DOI: 10.1590/1809-2950/17243825012018

ORIGINAL RESEARCH

Postural control of women with primary dysmenorrhea in different phases of the menstrual cycle

Controle postural de mulheres com dismenorreia primária em dois momentos do ciclo menstrual

Control postural de mujeres con dismenorrea primaria en dos momentos del ciclo menstrual

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ABSTRACT | Primary dysmenorrhea (PD) is a lower pelvic or abdominal pain related to menstruation that is associated to painful myofascial points, and its presence can alter somatosensory perception and muscle activation, which can affect postural control. This study's aim was to verify PD's influence on women's static postural control in two different phases of the menstrual cycle, with and without pain. 19 university students (22.4±3.0 years-old) with PD were evaluated by visual analog scale, algometry and force plate. The data were submitted to descriptive statistics and had their normality verified (Shapiro-Wilk), the variables were compared using the Student t-test and Wilcoxon test. The assessed group showed pain considered as average (4.1±2.3). The values for pressure pain threshold were lower in the moment with pain than in the moment without pain, in the right abdominal area (p=0.04) and bilateral lumbosacral (p<0.05), indicating a higher local sensitivity. Regarding the postural control, there was a higher range of anteroposterior movement of the center of pressure, both in the open and closed eyes condition, as well as in the average speed and area of the ellipse of the center of pressure in the closed eyes condition during the PD moment. Such changes point out to a stronger need for postural adjustments in the PD, possibly caused by pain interference over proprioception. It was concluded that there was higher pain sensitivity during the cycle's menstrual phase and that the pain interfered on this group's postural control, considering that the lack of sight increased these effects.

Keywords | Dysmenorrhea; Posture; Women's Health; Physical Therapy Specialty.

RESUMO | A dismenorreia primária (DP) é uma dor pélvica ou abdominal inferior relacionada à menstruação, associada a pontos dolorosos miofasciais, cuja presença é capaz de alterar a percepção somatossensorial e a ativação muscular, o que pode interferir no controle postural. O objetivo deste estudo foi verificar a influência da DP no controle postural estático de mulheres em dois momentos do ciclo menstrual, com e sem dor. Foram avaliadas 19 universitárias (22,4±3,0 anos) com DP por meio da escala visual analógica, algometria e plataforma de força. Os dados foram submetidos à estatística descritiva e verificados quanto à normalidade (*Shapiro-Wilk*), e as variáveis, comparadas utilizando-se o teste t de *Student* e o teste de *Wilcoxon*. O grupo avaliado apresentou uma dor considerada moderada (4,1±2,3), e os valores de limiar de dor à pressão foram menores no momento com dor quando comparado ao sem dor, na região do abdômen direito (p=0,04) e lombossacral bilateral (p<0,05), indicando maior sensibilidade local. Quanto ao controle postural, houve maior amplitude de deslocamento anteroposterior do centro de pressão, tanto na condição "olhos abertos" quanto "olhos fechados", bem como na velocidade média e área da elipse do centro de pressão, na condição "olhos fechados", durante o momento com DP. Essas alterações indicam maior necessidade de ajustes posturais na DP, possivelmente em virtude de uma interferência da dor sobre a propriocepção. Concluiu-se que houve maior sensibilidade dolorosa na fase menstrual do ciclo e que a dor interferiu sobre o

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controle postural deste grupo, eventos que foram intensificados pela ausência de visão.
Descritores | Dismenorreia; Postura; Saúde da Mulher; Fisioterapia.

