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Neuropsychological function in relation to dysmenorrhea in adolescents

Afsane Bahrami[a,b,1], Hamidreza Sadeghnia[c,1], Amir Avan[d,1], Seyed Jamal Mirmousavi[e], Alireza Moslem[f], Saeed Eslami[g], Masoud Heshmati[h], Hamidreza Bahrami-Taghanaki[i,*], Gordon A. Ferns[j], Majid Ghayour-Mobarhan[d,*]

[a] Department of Modern Sciences and Technologies, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran
[b] Student Research Committee, Mashhad University of Medical Sciences, Mashhad, Iran
[c] Pharmacological Research Center of Medicinal Plants, Mashhad University of Medical Sciences, Mashhad, Iran
[d] Metabolic Syndrome Research Center, Mashhad University of Medical Sciences, Mashhad, Iran
[e] Traditional Medicine Research Center, Sabzevar University of Medical Sciences, Sabzevar, Iran
[f] Department of Anestheiology,Sabzevar University of Medical Sciences, Sabzevar, Iran
[g] Pharmaceutical Research Center, School of Pharmacy, Mashhad University of Medical Sciences, Mashhad, Iran
[h] Cellular and Molecular Research Center, Basic Health Sciences Institute, Shahrekord University of Medical Sciences, Shahrekord, Iran
[i] Complementary and Chinese Medicine, Persian and Complementary Medicine Faculty, Mashhad University of Medical sciences, Mashhad, Iran
[j] Brighton & Sussex Medical School, Division of Medical Education, Falmer, Brighton, Sussex BN1 9PH, UK

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ABSTRACT

Objective: Hormonal variations during the menstrual cycle may affect emotional regulation. We aimed to investigate the association between dysmenorrhea (the severe abdominal pain and cramps associated with menstruation) and cognitive abilities, emotional function and sleep patterns in adolescent girls. Moreover, we evaluated the frequency of premenstrual syndrome (PMS) in our population and then divided them into 4 groups: subjects with only PMS; subjects with only dysmenorrhea; individuals with both PMS and dysmenorrhea and normal subjects.

Study design: In this cross sectional study, 897 adolescent girls who had entered menarche were recruited. Of these, 35.9% had only dysmenorrhea, 14.9% had only PMS, 32.7% had both PMS and dysmenorrhea while 16.5% had no PMS and/or dysmenorrhea (Normal). We assessed the tests for cognitive, emotional function and sleep patterns were compared for these groups.

Results: Individuals in the dysmenorrhea group had significantly higher depression, aggression, insomnia, daytime sleepiness and sleep apnea scores compared to normal controls and the PMS group, but did not have significantly different cognitive ability (P value <0.05). These differences were strongly correlated to pain intensity ($P < 0.001$). However, there were no significant differences between those with only PMS and control subjects with regard to cognitive ability, emotional function and sleep pattern tests.

Conclusions: Dysmenorrhea is highly prevalent among adolescents and appears to be associated with depressive mood, a tendency to aggressive behavior and sleep disorders among adolescent girls.

Introduction

Primary dysmenorrhea is characterized by pelvic pain or cramps in women with normal pelvic anatomy. Typically, lower abdominal cramping pain is restricted to before or during menstruation and lasts for several days. Dysmenorrhea is a cyclic event, which adversely impacts on the quality of life of women [1]. Studies in adolescent girls have reported the prevalence of dysmenorrhea to be between 20% to 90% [2].

Hormonal variations during the menstrual cycle are related to suicidal behavior, and sex hormone concentrations may affect the regulation of emotions by their effects in the brain [3]. Furthermore, estrogens may influence the risk of depression and depressive symptoms.

* Corresponding authors.
E-mail addresses: BahramiHR@mums.ac.ir (H. Bahrami-Taghanaki), ghayourm@mums.ac.ir (M. Ghayour-Mobarhan).
[1] Equally contributed as first author.

