The influence of the menstrual cycle on the flexibility in practitioners of gymnastics at fitness centers

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ABSTRACT

This study aims to verify if there are differences in the degree of flexibility in the phases of the menstrual cycle of adult young women who practice gymnastics at fitness centers. A sample of 20 adult women aged between 18 and 35 years (25.8 ± 6.06) was studied; they had regular menstrual cycle (28 up to 32 days) and were not taking oral contraceptives. Information concerning the menstrual cycle and routine physical activity was obtained through a questionnaire. The flexibility was evaluated through the goniometry, using eight movements, in three phases of the menstrual cycle. The subjects were submitted to a hormonal test, where the estrone, estradiol and progesterone levels were verified. The statistics treatment was conducted through descriptive and inferential analysis; Kolmogorov-Smirnov's test and ANOVA were used to verify hypothesis. The results demonstrated that no significant differences ($p < 0.05$) in the flexibility degree were observed during the follicular, ovulatory and luteal phases of the menstrual cycle.

Keywords: Flexibility. Menstrual cycle. Hormone.

INTRODUCTION

The menstrual cycle (MC) usually occurs every 28 days, beginning at the menarche and finishing at the menopause. The cycle suffers clinic changes of the ovarian function that occur monthly, causing variation of the feminine hormones secretion and of the structure of the internal filling of the uterus. It can be divided in three phases: follicular, that begins at the first day of the menstrual flow; the ovulatory, that can last up to three days; and the luteal, that goes from the end of the ovulation until the beginning of the menstrual flow[1].

Speroff *et al.*[2] mention that the maximum of the vascularization is reached associated to the maximum concentrations of progesterone and estradiol in the blood after the ovulation, and the lutean body synthetizes all the three classes of sexual steroids (androgens, estrogens and progestines). Great quantities of estrogen are secreted in the follicular and ovulatory phases, while in the lutean one there is a prevailing of progesterone[3].

The hormonal oscillations in women due to the changes, especially of estrogen and progesterone during the MC, affect the feminine physiology[4]. Hewett[5] suggests that the feminine hormones are the main reason for the increase of the ligaments looseness and decrease of the neuromuscular performance. On the other hand, Chaves *et al.*[1] did not confirm such speculations in the flexibility gains in women who took oral anovulatory.

Hence, the actual study had as aim to verify if in the different phases of the MC there is differentiation in the degree of flexibility in adult Young women who practice gymnastics in fitness centers.

MATERIALS AND METHODS

Subjects

The sample was composed of 20 volunteer women who practice gymnastics in fitness centers, between 18 and 35 years of age (25.8 ± 6.06), with a regular MC and who did not take oral contraception. The inclusion criteria were: at least six months of activity and a frequency between three and five times a week, who presented regular MC, of 28 to 32 days[6], and who did not take birth control pills. Women who suffered total hysterectomy, reported any osteomioarticular problem and were not within the normal hormonal limits were excluded.

Data collection procedures

An anmnese was conducted, where personal information such as name, age and address was registered, besides information about the MC and routine physical activity. In these questionnaires, the volunteers were selected according to the inclusion and exclusion criteria. On the same day, they filled and signed an agreement term, according to Resolution nº 196/96 of the National Health Committee of Brazil and day and time for the flexibility and hormonal level data that were used to homogynize the sample were set. The volunteers were taken to the hormonal exam between the 12º and 14º day of the cycle (in the end of the follicular phase – phase where the hormonal peak of the follicular hormone is seen – (FSH) stimulant, luteinizing hormone (LH), estrone and especially estradiol[7], where the progesterone, the estrone and the estradiol were collected, using the *DELFIA kit* through the immunofluorimetrical method.

