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MYOFASCIAL PAIN AND TREATMENT: Original Research

The prevalence of primary dysmenorrhea among students and its association with musculoskeletal and myofascial pain

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ABSTRACT

Objectives: To examine the association between dysmenorrhea and musculoskeletal pain amongst university students aged 20–35 and the association between dysmenorrhea and the occurrence of MTrPs.
Methods: The study comprised two stages: a cross-sectional study evaluated the association between dysmenorrhea and musculoskeletal pain and a case-control study evaluated the association between dysmenorrhea and the occurrence of MTrPs in the abdominal and pelvic area. Initially, questionnaires such as demographics, menstruation characteristics, Numeric Pain Rating Scale (NPRS), measuring the average pain during menstruation and Nordic, were distributed to female students. Twenty subjects who suffered from menstrual pain of >3 on the NPRS (ones with the highest scores) were included in the second stage as cases. An additional 20 who had not suffered from menstrual pain (NPRS ≤3) were considered controls. All 40 subjects underwent an assessment of MTrPs by two examiners blinded to each other's results and to the group allocation of the subjects.
Results: We found that dysmenorrhea is a very prevalent condition among young female students. Most frequent complaints were: lower abdomen and back pain, tiredness, breast tenderness, mood changes, and an increased appetite. Pain during menstruation indicated a significant positive association with neck, low back, and hip/thigh pain during the last 12 months. The results of the palpitation conclusively showed more active MTrPs in the rectus abdominis, quadratus lumborum and paraspinal muscles in women suffering from pain during menstruation than in those who were not in pain.
Conclusion: Our data provide an initial basis for the inclusion of a myofascial examination when evaluating women with dysmenorrhea.

1. Introduction

The menstrual period, one of the phases in the menstrual cycle, plays an important role in female fertility, both physically and emotionally (Lee and Park, 2015). Dysmenorrhea, defined as pain and tenderness in the lower abdomen or lower back is divided into two types: primary – experiencing pain before or during menstruation, unrelated to other illnesses, and is the most common gynecological complaint amongst young women (De Sanctis et al., 2017); secondary - experiencing pain during menstruation, caused by a disorder in the woman's reproductive organs, such as endometriosis, adenomyosis, uterine fibroids, or infection (Subasinghe et al., 2016). Dysmenorrhea occurs mainly in adolescent girls and young women with a prevalence between 70% and 90% (De Sanctis et al., 2015; Subasinghe et al., 2016) and may significantly affect a female's quality of life (Huang and Liu, 2014). In most cases, menstrual pain ceases after childbirth, owing to a change in hormonal balance (Avant, 1988).

The pain may begin prior to or upon the onset of menstrual bleeding, usually lasting for several hours to two days (Huang and Liu, 2014). It is generally a vague pain difficult to locate and sometimes difficult to describe. It can also be felt in the bones, muscles, and skin of the surrounding organs (Lee and Park, 2015). In some women, the pain is mild and manageable, but in others, the pain is moderate or severe, mainly concentrated in the lower abdomen. The pain is occasionally accompanied by nausea, vomiting, generalized abdominal pain, breast tenderness, anal swelling, and diarrhea. Moreover, in certain women, the pain occurs not only in the abdomen but also in the head, neck, lower back, pelvis, and thighs (Grandi et al., 2012). Amongst those suffering from

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dysmenorrhea, a higher percentage reported mood changes than those who did not suffer from dysmenorrhea (Subasinghe et al., 2016). Although it is very common, few women seek appropriate medical treatment (Banikarim et al., 2000).

The exact cause of dysmenorrhea symptoms is not well understood (Lee and Park, 2015). Some studies attribute the symptoms to prostaglandin activity in the uterus, specifically PGF2α (Coco, 1999). The overproduction of vasopressin, a hormone stimulating constriction of muscle tissue, has been identified as a contributing factor for primary dysmenorrhea (Proctor et al., 2006). Other studies have linked the symptoms with the musculoskeletal system. One theory suggests a connection between irregular positioning of the pelvis, lumbar vertebrae and a spasm of the abdominal muscles, which influence the position of the uterus, thus, increasing the chances of dysmenorrhea. The position of the lumbar vertebrae can also affect the blood supply to the uterus by vasoconstriction, thereby, causing pain. Another possible explanation is that the musculoskeletal system is also affected by the hormonal influences during the menstrual phase and can project pain (Abaraogu et al., 2017).