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Female adolescents are more prone to experience depressive symptoms than male adolescents [4]. Other studies have also shown that higher perceived stress and anxiety/depressive symptoms are related to increased reports of menstrual disorders and symptoms [5,6]. Furthermore, dysmenorrhea adversely affects mood and consequently affects the individual's attitude, relationships with family and friends, social interactions, sports activities, and academic performance, with adverse effects including school absenteeism, poor concentration, and failure to do homework [7]. Indeed, previous studies have shown that depression and aggression are important features of menstrual disorders [8,9].

Much of the literature on menstrual health, has focused on the epidemiology and etiology of premenstrual syndrome (PMS) and premenstrual dysphoric disorder (a state characterized by severe depressive symptoms, anxiety, and irritability) only during the premenstrual phase [10,11]; and few studies have assessed dysmenorrhea in adolescent girls.

The results of existing studies have been inconsistent, and it is not clear whether dysmenorrhea is associated with sleep quality and changing sleep patterns [12–15].

Two previous studies, in college students, have reported an association between psychological stress and PMS and irregular menstrual cycles [16,17]. Understanding how the experience of dysmenorrhea influences emotional wellbeing, in girls who have recently entered menarche may provide some insights into how to promote wellbeing and health in adolescent girls. Such information may be of some practical importance for parents, clinicians, and teachers who are faced with the effect of menstrual distress on school performance of their student. Therefore in the present study we investigated the prevalence of dysmenorrhea as well as its association with emotional and mood function, cognitive abilities and sleep disorders in a large population of adolescent girls.

Materials and methods

Study population

This cross sectional study was conducted in two cities (Mashhad and Sabzevar) in northeastern Iran during January 2015. Participants were randomly recruited from different areas in cities, using a cluster randomization method. Written consent was obtained from students and their parents.

Exclusion criteria were as follows: any inflammation and autoimmune diseases, cancer, renal or hepatic failure, cardiovascular disorders, chronic lung disease, diabetes, asthma, multiple sclerosis, polycystic ovary syndrome (PCOS), chronic bronchitis, fibromyalgia, metabolic bone disease and thyroid, or parathyroid diseases.

After these exclusion criteria were applied, 940 participants aged 12–18 years old remained. Among whom, 897 adolescents had the menarche at least one year before the study started. The Ethics Committee of Mashhad University of Medical Sciences (MUMS) approved the study.

Assessment of menstrual pattern

Answers on questions related to menstrual patterns during the past two cycles of menstruation were collected including menstrual cyclicity, cycle length, amount of blood loss, and duration of flow.

Dysmenorrhea was defined as abdominal pain, or cramping related to menstrual bleeding and participants rated their pains using a scale that ranged from a score of 0 (painless) to a score of 1 (mild), 2 (moderate), 3 (severe), 4 (very severe) and a score of 5 (most severe). Subsequent, were divided target population into two groups: those with dysmenorrhea and those without (Control) [18].

Also, participants were instructed to answer questions on the most frequent physiological and psychological symptoms that occurred before the onset of menses including: leg ache, backache, nausea, vomiting, diarrhea, fatigue, irritability, appetite changes, palpitation, poor sleep, energy depletion, feeling sad or blue, decrease interest, tendency to cry easily and loss of concentration. Those having at least 2 symptoms, 1 physical and 1 psychological symptom were given a diagnosis of PMS, while those with 1 symptom or no symptoms were regarded as not having PMS [19]. For further evaluation we also categorized participants into four groups as follows: those with only PMS, those with only dysmenorrhea, those with both PMS and dysmenorrhea and normal subjects.

Tests of cognitive abilities

Cognitive performance was assessed using the Cognitive Abilities Questionnaire (CAQ). The CAQ consists of 30 items, each of which is rated on a 5-point Likert scale (1–5) and hence a total score ranging between 30–150. Higher scores represent better cognition abilities. The CAQ evaluates memory, inhibitory control and selective attention, decision making, planning, sustained attention, social cognition and cognitive flexibility. Total and subscale scores of CAQ were recorded [20].