The data collection was conducted keeping the tests time distant from the first and last hours of the day, from 10:00 to 18:00 h[6], repeating at the same time the following measurements. The individuals were dressed with exercise practice gear, so that the movements execution was not affected. They were also asked not to practice any exercise before the test. Their skin was clean and dry, and it was marked with access to touching of the anatomic points used to lead the collocation of the still and moving arms of the goniometer. The fat-mass and height were checked for the IMC calculation. The data of eight movements from the shoulder, elbow, hip, knee and low back, all from the right side of the body, were collected to verify the flexibility, in the three phases of the cycle (follicular- between the 1º and 3º day; lutean – between the 25º and 28º day and ovulatory – 12 and 14º day), all checked by the same evaluator who had access to the MC phases, by the LABIFIE protocol of goniometry[8]. The evaluator previously conducted the check of the reproductibility of the measure (ICC = 0.96). The used

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instrument was the *Laffayete* universal steel goniometer 360º (Cardiomed, Brazil).

The passive articulatory mobility was measured, with no previous warm-up, within the medium broadness in grades of articulatory movements, respecting the morphological limits. The individual was previously informed about the executed procedures. The goniometer was tightly held by its handles, so that the axis would not move away from the set point, and each movement was done until the end of the articulatory arch, with no help or resistance from the individual.

The used movements were:

• Flexing movement of the shoulder articulation (0-180°) – With the individual standing, the goniometer was placed on the outer side of the arm, with its central axis over the acromial point; later the movement was done, while one of the handles stuck on the arm, and the other in the direction of the underarm line.

• Extension of the shoulder articulation (0-180°) – With the individual sat, the goniometer was placed having its central axis lined with the acromial point on the back side of the arm; one of the handles was stuck on the back side of the arm over a line traced from the acromial point until the olecraniano process; the other was stuck on the back of the individual, on the transversal direction, over the traced line between the acromial points and the movement was done until the maximum broadness.

• Flexing movement of the elbow articulation (0-154°) – With the individual in dorsal decubit,, the goniometer was placed with the central axis over the radial point until the stylon; the other stuck on the arm in its outer side over a traced line from the radial point until the acromial point; the flexion of the elbow articulation was then performed.

• Flexing movement of the hip articulation (0-125°) – in dorsal decubit, the goniometer was placed with its central axis over the trochanteric point, one of the handles stuck on the side of the body, over the continuation of the underarm line, and the other on the outer side of the thigh and its medium line; the flexion of the hip articulation was then performed.

• Extension of the hip articulation (0-10°) – With the individual in ventral decubiti, the goniometer was placed with its central axis over the trochanteric point, one of the handles stuck on the side of the body, in the continuation of the underarm line, and the other on the outer side of the thigh, on its medium line; the extension movement of the hip articulation was then performed.

• Abduction of the hip articulation (0-45°) – In ventral decubiti, the goniometer was placed with its central axis over the coccyx over the parallel handles, and over a surface traced from the continuation of the longitudinal axis of the vertebral column. Later on, the abduction movement of the lower limbs was performed. After this movement, the handles were placed over the medium lines of the thighs.

• Flexing movement of the knee articulation (0-140°) – With the individual in ventral decubiti, the goniometer was placed over the side tibial point, one of the handles stuck on outer side of the thigh over a line traced from the trochanteric point to the tibial point and the other outer side of the leg over a line traced from the tibial point to the sphirion point; later on, the flexion movement of the knee articulation was performed.

• Flexion of the lumbar column (0-95°) – With the individual sat, the central axis of the goniometer placed over the trochanteric point, one of the handles stuck on the side of the body over the continuation of the underarm line, and the other on the side of the thigh, on its continuation line. Later on, the flexion of the lumbar column was performed[9].

Statistics treatment

The descriptive statistics was initially used to estimate the place measurements (average and medium) and dispersion ones (standard error, variation coefficient and standard deviation), with the aim to define the data profile.

The application of the *Kolmogorov-Smirnov* test was conducted after that phase, with the purpose to verify the normality of the variables and consequently define the inferential approach in order to test the existence of average difference among the variables.

Later on, the inferential analysis was used, where the choice of the parametric approach led to the establishment of the Analysis of Variables of Repeated Measurements (ANOVA) as the test to be applied, once three groups were compared (progesterone, estradiol and estrone) with distribution of probability close to normal. The study admitted the $p < 0.05$ level for statistics significance.