RESUMEN | La dismenorrea primaria (DP) es un dolor pélvico o en la parte baja del abdomen asociado a la menstruación, y está relacionada a puntos dolorosos miofasciales, que puede alterar la percepción somatosensorial y el funcionamiento muscular, interfiriendo en el control postural. El propósito de esta investigación es comprobar la influencia de la DP en el control postural estático de mujeres en dos momentos del ciclo menstrual: con dolor y sin dolor. Se evaluaron 19 estudiantes universitarias (22,4±3,0 años) con DP mediante la escala visual analógica, la algometría y la plataforma de fuerza. Se evaluaron los datos por la estadística descriptiva y contrastadas su normalidad (*Shapiro-Wilk*) y las variables comparables mediante la prueba *t* de Student y la prueba de Wilcoxon. El grupo evaluado presentó un dolor moderado (4,1±2,3), y el umbral de dolor a la presión fue menor durante el momento de dolor en comparación al momento sin dolor en el lado derecho del abdomen (p=0,04) y en la región lumbosacra bilateral (p<0,05), demostrando sensibilidad local. Respecto del control postural, hubo una amplitud más grande del movimiento anteroposterior del centro de la presión tanto en la condición "ojos abiertos" como la de "ojos cerrados", así como en el promedio de velocidad y la zona de elipsis del centro de presión, en la condición "ojos cerrados", durante el momento con DP. Estas alteraciones señalan que son necesarios cambios posturales durante la DP, probablemente porque el dolor interfiere en la propiocepción. Se concluye que durante la fase menstrual del ciclo hubo más sensibilidad dolorosa y que el dolor interfirió en el control postural del grupo evaluado, más intenso en la condición ojos cerrados.
Palabras clave | Dismenorrea; Postura; Salud de la Mujer; Fisioterapia.

INTRODUCTION

Dysmenorrhea is defined as any painful episode perceived during menstruation, specially in the lower abdomen area. When it happens along with the lack of pelvic disease, it is classified as primary dysmenorrhea (PD). It is one of the most present gynecological conditions in women at childbearing age, given that its prevalence ranges between 54.5% and 88%[1-3].

It is believed that the cause of cramps pain episodes in PD is related to the excessive prostaglandins production and release by the endometrium during menstruation, causing uterus hypercontractility and, consequently, ischemia and hypoxia[4,5]. Moreover, hormone fluctuations during the menstrual cycle of PD women seem to be related to pain awareness mechanisms in the central level[6].

Postural control has, as one of its most important tasks, to effectively integrate its systems (visual, vestibular and somatosensory) in order to keep the balance on the support base provided by the feet. Such maintenance includes sensory detection of body movements, integration of sensory-motor responses in the Central Nervous System (CNS) and the execution of proper muscle-skeleton responses[7].

In physiological situations, small sway in the postural control happen since the forces and body force moments are of low magnitude[7]. While in pain situations, the CNS performance in relation to postural control is reduced, given that processing the pain is the priority[8].

The connection between pain and postural control has already been described in acute[9] and chronic[10-12] musculoskeletal conditions, proving that changes in this system can cause disturbance on balance. Moreover, the adjustments in postural control can be affected by the adoption of antalgic postures[13], the presence of myofascial trigger points[11] and paradoxical torso muscle contraction[12,14], besides alterations in proprioception[8,15].

It is believed that somatosensory changes[9,10] and differences in the activation of deep abdominal muscles[7] due to the presence of pain can interfere on postural control of women with PD. Such postural control disarrangements can cause unbalance that negatively reflects on these women's performance in daily life activities, specially in when practicing physical and sports activities[7]. Given that, this study aims to verify the influence of PD on the static postural control of women in two phases of the menstrual cycle, with and without pain, relating the presence of painful abdominal and lumbosacral spots in the possible alterations of this control.

The hypotheses of this study were that: (a) Women with PD show higher sway of postural control variables at the moment with pain when compared to the moment

without pain; and (b) At the moment with pain, women with PD have presented lower pain threshold in the painful abdominal and lumbosacral spots, which will impact on their postural control.

METHODOLOGY

This research is observational, being transversal, with a quantitative approach and it was approved by the Committee for Ethics and Research of the Universidade Federal de Santa Maria (CAAE: 48387315.2.0000.5346, statement: 1.442.320, of march, 08th 2016).

Sample

The study included women aging from 18 to 35 years-old, classified as having primary dysmenorrhea according to the Primary Dysmenorrhea Guideline[3], nulligravidae, physically inactive (criteria from the International Physical Activity Questionnaire – IPAQ, short form[15]), who used oral contraceptives non-continuously and who accepted to participate in the research by signing the Informed Consent Form. Were excluded from the study women who had any gynecological pathology or other pathologies that could hamper balance, such as labyrinthitis and musculoskeletal injuries, who have felt any discomfort during the tests' application or who have not fulfilled all the study's phases.