Tests of emotional function

Depression score: The Beck Depression Inventory (BDII) is a 21-items self-report questionnaire. Item scores range from 0 to 3 and the minimum and maximum total scores for the questionnaire are 0 and 63 respectively [21]. The cut-off scores are as follows: Minimal or No depression (0–9), Mild depression (10–18), Moderate depression (19–29) and Severe depression (30–63).

Aggression score: The 29-items with five-point Likert scale (1–5), the Buss-Perry Aggression Questionnaire (BPAQ) has been widely used for the assessment of overall and subscale symptom severity aggression [22].

Tests of sleep pattern

Insomnia Severity: The Insomnia Severity Index (ISI) is a reliable instrument that results a quantitative index of insomnia severity [23]. The instrument involves 7 items focusing on sleep disorder severity, sleep related satisfaction and anxiety related to the sleeping disorder. Items are rated on a 5-point Likert scale (0–4) and calculate to provide a total score ranging from 0 to 28. Higher scores indicate that more severe insomnia. Scores may be categorized as: no clinically significant insomnia (0–7), subthreshold insomnia or mild (8–14), moderate insomnia (15–21) and severe insomnia (22–28).

Severity of sleepiness: The Epworth Sleepiness Scale (ESS) is a questionnaire-derived scale of which can be used to assess the degree of daytime sleepiness. It is an 8-item, 4-point Likert scale that measures the habitual likelihood to fall asleep in common situations of daily living. Total scores range from 0 to 24. Severity of daytime sleepiness is defined based on following criteria: <10 (normal), 10–16 (mild to moderate), $16\geq$ (severe sleep apnea or narcolepsy) [24].

Sleep apnea: This Stop-Bang Sleep apnea questionnaire is a scoring model consisting of eight questions and is scored based on Yes/No answers (score: 1/0). Hence, the range of the total score is 0–8.The severity code scoring the degree of sleep apnea is as follows: low risk (0–2), Intermediate risk (3–4), High risk (5–8) [25].

Assessment of covariate

Body mass index (BMI) was calculated as weight (kilograms) divided by height (meter) squared. Questions associated to

smoking included "How many hours are you expose to cigarettes? How many hours are you expose to tobacco smoke?"

Chi-square or ANOVA tests were used to compare quantitative variables in four groups (dysmenorrhea, PMS, dysmenorrhea and PMS, as well normal control), followed by Tukey HSD. The subjects with different severity of dysmenorrhea and without dysmenorrhea (controls) were compared with ANOVA test or chi-square. Furthermore, we conducted correlation coefficient analysis between severity of pain of dysmenorrhea and other variables. All data are expressed as mean ± SD. Two-sided tests were used, and $P < 0.05$ was considered statistically significant. Statistical analyses were performed with SPSS version 17 (SPSS Inc, Chicago, Ill., USA).

Results

Nine hundred and forty subjects (360 passive smoking and tobacco exposure) were recruited to the study. Six hundred and seven of the 897 subjects had criteria for a diagnosis of dysmenorrhea (68.8%); 280 subjects were included in the control group (31.2%). In the dysmenorrhea group 85, 187, 162, 110 and 73 subjects had mild, moderate, severe, very severe and worst pain, respectively. Regarding the criteria for PMS, 47.6% of subjects fulfilled the criteria for PMS. Altogether, 35.9%, 14.9%, and 32.7% subjects had dysmenorrhea, PMS, both PMS and dysmenorrhea, respectively, while 16.5% had no PMS and/or dysmenorrhea. Moreover ANOVA and chi-square tests showed the four groups of responders (dysmenorrhea, PMS, dysmenorrhea and PMS or control) were well-matched for age and BMI (Table 1).

The distribution of menstrual pattern and common menstruation associated symptoms between four groups are shown in Table 2. There were no statistically significant differences for the dysmenorrhea and PMS with respect to age at menarche, days of bleeding, duration of the menstruation cycle and menstrual flow. Among menstruation-associated symptom prevalence of leg ache, nausea, palpitation, feeling sad or blue and tendency to cry easily are statistically significant higher in group with both dysmenorrhea and PMS compared to other groups.

