feature increases the strength levels. This theory may also explain the results of the EMG activation that, in the luteal and final phase evaluated, resulting in the synchronization of labor muscle QF, thus causing the best recruiting muscle fibers and decreased energy expenditure, results these that cause the best performance in achievement of motion. [7]

Samples	Phase	Rectus Femoris (μv)	Vastus Lateralis (μv)	Vastus Medialis (μv)
9	Follicular	195,84 \pm 45,21*	270,54 \pm 48,32 [#]	152,94 \pm 39,50
	Ovulatory	171,42 \pm 44,10	282,80 \pm 55,19	163,68 \pm 38,60
	Luteal	186,14 \pm 47,33	181,22 \pm 52,42	144,57 \pm 40,20

* $p < 0.05$ significance difference of the Rectus Femoris in the between Phases Follicular and Ovulatory

[#] $p < 0.05$ significance difference of the Vastus Lateralis in the between Phases Follicular and Ovulatory

Table 1- EMG in the Leg Extension.

CONCLUSIONS

It can be concluded that the luteal phase was analyzed as greater strength, confirming the influence of the CM on the strength performance of QF. The neural adaptations from the TP justify the improvement of muscle fiber recruitment.

REFERENCES

1. Constantini NW, et al. The Menstrual Cycle and Sport Performance. *Clinical Sports Medicine*; 24: e51– e82, 2005.
2. Loureiro S, et al. Efeito das Diferentes Fases do Ciclo Menstrual no Desempenho da Força Muscular em 10RM. *Revista Brasileira de Medicina do Esporte*; 17 (1): 22-25, 2011.
3. Merletti R. Standards for Reporting EMG Data. *Journal Electromyography Kinesiology*; 9(1): 3-4, 1999.
4. Baechle T. R.; Groves B. R. *Weight Training*. Champaign: Leissure Press, 1992.
5. Simão R, et al. Variações na Força Muscular de Membros Superior e Inferior nas Diferentes Fases do Ciclo Menstrual. *Revista Brasileira de Ciência e Movimento*; 15(3): 47-52, 2007.
6. Tsampoukos A, et al. Effect of menstrual cycle phase on sprinting performance. *European Journal of Applied Physiology*; 109: 659–667, 2010.
7. Gabriel DA, et al. Neural Adaptations to Resistive Exercise: Mechanisms and Recommendations for Training Practices. *Sports Medicine*. 36 (2): 133-149, 2006.