The sample estimation was performed using the software G-Power 3.1.9.2, based on the results by Petrofsky and Lee[16]. A sample of 17 subjects was estimated for achieving a high level of significance (alpha) of 5% ($p<0.05$) and of power (beta) of 80%.

Procedures

The participant women were reached through social networks, e-mails and promotion in their academic areas. Those who voluntarily accepted to participate in the research answered to the evaluation questionnaire with personal characteristics, gynecological history and dysmenorrhea characteristics, as well as filled the Visual Analog Scale (VAS) and marked a body chart with the graphic representation of feminine anatomy, front and back, marking the spots of said pain during menstruation. Those who were classified as having primary dysmenorrhea followed to the other study procedures, which were the evaluation of painful points (algometry) and the evaluation of postural control.

All evaluations were done in two different moments for each participant: first, on the first day of the menstrual cycle (with pain); and after, on the 14th day of the menstrual cycle, which was set as the phase without pain.

The use of analgesic medication by the women during this menstrual cycle was registered, considering that they were instructed not to take these medicines in the 24 hours previous to each of the gatherings.

Pressure pain threshold

The pressure pain threshold, defined as the point when the pain starts to be perceived, was evaluated in the patients by using a nozzle in the handheld dynamometer Microfet 2 HHD (HogganHealth, United States), having its measures expressed in kg/cm^2.

The evaluation protocol was based on the study by Molins-Cubero et al.[17] and Travel et al.[18]. A pre-experiment reliability evaluation was performed with healthy women (n=10) and the intra-examiner reliability for the evaluation of the pressure pain threshold was considered excellent, having a correlation coefficient of 0.91. Thus, in order to maintain data gathering consistent, the patients were examined by only one researcher.

Initially, the test procedure was demonstrated on the upper right trapezius muscle, so that the patient could identify the point when the pressure feeling turned into a pain feeling[19]. Then, the patient remained in the orthostatic position, with feet position parallel to hip width. The mean spot between the umbilical scar and the pubic symphysis was located, and then two spots were marked at about 5 cm to the right and 5 cm to the left from that spot. Later on, the patient stayed in a sitting position, with feet touching the floor and upright backbone. The examiner, standing behind the patient, located through palpation the right and left postero superior iliac spines (PSIS) and marked these spots.

The algometer was positioned perpendicularly in relation to the body surface in each of the marked spots, and it increased pressure at a growing and constant rate (1kg/s), without abrupt shifts. The participants were instructed to report the beginning of the painful feeling by saying the word "pain" and, at this moment, the pressure was interrupted, and the value observed was registered. The measurements were

made three consecutive times in each spot, with a rest period of 30 seconds between each one of them, and the value considered was the average among these measurements.

Figure 1. Representation of the four spots evaluated by algometry.

Evaluation of postural control

In order to gather data regarding the static postural control, the force plate AMTI model OR6-6 (Advanced Mechanical Technologies, Inc.) was used. For the evaluation, the participants were instructed to stand on the plate with bare feet apart from each other in the hip width, in a comfortable position, with arms alongside the body and the head facing the front, eyes fixed on a target located at about two meters away. The feet position was marked in a paper so that each trial was performed in the same position. Proper environment conditions were taken into account, such as temperature, lighting and noise, so that they would not interfere on the evaluations of postural control.

Three trials were done, each lasting 30 seconds, with open eyes, and right after with closed eyes, given that the volunteers that wore glasses had them on during the gathering. A short break was done between each trial, which consisted on the participant going out and back again on the plate.

The force plate acquisition frequency was 100Hz. Raw data collected in the force plate were filtered using a fourth order butterworth low-pass filter, with a 10Hz cutoff frequency, in order to smooth possible signal noises, according to the proposed protocol[20]. After being filtered, the data were used for calculating the coordinates for the center of pressure (COP), from which the interest variables were obtained. To evaluate the postural control, the variables used were the width of antero-posterior dislocation of COP (COPap), width of medium-lateral dislocations of COP (COPml), average speed of COP dislocation (COPvel) and ellipsis' area (AE95%). These variables, when presenting higher values, indicate that there was a higher postural sway.