According to earlier studies analyzing the association between menstrual pain and musculoskeletal pain, women suffering from menstrual pain at $\geq$3 on the Visual Analog Scale (VAS) suffered more from musculoskeletal pain (Lee and Park, 2015). Although the mechanism of dysmenorrhea differs from that of musculoskeletal pain, the symptoms overlap. Therefore, in many cases, pain complaints during menstruation are basically the same complaints as musculoskeletal pain (Lee and Park, 2015). Moreover, research has shown a strong correlation between physical activity and menstrual pain, both in aerobic activity and strengthening exercises, which can prevent musculoskeletal pain and reduce menstrual pain (Dehnavi et al., 2018). During menstrual bleeding, the uterus contracts in order to expel the debris accumulated during the menstrual cycle. Hormones trigger the start of the uterine contractions and vasoconstriction of the blood vessels in the pelvic floor and abdomen, thus, causing a decreased blood flow and metabolic deficits in the muscles which may lead to the development of myofascial pain.

Myofascial pain is “the complex of the sensory, motor and autonomic symptoms caused by myofascial trigger points (MTrPs)” (Simons et al., 1999). A MTrP is a hyperirritable spot in the skeletal muscle associated with a hypersensitive palpable nodule in a taut band. In addition, the spot is painful on compression and may produce characteristic referred pain and tenderness, motor dysfunction and an autonomic phenomenon. Two major types of MTrPs have been described: active and latent. Active MTrPs are associated with spontaneous complaints of pain. In contrast, latent MTrPs do not cause spontaneous pain, however, pain may be elicited by manual pressure or needling of the MTrP. Although latent MTrPs are not spontaneously painful, it has been theorized that they restrict the range of motion and alter motor recruitment patterns (Simons, 2004). These points can also affect the function of the adjacent internal organs, particularly in the abdomen, chest and pelvic floor (Montenegro et al., 2009).

Studies have found associations between the presence and treatment of levator ani trigger points and chronic pelvic pain (Langford et al., 2007). Furthermore, an association was found between the presence of MTrPs and menstrual pain; however, due to a scarcity of studies, there is no proof of an explicit connection between the two. During menstruation, the most common locations for MTrPs are the lower abdomen, lower back, chest, and head (Motahari-Tabari et al., 2017). The muscles relevant to these areas are primarily oblique muscles, rectus abdominis, and quadratus lumborum (Lee and Park, 2015).

The pharmacological treatments recommended for women suffering from menstrual pain are prostaglandin inhibitors, NSAIDs and hormonal medications such as contraceptives (Subasinghe et al., 2016). Hormonal contraceptives are one of the options for treating dysmenorrhea, however, others have found that there were no distinct differences between women's complaints of those treated with hormonal contraceptives and those not treated (Subasinghe et al., 2016). Women who are unable to take these medications due to various side effects can obtain relief using non-pharmacological treatments, such as physical therapy. Alvarez and Rockwell, (2002) hypothesized that aerobic activity and stretching can reduce symptoms of dysmenorrhea. The treatment group who performed aerobic activities and stretches during three menstrual cycles experienced significantly less dysmenorrhea and muscle pain than the control group who did not perform the aerobics and stretches. A study comparing reflexology treatment to connective tissue manipulation (relaxed muscle contraction, improved blood flow, and a balanced autonomic system), found no difference in dysmenorrhea prevention between the two treatments (Demirturk et al., 2016). Other treatments, such as dry needling in abdominal muscles, have been found to effectively reduce symptoms (Huang and Liu, 2014). Simons and Dommerholt, (2005) stated that acupuncture and dry needle therapy are effective in treating abdominal MTrPs and decreasing pain after two to three treatments.

The aims of our study were: 1) to examine the prevalence of dysmenorrhea amongst university students aged 20–35; 2) to examine the association between dysmenorrhea and musculoskeletal pain; 3) to examine the association between dysmenorrhea and the occurrence of MTrPs.

Hypotheses: 1) In accordance with worldwide data, the prevalence of dysmenorrhea amongst university students will be high; 2) an association exists between dysmenorrhea and musculoskeletal pain. Women who suffer from menstrual pain >3 on the VAS scale will also report higher rates of musculoskeletal pain; 3) women who suffer from menstrual pain >3 on the Numeric Pain Rating Scale (NPRS) have a higher prevalence of MTrPs than those experiencing menstrual pain $\leq$3.