RESULTS

In table 1, the descriptive results of the sample concerning the age, the IMC and the hormonal levels are shown.

TABLE 1
Average values and their derivations for age, weight, height, IMC, estrone, estradiol and progesterone

Statistics	Average	ε	Medium	CV (%)	S
Age	25.8	1.36	25.0	19.0	6.06
Weight	61.4	1.86	61.9	13.5	8.30
Height	163.9	1.26	165.2	3.4	5.63
IMC	23.0	0.68	22.2	25.3	3.04
Estrone	86.0	11.65	79.0	60.5	52.08
Estradiol	107.8	13.82	120.7	57.4	61.81
Progesterone	1.2	0.10	1.3	36.6	0.44

IMC = fat-mass index; ε = standard error; CV = variation coefficient; S = standard deviation.

It was observed in table 1 that the age variable showed low dispersion, that is, an acceptable variability, while the IMC showed a high variability (CV > 20.0%). In the first case, the average as measurement of central tendency, and in the IMC case, the medium. It is expected that these figures stabilize in the population. The two variables showed a standard error smaller than 3.50.

Concerning the figures related to the hormones, it was observed that the great dispersions (CV > 20.00%) were found in the estrona, estradiol and progesterone variables, which have the best estimate of central tendency in the Medium. Moreover, the standard error of estrona and estradiol has appeared too high.

Table 2 shows the descriptive results of flexibility in the follicular phase. Comparing the results of the different articulations of the flexibility test, it can be observed that in the follicular phase (table 2) only the elbow flexion and the lumbar column flexion showed high variability (CV > 20.00%).

TABLE 2
Descriptive results of the averages of the flexibility in the follicular phase in gymnastics practitioner women with normal menstrual cycle (n = 20)

	$\bar{x}$	ε	Md	CV	S	α = 5.00%	Value-p
Flex. shoulder	168.85	1.71	168.50	4.53	7.65	3.58	0.97
Abd. shoulder	82.10	2.05	84.00	11.16	9.16	4.29	0.52
Flex. elbow	29.10	1.32	28.50	20.28	5.90	2.76	0.73
Flex. hip	87.85	2.10	88.00	10.69	9.39	4.40	0.66
Ext. hip	155.05	1.10	154.00	3.18	4.94	2.31	0.38
Abd. hip	94.10	2.72	96.00	12.93	12.17	5.70	0.53
Flex. knee	47.60	1.40	48.00	13.15	6.26	2.93	0.77
Flex. col. lumb.	60.10	3.38	63.50	25.18	15.13	7.08	0.60
Temperature	21.25	0.61	22.00	12.76	2.71	1.27	0.69

$\bar{x}$ = Average; ε = Standard error; Md = medium; CV = variation coefficient; S = standard deviation; α = Alfa value; p = value.

Table 3 shows the descriptive results of flexibility in the ovulatory phase. In the ovulatory phase (table 3), the lumbar column flexion kept the high dispersion.

TABLE 3
Descriptive results of the averages of flexibility in the ovulatory phase in gymnastics practitioner women with normal menstrual cycle (n = 20)

	$\bar{x}$	ε	Md	CV	S	α = 5.00%	Value-p
Flex. shoulder	170.65	1.26	172.50	3.29	5.61	2.63	0.57
Abd. shoulder	84.25	2.02	86.00	10.73	9.04	4.23	0.56
Flex. elbow	26.20	0.89	25.00	15.15	3.97	1.86	0.62
Flex. hip	86.45	2.05	87.50	10.61	9.17	4.29	0.56
Ext. hip	157.80	1.46	159.00	4.15	6.54	3.06	0.92
Abd. hip	96.35	2.48	98.00	11.51	11.09	5.19	0.97
Flex. knee	46.30	1.39	46.00	13.43	6.22	2.91	0.98
Flex. col. lumb.	59.10	3.19	63.00	24.17	14.28	6.68	0.53
Temperature	21.05	0.62	20.00	13.21	2.78	1.30	0.42

$\bar{x}$ = average; ε = Standard error; Md = medium; CV = variation coefficient; S = standard deviation; α = Alfa; p = value.