Statistical analysis

Descriptive statistics was performed to represent the sample. After that, the Shapiro-Wilk normality test was performed. To analyze the differences in variables between groups, the Student's T-Test was used for symmetric measures and the Wilcoxon test was used for asymmetric ones. The Spearman correlation test was used to correlate data from VAS, algometry and postural control. All statistical analyses were performed using the software SPSS 14.0 for Windows, considering an adopted significance level of 5% ($\alpha<0.005$).

OUTCOMES

Of the 25 interviewed volunteers, four were excluded for not having met the inclusion criteria and two other for not being present at the second evaluation moment, having 19 remaining participants (Figure 2).

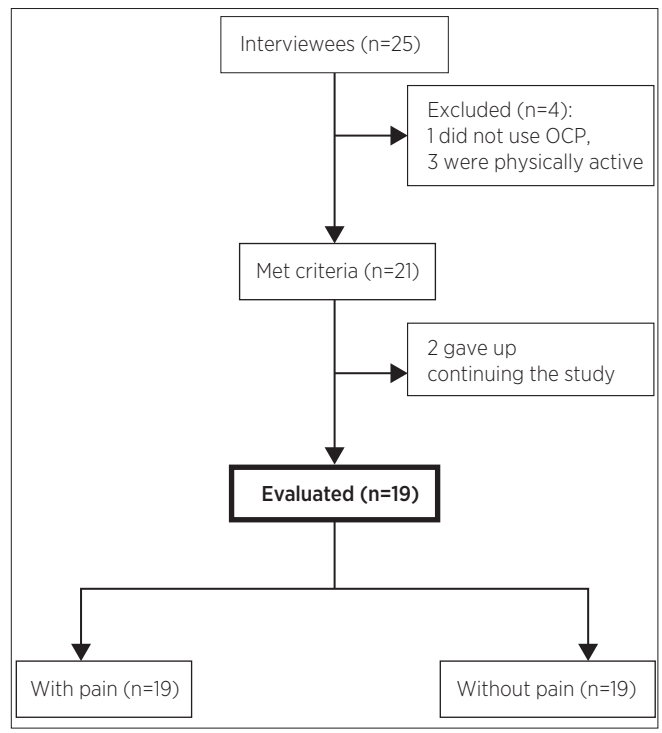

Figure 2. Sample selection flowchart. OCP: oral contraceptive

The participants' characterizing data, such as age, anthropometric measures, and gynecological history are shown in Table 1.

Table 1. Characterization of the sample of university women with primary dysmenorrhea in relation to anthropometric data and gynecological history

	n=19
Age (years)	22.4±3.0
BMI (kg/m²)	22.5±2.4
Menarche (years)	12.0±1.8
Dysmenorrhea duration (days)	2.3±0.7
Average menstrual flow (n(%))	12(63.2%)
Sexually active (n(%))	17(89.5%)
Family history of dysmenorrhea (n(%))	14(73.7%)

Values expressed in average±PD or n (%); BMI: body mass index.

The group of evaluated women presented a 4.1±2.3 score at the VAS, which represents moderate pain. The painful spots marked in the body chart were mainly the lower abdomen (100%) and the lumbar region (52.6%).

In the algometry, the results pointed out differences between the pressure pain threshold values obtained in the moment with pain and in the moment without pain in women with primary dysmenorrhea (Figure 3). There was more pain sensitivity to the pressure stimulus during the menstrual phase of the cycle.

Moreover, for 26.3% of the evaluated women, the algometry on myofascial points considered as representing PD was able to increase pain intensity.

There was no correlation between VAS and pressure pain threshold data for the evaluation of the moment with pain (abdomen R: p=0.06 and r=-0.43; abdomen L: p=0.17 and r=-0.33; PSIS R: p=0.65 and r=0.11; PSIS L: p=0.24 and r=028).