2. Methods

2.1. Study design

The study encompassed two stages: a cross-sectional study evaluating the association between dysmenorrhea and musculoskeletal pain and a case-control study evaluating the association between dysmenorrhea and the occurrence of MTrPs in the abdominal and pelvic area.

2.2. Setting

Department of Physical Therapy, Recanati School for Community Health Professions, Faculty of Health Sciences, Ben-Gurion University of the Negev, Beer Sheva, Israel.

2.3. Sample

Nulliparous female students attending Ben-Gurion University, aged 20–35, who have regular monthly menstrual periods.

2.4. Exclusion criteria

- Use of oral contraceptives or a hormonal intrauterine device.
- Fibromyalgia and other rheumatic diseases.
- Fractures or surgeries in the pelvic or hip area during the past year.

- Other gynecological diseases (excluding dysmenorrhea). No women with surgically confirmed endometriosis were found among screened subjects.

2.5. Ethical considerations

Participation in the study was voluntary. Each subject received an explanation as to the aims of the study and methods of collecting data. All participants signed an informed consent form. The study was approved by the Ethics Committee of the Recanati School for Community Health Professions, Ben Gurion University, Israel.

2.6. Evaluation procedure

Each subject completed several questionnaires: demographics, menstruation characteristics questionnaire, NPRS measuring the average pain during menstruation and the Nordic questionnaire evaluating the prevalence of musculoskeletal morbidity.

2.7. Demographic questionnaire

Basic demographic data were collected using a self-administered questionnaire and included age, sex, self-reported weight and height (from which the body mass index (BMI) was calculated (weight in kg divided by height in meters squared), physical activity and smoking.

2.8. Menstruation characteristics questionnaire

Menstruation characteristics were collected via a self-reported questionnaire based on questionnaires used in three previous studies (Lee and Park, 2015; Subasinghe et al., 2016; Takeda et al., 2016) and included general questions about menstruation: hormonal contraceptive treatment, age at menarche, regularity of menstruation, and timing of menstruation cycle, as well as pain during menstruation, onset and duration of symptoms, and marking of pain locations. The participants also reported if they had experienced the following symptoms during menstruation: lower abdominal pain, low back pain (LBP), headaches, general pain, tiredness, nausea, vomiting, diarrhea, breast tenderness, acne, swelling, mood changes, increase or decrease in appetite, irritability, anger, and insomnia.

2.9. NPRS measuring average pain during menstruation

Patients were asked to assess the average intensity of pain during menstruation using a scale ranging between 0 and 10 (0 = "no pain" and 10 = "unbearable pain"). The NPRS is not age-dependent, contains a low risk for error, high face validity and convergent and criterion validity compared to other pain scales (Gagliese et al., 2005; Jensen et al., 1998). It is considered a gold standard for self-assessment of pain and a reliable and accurate tool (Mosele et al., 2012). A 2-point decrease or a 30% reduction found on the NPRS represents a significant clinical change (Childs et al., 2005; Farrar et al., 2001).

2.10. Evaluation of the prevalence of musculoskeletal morbidity

The prevalence of musculoskeletal complaints (pain, aches or discomfort) in the neck, upper back, lower back, shoulders, elbows, hands, thighs, knees, and lower leg were evaluated during the last 12 months and the last 7 days by the modified Nordic questionnaire (Kuorinka et al., 1987). This questionnaire has been shown to be repeatable, reliable and valid and was found appropriate for use in an Israeli population (Ratzon et al., 1998).

2.11. MTrP assessment

The examiners performed an evaluation of MTrPs using the flat palpation technique according to the diagnostic criteria established by Simons et al., (1999) to identify the following:

- The presence of a taut band.
- The presence of a tender spot during palpation.
- Reproduction of referred pain during MTrP compression.

All criteria were scored dichotomously, as presence or absence of each criterion. If the examiner was unsure of the result, he was instructed to score that specific criterion as absent. All subjects were asked if the palpation caused referred pain and if the referred pain was relevant to their complaint. Definition of the active and latent MTrPs was made by summation of the diagnostic criteria. A point was considered an MTrP when a taut band, tenderness and referred pain were all present. If the subject answered that the referred pain was relevant to his complaints, the MTrP was labeled as active; if not, the MTrP was considered latent. The evaluation was performed on four muscles on both sides: gluteus medius, quadratus lumborum, rectus abdominis and paraspinal muscles of the low back.