Tests of cognitive abilities, emotional function and sleep pattern

The control group did not perform better than the dysmenorrhea group with different severity of pain for most of the cognitive ability tasks. However, the control group scored more favorably than the dysmenorrhea group on the BDII test (depressed mood), BPAQ (aggression behavior), insomnia severity, severity of daytime sleepiness, and sleep apnea. In all these tests, dysmenorrhea associated with the most severe pain group had statistically significant higher scores compared to control group (Table 3). A strong correlation has been found between severity of pain and score at depression, aggression, insomnia, daytime sleepiness, and sleep apnea (Supplementary Table 1). There were no significant differences between those with PMS and control subjects with regard to cognitive ability, emotional function and sleep pattern tests (Supplementary Table 2).

The comparison of the scores for cognitive abilities, emotional function and sleep pattern tests in different groups (only PMS, only dysmenorrhea, both PMS and dysmenorrhea as well normal subjects) was shown in Table 4. These data showed that the cognitive ability were similar between all four groups. However cases with dysmenorrhea had a worse situation with respect to the depression, aggression, severity of daytime sleepiness, and sleep apnea compared to other groups ($P < 0.05$). Although there were no statistically significant differences between PMS and normal subjects in the cognitive abilities, emotional function and sleep pattern tests.

Comments

The current study focused on neuropsychological function in subjects with dysmenorrhea, and also relating menstrual pattern to an extensive range of neuropsychological tests.We found that the frequency of dysmenorrhea was 68.8% among female adolescents which is relatively low compared to other countries. In previous studies, the frequency of dysmenorrhea was 82.2% in Indian female students [26] and 85.5% among Omani girl adolescents [27].

We administered a total 12 tests of cognitive abilities, emotional function and sleep pattern. For five of these tests, relating to depressed mood, aggression behavior, daytime sleepiness, and sleep apnea, the control subjects scored significantly better than those with dysmenorrhea. However, for none of the tests of cognitive ability, did the control subjects score better than those with dysmenorrhea. Previous studies have assessed how facial emotion recognition and emotional memory are affected by the menstrual cycle [28–30]. However, this study reported no association between dysmenorrhea and cognitive impairment in a large sample of Iranian female adolescents. Funtana et al. have reported that, although girls with dysmenorrhea were significantly more neurotic compared to those without menstrual distress, there was no significant difference between the two groups in cognitive and academic tasks or in school attendance. However, the sample size of this study was small, and was recruted from a single school [31].

We found a significant difference between those with dysmenorrhea and the control with respect to depression and aggression scores, and sleep disorders. These differences were strongly correlated to pain severity. Rodrigues and coworker in their study on adolescents and young adult reported that in dysmenorrhea cases, limitations in daily living activities including anxiety/depression was related to pain intensity ($r = 0.281$; $p < 0.001$) [32]. Also, in a population-based study of menstrual health covering over 2000 Indian women, the severity of dysmenorrhea increased with the intensity of anxiety, depression, and somatic complaints. The authors suggested that dysmenorrhea should be viewed as one of the spectrum of medically unexplained syndromes, also considered as a multifactorial disorder [33]. Further, there is growing evidence of a significant association between adolescent dysmenorrhea and mood instabilities/emotional fluctuations such as anger, aggression, joy, stress, intense feeling of depression, guilt, loneliness, self-dislike, suicidal thoughts, dissatisfaction with life and reduce quality of life [34–

Table 1
Characteristics of the study participants.

	Normal n = 148(16.5%)	PMS n = 134(14.9%)	Dysmenorrhea n = 322(35.9%)	PMS+ Dysmenorrhea n = 293(32.7%)	P-value
Age (years)	14.6 ± 1.7	14.6 ± 1.4	14.6 ± 1.5	14.7 ± 1.5	0.930[a]
BMI (kg/m 2)	21.0 ± 3.6	21.0 ± 3.6	21.5 ± 3.9	21.7 ± 4.6	0.324[a]
Smoking exposure, n(%)	53(35.5%)	48(35.9%)	102(31.8%)	90(30.8%)	0.326[b]

[a] Using ANOVA test.
[b] Using chi-square test.