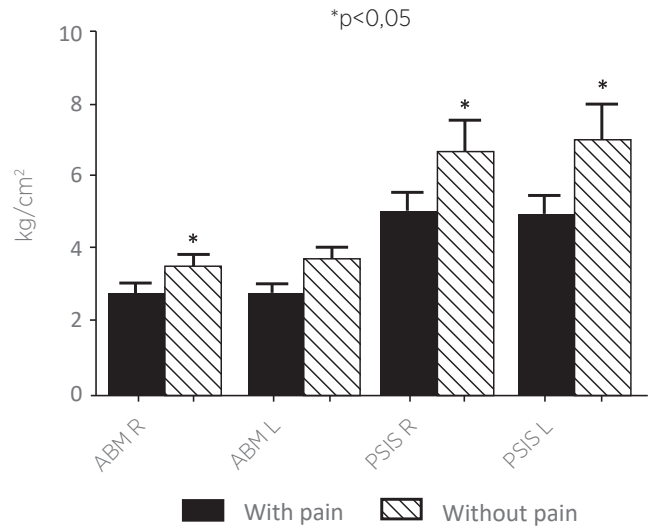

Figure 3. Algometry measurement on the four evaluated points, measured in different phases of the menstrual cycle (with and without dysmenorrhea). ABM: abdomen; PSIS: postero superior iliac spine

Table 2 shows the values for postural control in the different cycle phases. There was a difference in relation to the variable width of antero posterior displacement of COP (COPap), both in the open eyes (OE) and closed eyes (CE) conditions, as well as in the variables average speed of center of pressure displacement (COPvel) and ellipsis area (AE95%) in the CE condition, considering that, during the PD moment, the women presented a higher sway in these variables.

There was no correlation between pressure pain threshold data in all points and the variables of postural control, in the evaluation during the moment with pain.

Table 2. Data regarding postural control, measured in different phases of the menstrual cycle (with and without dysmenorrhea). Values expressed in averages (p25-75)

	1st day of cycle (with dysmenorrhea)	14th day of cycle (without dysmenorrhea)	P value
Open eyes			
COPap (cm)	2.2 (1.8-2.7)	1.9 (1.6-2.3)	0.02*
COPml (cm)	1.3 (1.0-1.5)	1.1 (0.9-1.4)	0.22
COPvel (cm/s)	0.9 (0.8-1.0)	0.8 (0.7-1.0)	0.32
AE95% (cm²)	2.0 (1.5-2.7)	1.2 (1.0-2.5)	0.06
Closed eyes			
COPap (cm)	2.6 (1.9-3.3)	2.3 (1.7-2.7)	0.01*
COPml (cm)	1.4 (1.2-2.2)	1.2 (0.9-1.9)	0.09
COPvel (cm/s)	1.1 (0.9-1.3)	1.0 (0.8-1.3)	0.05*
AE95% (cm²)	2.3 (1.6-4.0)	1.6 (1.0-3.4)	0.03*

Values expressed in averages (p25-p75). COPap = width of antero posterior displacement, COPml = width of medium lateral displacement of center of pressure, and COPvel = average speed of center of pressure displacement, AE95% = ellipsis area; *Wilcoxon test, p<0,05.

DISCUSSION

This study aimed to verify the influence of PD on women's static postural control in two phases of the menstrual cycle, with and without pain, correlating the presence of painful abdominal and lumbosacral spots to possible alterations in this control. The results showed that the pressure pain threshold was reduced in all spots evaluated during the menstrual phase (with pain) and that there was a higher postural sway of women in the phase with pain when compared to the phase without pain, specially when visual information was suppressed.

Similarly to this study, Baiai et al.[21] have assessed the pressure threshold and have found its reduction in the abdomen and back. While in comparison to the findings by Molins-Cubero et al.[17], the pressure thresholds in these study for lumbosacral spots are much higher (4.96 and 4.90, R and L, respectively, against 1.32 and 1.40). This may have happened because, in the study by these authors, the participants reported severe pain, compared to this study, in which volunteers reported moderate pain.

The women evaluated in this study reported feeling pain specially in the lower abdomen (100%) and the lumbar area (52.6%), data in concordance to previous studies[6,21]. The most accepted explanation for these findings concerns the fact that the uterus' highest innervation occurs in the thoracolumbar transition segments (T10-L1) and sacral segments (S2-S4)[6].

Even though having a pain average considered as moderate, the volunteers presented a significant reduction in their pressure pain threshold, without, however, existing a correlation between data from algometry and pain intensity. Previous researches[22] highlight that many times, women with PD have a low pain perception threshold, disproportionate to its intensity.