Before the commencement of the current study, both examiners (YY and NC) underwent training by an experienced instructor in myofascial pain evaluation and treatment (LK) as to locating MTrPs. During the training, they practiced palpation skills, studied the surface anatomy of the relevant areas, discussed techniques as to the amount of pressure and the subjects' position and prepared a detailed protocol of MTrPs evaluation.

2.12. Study procedures

At the initial stage, the study questionnaires distributed to female students at the Recanati School for Community Health Professions, Ben-Gurion University were demographic, menstruation characteristics, NPRS, and the Nordic. Data were collected, entered into an electronic database and analyzed. Twenty subjects suffering from menstrual pain and had scored >3 on the NPRS (ones with the highest scores), were included in the second stage of the study as cases. Another 20 who did not suffer from menstrual pain or scored $\leq$3 on the NPRS served as controls. All 40 subjects underwent an assessment of MTrPs, as described above, by two examiners, blinded to each other's results and to group allocation of subjects. Consensus results were recorded.

2.13. Statistical analysis

All statistical analyses were performed by the SPSS statistical package (Version 23). Significance levels were set at $p < 0.05$. The descriptive statistics were calculated to characterize the study sample, describe the prevalence of menstruation-related symptoms and musculoskeletal complaints in the study subjects.

3. Results

Study participants' characteristics are summarized in Table 1. In total, 119 subjects completed the questionnaires. The mean age of the subjects was 25.10 ± 2.19, BMI 21.72 ± 2.70 and age at menarche 13.10 ± 1.43. Most did not smoke (81.4%), regularly performed physical activity (72%), had normal menstruation (87.3%) (a cycle of 21–28 days, 86.3%). Almost half of the sample (46.2%) used birth

Table 1
Descriptive statistics (N = 119).

Variables		Mean ± SD	Range
Age		25.10 ± 2.19	21–32
Age at menarche		13.10 ± 1.43	10–17
BMI		21.72 ± 2.70	16.41–31.11
Pain level during menstruation (NPRS)		4.95 ± 2.69	0–10
Variables		**Frequencies N (valid %)**	
Smoking	Yes	12 (10.2%)	
	No	96 (81.4%)	
	Smoked in the past	10 (8.5%)	
Regular physical activity		85 (72.0%)	
Birth control pills		54 (46.2%)	
Regular menstruation		103 (87.3%)	
Duration of menstrual cycle	<21 days	1 (0.9%)	
	21–28 days	101 (86.3%)	
	>28 days	15 (12.8%)	
Duration of menses	1–3 days	22 (18.6%)	
	4–7 days	93 (78.8%)	
	>7 days	3 (2.5%)	
Duration of pain during menstruation	No pain	18 (15.1%)	
	1 day	20 (16.8%)	
	1–2 days	55 (46.2%)	
	2–3 days	20 (16.8%)	
	>3 days	6 (5.0%)	
Onset of symptoms	No pain	18 (15.1%)	
	Day before the menstruation	38 (31.9%)	
	On the 1st day	31 (26.1%)	
	On 2nd day	32 (26.9%)	
	Toward the end of menstruation	0 (0.0%)	

BMI – body mass index, VAS – visual analog scale, SD – standard deviation.

control pills. Only 15.1% of the subjects reported no pain during the menstruation. The average level of pain during menstruation was 4.95 ± 2.69. Table 2 illustrates the prevalence of menstruation-related symptoms. Symptoms with the highest prevalence were a pain in the lower abdomen (83.1%), mood changes (71.2%), LBP (59.3%), increased appetite (52.5%) and sensitivity/pain in the breasts (50.8%). Table 3 shows the prevalence of musculoskeletal symptoms obtained by the Nordic questionnaire. The highest 12-month prevalence was found in the neck (57.1%), lumbar area (52.1%) and shoulders (44.5%).