Table 4 shows the flexibility descriptive results of the lutean phase. In the lutean phase (table 4), the situation of the follicular phase repeated, that is, only the elbow flexion and the lumbar column flexion showed high variability (CV > 20.00%). The air temperature was also checked in each phase of the cycle and it kept low variability in all of them.

TABLE 4
Descriptive results of the averages of flexibility in the lutean phase in gymnastics practitioner women with normal menstrual cycle (n = 20)

	$\bar{x}$	ε	Md	CV	S	α = 5.00%	Value-p
Flex. shoulder	171.20	1.63	172.50	4.26	7.30	3.41	0.98
Abd. shoulder	80.35	2.07	80.50	11.54	9.28	4.34	0.69
Flex. elbow	26.05	1.31	25.00	22.54	5.87	2.75	0.38
Flex. hip	84.90	1.58	87.00	8.35	7.09	3.32	0.17
Ext. hip	156.45	1.55	155.00	4.43	6.92	3.24	0.84
Abd. hip	98.30	1.74	96.00	7.89	7.76	3.63	0.64
Flex. knee	45.60	1.27	45.50	12.47	5.69	2.66	0.60
Flex. col. lumb.	59.90	2.79	62.50	20.86	12.50	5.85	0.38
Temperature	21.35	0.60	20.50	12.65	2.70	1.26	0.46

$\bar{x}$ = Average; ε = Standard error; Md = medium; CV = variation coefficient; S = standard deviation; α = Alfa; p = value.

Figure 1 shows the descriptive results of the sample concerning the flexibility levels in the three studied phases. The standard error has shown below the reference limit at all times, indicating that the variability among "samples" is constant.

The Kolmogorov-Smirnov test was used for the homogeneyzation of the sample, where it was observed that all flexibility variables in the three considered steps were close to the normal distribution. Such fact reinforces the use of the ANOVA to test the existence of average differences in the flexibility variables, in the distinct steps.

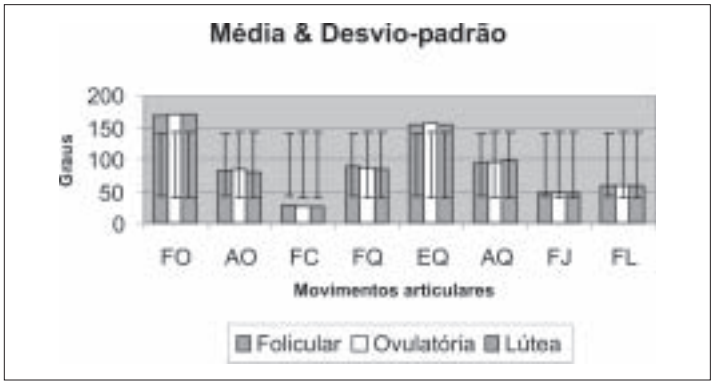

Figure 1 *– Descriptive results of the flexibility levels in the follicular, ovulatory and lutean phases in gymnastics practitioner women with normal menstrual cycle (n = 20)*

FO(SFM) = shoulder flexing movement; AO(AS) = shoulder abduction; FC(EFM) = elbow flexing movement; FQ(HFM) = hip flexing movement; EQ(HE = hip extension; AQ(HÁ) = hip abduction; FJ(KFM) = knee flexing movement; FL(LCFM) = lumbar column flexing movement.

In the tests of the possible average differences in the articulatory movements of the sample, the lack of differences among the averages of all variables is observed, in other words, in the follicular, ovulatory and lutean phases, the flexibility averages are similar. Therefore, the different phases of the MC did not influence the degree of flexibility of the sample of the actual study.

DISCUSSION

The results of this study showed that the three phases of the MC (follicular, ovulatory and lutean) probably did not influence the flexibility in the studied group, once they did not present significant differences among them. Chaves *et al.*[1] have reached to the same conclusion when analyzing the global body flexibility behavior, by articulation and by movement, in adult Young women, in the different phases of the MC.