On the other hand, when the pressure pain threshold was evaluated in comparative studies between women with and without PD, the ones with PD presented high response to a harmful stimulus, not only when they were feeling pain[23]. This supports the hypothesis that women with PD have an increased sensitivity to pain in the CNS level, caused by repetitive episodes of monthly pain[6]. Other authors[24] highlight that, in such cases, there is a variation in the way systemic pain is processed, so that peripheral nociceptive information created by reproductive organs during menstruation is amplified, and this causes a higher excitability in somatovisceral neurons converging in the spinal cord, eventually increasing pain perception in the central level.

Pain exacerbation caused by algometry on myofascial points considered as representing PD reaffirms that painful spots in torso muscles can frequently affect the function of surrounding internal organs, specially abdomen, thorax and pelvic floor muscles[11]. The reduction of pressure pain threshold and the presence of trigger points creates a vicious cycle, which includes harms to the activation of core muscles[14,25], antalgic positions[13] and deficit in stabilization and balance[15]. All these characteristics affect postural control, since its maintenance depends on sensory information from the visual, vestibular and somatosensory systems[26].

In our study, women with PD had a higher sway in their center of pressure during the period with pain when compared to the period without pain. This alteration was not observed in all variables from the plate, which, according to Duarte and Freitas[7], would not allow us to conclude that the volunteers showed worse postural control in the phase with pain.

The only study found that has also evaluated the postural control of women with PD was the one by Petrofsky and Lee[16]. These authors, however, correlated this variable to connective tissue elasticity, which would be altered due to the hormone variation that occurs during menstrual cycles, and they have found a reduction in postural control during the ovulation phase. Considering that this study did not intend to verify the hormone variations throughout the cycle, but only pain and its relation to postural control, it is not possible to compare data between the studies.

It is widely known by literature[26] that, in order to keep an erect posture, the postural control selects proper strategies, given that two of the most studied ones are the ankle strategy and hip strategy, which differ, among other aspects, in which muscle group is first used when there is a postural instability. Considering the inverted pendulum model, the ankle strategy regulates mainly the balance in the antero posterior direction, while the hip strategy regulates medium lateral balance[27].

In this study, when women with PD were in pain, there was a higher sway in the COPap variable in relation to the day without pain. This result was expected considering that postural adjustments are more easily performed in the antero posterior direction, since, besides the ankle, all articulations responsible for these adjustments have a higher movement width in this

direction[12]. Thus, when individuals show any alterations in postural control under any specific condition, the first variable to represent it is precisely the antero posterior sway.

When the visual information was suppressed, the COPap, COPvel, and AE95% variables showed higher sway in the day with pain when compared to the day without it. This happens because, without the sight, somatosensory and vestibular systems are more required for postural control[27]. Considering that the fibers that propagate the painful impulse have fast transmission and processing priority in the CNS, the other stimuli from the body are suppressed, such as proprioceptive ones[8,15]. Through this mechanism, pain compromises proprioception and, therefore, a higher alteration in the postural control of women with PD was expected in the closed eyes condition.

Likewise evident in other studies[12,28], pain was able to affect postural control and the lack of sight intensified these effects. However, there was no direct relationship between this variable and the pressure pain threshold and VAS. That is, pain had affected this group's postural control, regardless of its intensity.

Such higher susceptibility to pain during the menstrual phase and the consequent alteration in postural control shows that the disfunctions caused by PD are not limited to the pelvic area. Given that, there is the need for a more complete clinical approach to these women by health professionals, since PD can interfere with the practices of daily life and predispose the appearance of chronic conditions.

This study has some limitations, such as its transversal design and not having a control group the consumption of analgesics by the study's subjects was not controlled. Central sensibility was not verified, through an evaluation of pressure pain threshold in a peripheral area. Dynamic evaluations of postural control were also not performed, which could be better related to the daily life activities affected by PD.

CONCLUDING REMARKS

There was a higher painful sensitivity to pressure stimulus during the cycle's painful phase for the studied university women. The pain caused a higher sway of the center of pressure in this groups, negatively affecting postural control, which was intensified by the suppression of sight.

ACKNOWLEDGEMENTS

To the Prof. Dr. Carlos Bolli Mota and, on his behalf, to the whole team of Labiomec for lending the physical area and equipment necessary for performing this research.

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