In analysis of association (χ^2-test) between prevalence (dichotomous variable) of musculoskeletal pain felt in different parts of the body (data from the Nordic questionnaire) during the last 12 months and menorrhea-related symptoms, the results were as follows: regularity of menstruation, duration of menstrual cycle and menses, headaches, general pain, nausea, vomiting, diarrhea, sensitivity/pain in the breasts, acne, swelling/edema, increased appetite, and anger showed no association with pain in any part of the body. Pain in the lower back during menstruation showed a significant positive association with the neck ($\chi^2 = 9.750$, d.f. = 1, $p = 0.002$) and low back ($\chi^2 = 8.586$, d.f. = 1, $p = 0.003$) pain during the last 12 months, but not with pain in other parts of the body. Tiredness showed a significant positive association with neck ($\chi^2 = 5.329$, d.f. = 1, $p = 0.021$) and thoracic pain ($\chi^2 = 8.620$, d.f. = 1, $p = 0.003$). Mood changes during menstruation showed a significant positive association with LBP ($\chi^2 = 4.867$, d.f. = 1, $p = 0.027$). Loss of appetite showed a significant positive association with shoulder ($\chi^2 = 4.421$, d.f. = 1, $p = 0.036$) and hand/wrist ($\chi^2 = 5.093$, d.f. = 1, $p = 0.024$) pain. Insomnia showed a significant positive association with elbow ($\chi^2 = 4.182$, d.f. = 1, $p = 0.041$), hand/wrist ($\chi^2 = 8.428$, d.f. = 1, $p = 0.004$), and hip/thigh ($\chi^2 = 5.142$, d.f. = 1, $p = 0.023$) pain.

Table 2
Prevalence of menstruation-related symptoms in the studied sample (N = 119).

Variables	N (valid %)
Pain in lower abdomen	98 (83.1%)
Low back pain	70 (59.3%)
Headache	21 (17.8%)
General pain	30 (25.4%)
Tiredness	56 (47.5%)
Nausea	18 (15.3%)
Vomiting	4 (3.4%)
Diarrhea	41 (34.7%)
Sensitivity/pain in the breasts	60 (50.8%)
Acne	46 (39.0%)
Swelling/edema	32 (27.1%)
Mood changes	84 (71.2%)
Loss of appetite	18 (15.3%)
Increased appetite	62 (52.5%)
Anger/bad temper	48 (40.7%)
Insomnia	18 (15.3%)

Pain during menstruation in general showed a significant positive association (χ^2-test) with neck ($\chi^2 = 4.909$, d.f. = 1, $p = 0.027$), low back ($\chi^2 = 7.587$, d.f. = 1, $p = 0.006$), and hip/thigh ($\chi^2 = 5.358$, d.f. = 1, $p = 0.021$) pain during the last 12 months. The mean severity of pain during menstruation showed a significant positive association (results of the *t*-test) only with thoracic pain ($t = 2.016$, $p = 0.046$).

Comparison of MTrP prevalence between subjects with significant pain during menstruation and subjects without pain is presented in Table 4. No difference was found in the prevalence of MTrPs in the gluteus medius of either side between subjects suffering from menstrual pain and those who did not. However, there were significant differences in the prevalence of active MTrPs in the quadratus lumborum, rectus abdominis and paraspinal muscles of both sides. Subjects suffering from pain during

Table 3
Prevalence of musculoskeletal symptoms in the studied sample (N = 119) - Nordic questionnaire.

Area of symptoms	At last 12 months N (valid %)	At last 7 days N (valid %)
Neck	68 (57.1%)	31 (26.1%)
Shoulders	53 (44.5%)	20 (16.8%)
Elbows	11 (9.2%)	5 (4.2%)
Hands/wrists	23 (19.3%)	7 (5.9%)
Thoracic spine	40 (33.6%)	18 (15.1%)
Lumbar area	62 (52.1%)	31 (26.1%)
One or both hips/thighs	24 (20.2%)	8 (6.7%)
One or both knees	37 (31.1%)	17 (14.3%)
One or both ankles of feet	38 (31.9%)	19 (16%)

Table 4
Comparison of MTrP prevalence between subjects with significant pain during menstruation (N = 20) and subjects without pain (N = 20).