The referred study[1] analyzed the flexibility by the Flexiteste protocol in 15 women, divided in two groups: experimental group – consisted of eumenoreics, and control group – consisted of women in regular use, for at least a month, of oral contraception. The results showed that there are no differences in flexibility, movement by movement, or through the Flexíndice, in the different phases of the MC for both groups. However, the authors mentioned the lack of hormonal control in the different phases of the cycle as a limitation to the study. It has been concluded that the obtained data do not corroborate the emphyrical impression that flexibility varies during the MC phases. Nevertheless, such data agree with the ones found in the actual study.

Viana *et al.*[10] conducted a similar study with the aim to verify whether the hip flexibility indexes in female college students would suffer significant decrease in the 1º day and in the 15º day after menstruation. The 15º day corresponds to the lutean phase, where no variation was observed when compared to the menstrual phase. In such study, the sitting and reaching test was applied. Statistically, it was concluded that in the correlation test there was no significance between them.

Charkoudian e Johnson[12], did no find significant differences in the three phases of the MC between the experimental and control groups when they studied about the estrogen and progesterone association with the increase of the body temperature of up to 0.5 Celsius degree. Such results were similar to the ones found in the actual research.

However, other studies[4,13,14] show that variations in the estrogen and progesterone levels during the MC, affect the feminine physiology in many factors such as: use of energetic substrate in different training intensities and volumes, oxygen consumption, energetic substrate storage and fats oxidation. Yet, these physiological changes did not demonstrate significant alterations in the flexibility levels in the three phases of the MC of the actual study.

The probable lack of modification in the flexibility degree of the actual investigation can be justified by the findings by Tenaglia *et al.*[15]. The increase of the body temperature in the lutean phase is not sufficient to cause increase in the flexibility during the MC under the use and no-use of oral contraceptives in the tolerance of the thermal stress. In the referred study it was observed that in the lutean phase the rectal temperature was higher than in the follicular for the two groups, reaching to the conclusion that these alterations are due to the circadian rhythm, and not to the synthetic hormone administration.

Samuel *et al.*[16] demonstrated in their studies that the relaxin decreases the soft tissues tension and the amount of this hormone varies according to the MC phases. Wojtys *et al.*[17] corroborate these finidings reporting that, in their research on MC and lesion of the crossed ligament, that this hormone has the ability to increase the lassitude of these tissues, increasing its concentra-

tion in the 12° day and reaching its peak on the 14°. In the middle of the lutean phase (20° day of the cycle) the increase is repeated, with hormonal alterations capable of causing physical and metabolic changes in the articulation mobility expression or of ligament lassitude. Such evidence disagrees with the results of the actual investigation.

Lebrun[18], in his research, found significant differences in the soft tissues lassitude in the group that did not make use of oral contraceptives in relation to another that made use of the method. These findings disagree with the study by Hinnerichs *et al.*[19]. This investigation did not show significant differences in the muscular force, resistance and flexibility, in physically active adult young women, in the MC phases, when the same comparison with the use of oral contraceptives was made. Once again, these data disagree with the results found in the actual study, since the sample did not use contraceptive pills nor obtain differences in the broadness of the measured articulation arches.

Sarwar *et al.*[20] reported significant changes in the contrariation and relaxation properties of the skeletic muscle during the ovulatory phase. However,, Fridén *et al.*[21] did not obtain the same answers in the three phases of the MC. These findings corroborate with the results of the actual study, suggesting that there is no significant differences in the flexibility levels during the three phases of the cycle.

Finally, the changes of the physical abilities presented during the phases of the MC are prone to considerable individual variation. Some women do not present any tangible change in their capacity in the performance in any period of their MCs, while others show variable performances during the cycle. According to the data found in this research, and taking the study limitations into consideration, one come to the conclusion that there is some evidence that the MC does not interfere in the flexibility variable in the studied phases. New investigations are recommended, using larger samples, observing other phases of the MC, checking the flexibility levels during the menstrual phase, or even daily measuring the flexibility during the whole cycle.

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