Muscle	Side	MTrPs	With pain N (valid %)	Without pain N (valid %)	Comparison (χ^2 test)
Gluteus medius	Right	Active	3 (15.0%)	0 (0.0%)	$\chi^2 = 3.343$, d.f. = 1, p = 0.072
		Latent	4 (20.0%)	4 (20.0%)	$\chi^2 = 0.000$, d.f. = 1, p = 1.000
		Total	7 (35.0%)	4 (20.0%)	$\chi^2 = 1.129$, d.f. = 1, p = 0.288
	Left	Active	3 (15.0%)	0 (0.0%)	$\chi^2 = 3.343$, d.f. = 1, p = 0.072
		Latent	5 (25.0%)	3 (15.0%)	$\chi^2 = 0.625$, d.f. = 1, p = 0.429
		Total	8 (40.0%)	3 (15.0%)	$\chi^2 = 3.135$, d.f. = 1, p = 0.077
Quadratus lumborum	Right	Active	4 (20.0%)	0 (0.0%)	**$\chi^2 = 4.444$, d.f. = 1, p = 0.035**
		Latent	5 (25.0%)	6 (30.0%)	$\chi^2 = 0.125$, d.f. = 1, p = 0.723
		Total	9 (45.0%)	6 (30.0%)	$\chi^2 = 0.960$, d.f. = 1, p = 0.327
	Left	Active	8 (40.0%)	0 (0.0%)	**$\chi^2 = 10.000$, d.f. = 1, p = 0.002**
		Latent	6 (30.0%)	7 (35.0%)	$\chi^2 = 0.114$, d.f. = 1, p = 0.736
		Total	14 (70.0%)	7 (35.0%)	**$\chi^2 = 4.912$, d.f. = 1, p = 0.027**
Rectus abdominis	Right	Active	6 (30.0%)	0 (0.0%)	**$\chi^2 = 7.059$, d.f. = 1, p = 0.008**
		Latent	0 (0.0%)	0 (0.0%)	
		Total	6 (30.0%)	1 (5.0%)	**$\chi^2 = 7.059$, d.f. = 1, p = 0.008**
	Left	Active	7 (35.0%)	0 (0.0%)	**$\chi^2 = 8.458$, d.f. = 1, p = 0.004**
		Latent	1 (5.0%)	0 (0.0%)	$\chi^2 = 1.026$, d.f. = 1, p = 0.311
		Total	8 (40.0%)	0 (0.0%)	**$\chi^2 = 10.000$, d.f. = 1, p = 0.002**
Paraspinal	Right	Active	5 (25.0%)	0 (0.0%)	**$\chi^2 = 5.714$, d.f. = 1, p = 0.017**
		Latent	3 (15.0%)	2 (10.0%)	$\chi^2 = 0.229$, d.f. = 1, p = 0.633
		Total	8 (40.0%)	2 (10.0%)	**$\chi^2 = 4.800$, d.f. = 1, p = 0.028**
	Left	Active	6 (30.0%)	0 (0.0%)	**$\chi^2 = 7.059$, d.f. = 1, p = 0.008**
		Latent	2 (10.0%)	5 (25.0%)	$\chi^2 = 1.558$, d.f. = 1, p = 0.212
		Total	8 (40.0%)	5 (25.0%)	$\chi^2 = 1.026$, d.f. = 1, p = 0.311

Table 5
Comparison of a number of trigger points between subjects with significant pain during menstruation (N = 20) and subjects without pain (N = 20).

Variables	With pain (Mean ± SD)	Without pain (Mean ± SD)	Comparison (*t*-test)
Number of active trigger points	2.10 ± 2.08	0.00 ± 0.00	**t = 4.526; p<0.001**
Number of latent trigger points	1.30 ± 1.53	1.35 ± 1.27	t = −0.113; p = 0.911
Total number of trigger points	3.40 ± 2.19	1.35 ± 1.27	**t = 3.628; p = 0.001**

menstruation had a significantly higher number of active MTrPs and the total amount of MTrPs than subjects without pain (p < 0.001 in both comparisons) (Table 5).

4. Discussion

Menstruation affects all facets of a woman's life (Lee and Park, 2015). Dysmenorrhea is very common amongst young women, greatly affecting their quality of life. Symptoms of dysmenorrhea include headaches, tiredness, acne, nausea, diarrhea, mood changes, loss of appetite, increased appetite, insomnia, breast tenderness, and swelling. Musculoskeletal complaints are very common in these women. However, very few studies have evaluated the association between dysmenorrhea and musculoskeletal complaints (Lee and Park, 2015) and no previous studies have evaluated the association between menstruation-related complaints and prevalence of MTrPs.

In our study, we found that the most prevalent menstruation-related complaints were: lower abdomen pain (83.1%), LBP (59.3%), tiredness (47.5%), breast tenderness (50.8%), mood changes (71.2%) and increased appetite (52.5%). An Australian study (Subasinghe et al., 2016) also found that 70%–90% of young women suffer from dysmenorrhea and other problems during menstruation. A similar prevalence of dysmenorrhea was reported in Iranian (Habibi et al., 2015), Ethiopian (Shiferaw et al., 2014) and Egyptian (Nooh et al., 2016) students and other adolescents (De Sanctis et al., 2015).

We found that pain during menstruation, in general, showed a significant positive association with neck, low back, and hip/thigh pain during the last 12 months. The mean severity of pain during menstruation showed a significant positive association only with thoracic pain. Pain in the lower back during menstruation was significantly positively associated with neck and LBP during the last 12 months, but not with pain in other parts of the body. Some other menstruation-related symptoms, such as tiredness, mood changes, loss of appetite, and insomnia also showed an association with

musculoskeletal complaints in various parts of the body. These findings are in accordance with results of a small case-control study that found that women who suffer from pain during menstruation, also suffer from musculoskeletal pain in the neck and lower back (Lee and Park, 2015). The authors of this study did not specify a connection between menstrual pain and thigh pain (pain projected from the lower back or relevant muscles). Surprisingly, we were unable to find other publications on this subject.

The results of the palpation conclusively showed more active MTrPs in the rectus abdominis, quadratus lumborum and paraspinal muscles in women who suffer from pain during menstruation than in those who do not. The average number of total MTrPs (active and latent) in the experimental group was 3.40 and in the controls 1.35 ($p = 0.01$). Indirect support for our findings can be found in several interventional studies. Huang and Liu, (2014) treated dysmenorrhea symptoms by wet needling and stretching exercises into the MTrPs of the abdominal muscles. After a single wet needling session, a significant reduction in pain in most patients was noted during their following menstrual cycle. After a 1-year follow-up, pain score amongst all patients was very low, with a response rate of 100%.

A recent study (Gaubeca-Gilarranz et al., 2018) compared the effectiveness of a single session of rectus abdominis MTrPs dry needling versus placebo needling, relative to an untreated control group on pain and quality of life in primary dysmenorrhea. Females receiving dry needling exhibited significantly greater decreases in pain than those receiving a placebo or assigned to the untreated control group, one and two months after treatment. The women also exhibited a greater decrease in the amount of prescribed medications. We believe that our data provide an initial basis for the inclusion of a myofascial examination when evaluating women with dysmenorrhea. These findings should be replicated in other samples.

4.1. Limitations

The first limitation of this study is the relative lack of experience of the examiners. The researchers tried to minimize the possible bias by specific training, strict protocol and double (by both examiners, blinded to results of each other) evaluation of MTrPs. Only consensus results were recorded.

The results of the current study pertain to 21–32-year-old, apparently healthy university students. It is possible that women of different ages, education or health backgrounds will show different prevalences of musculoskeletal or myofascial pain.

5. Conclusions

In our study, we found that dysmenorrhea is a very prevalent condition amongst young nulliparous female students. Most prevalent menstruation-related complaints were: lower abdomen pain, LBP, tiredness, breast tenderness, mood changes, and an increased appetite. We found that pain during menstruation showed a significant positive association with neck, low back, and hip/thigh pain during the last 12 months. The results of the palpation conclusively showed more active MTrPs in the rectus abdominis, quadratus lumborum and paraspinal muscles in women who suffer from pain during menstruation than in those who did not suffer. We believe that our data provided an initial basis for the inclusion of a myofascial examination when evaluating women with dysmenorrhea. These findings should be replicated in other samples.

6. Clinical relevance

- Dysmenorrhea is a very prevalent condition amongst young nulliparous female students.
- Pain during menstruation significantly associated with neck, low back, and hip/thigh pain during the last 12 months.
- There is a higher prevalence of active MTrPs in the rectus abdominis, quadratus lumborum and paraspinal muscles in women who suffer from pain during menstruation than in those who did not suffer.
- In our opinion, evaluation of MTrPs should be essential part of evaluation of women suffered from dysmenorrhea.

Conflicts of interest

The authors declare no conflict of interest.

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