Table 2
Distribution of menstrual pattern and common menstruation associated psychovegetative symptoms between the Dysmenorrhea and control Group.

	Normal n = 148(16.5%)	PMS n = 134(14.9%)	Dysmenorrhea n = 322(35.9%)	PMS+ Dysmenorrhea n = 293(32.7%)	P-value*
Age at menarche(year), mean ± SD	12.6 ± 1.1	12.7 ± 1.7	12.4 ± 1.1	12.4 ± 1.1	0.127
Average days of bleeding, n (%)					
Short bleeding periods(4 days)	3(2.2)	7(5.8)	16(5.0)	17(5.7)	0.331
Normal periods (4–7 days)	126(84.8)	110(81.2)	263(81.7)	217(74.1)	
Long periods(>7 day)	19(13.0)	17(13.0)	43(13.4)	59(20.2)	
Duration of the menstruation cycle, n (%)					
<21 days	27(18.2)	32(24.1)	64(19.9)	72(24.6)	0.658
21–35 days	113(76.1)	100(74.1)	245(76.1)	204(69.6)	
>35 days	8(5.7)	2(1.8)	13(4.0)	17(5.8)	
Amount of menstrual flow, n (%)					
Little	38(25.9)	30(22.4)	77(23.9)	59(20.0)	0.398
Moderate	109(72.8)	103(77.5)	240(74.6)	223(76.3)	
Heavy	1(1.3)	1(0.07)	5(1.5)	11(3.7)	
Menstruation-associated symptoms, n (%)					
Leg ache	18(12.0)	28(20.7)	59(18.3)	72(24.7)	**0.037**
Backache	88(59.8)	82(61.6)	195(60.7)	190(65.0)	0.763
Nausea	3(2.2)	12(8.7)	14(4.3)	35(12.0)	**0.010**
Vomiting	1(0.9)	0(0.0)	13(4.2)	9(3.0)	0.095
Diarrhea	2(1.1)	6(4.2)	8(2.6)	11(3.9)	0.496
Appetite changes	1 (1.3)	1 (0.7)	0(0.0)	5(1.8)	0.221
Irritability	7.0(4.5)	7(5.1)	20(6.3)	22(7.4)	0.744
Fatigue	11(7.3)	13(10.0)	27(8.5)	33(11.3)	0.139
Palpitation	7(4.7)	14(10.1)	20(6.3)	37(12.7)	**0.045**
Energy depletion	15(10.1)	10(7.6)	34(10.7)	32(11.0)	0.631
Poor sleep	3.0(1.8)	3(2.6)	3(0.9)	3(1.1)	0.869
Feeling sad or blue	4(2.5)	12(9.0)	16(5.0)	36(12.3)	**0.030**
Decrease interest	16(11.0)	19(13.9)	29(8.9)	40(13.8)	0.391
Loss of concentration	34(22.9)	42(30.3)	92(28.6)	97(33.0)	0.312
Tendency to cry easily	22(15.0)	41(30.8)	55(17.0)	105(35.8)	**0.047**

* Using ANOVA or chi-square tests.

Table 3
Score at cognitive abilities, emotional function and sleep pattern tests in Dysmenorrhea group and control.

		Severity of dysmenorrhea(n = 617)					P value
	Control n = 280 (31.8%)	Mild n = 85 (9.5%)	Moderate n = 187 (20.8%)	Severe n = 162 (18.1%)	Very severe n = 110 (12.3%)	Worst n = 73 (8.1%)	
Test of cognitive abilities							
Memory	14.1 ± 7.8	15.1 ± 7.8	14.3 ± 8.0	14.5 ± 7.5	12.5 ± 6.0	13.4 ± 6.8	0.211
Inhibitory control and selective attention	15.5 ± 6.3	16.4 ± 6.6	15.8 ± 6.0	16.2 ± 5.5	15.5 ± 5.2	16.1 ± 5.0	0.757
Decision making	13.2 ± 5.7	13.4 ± 5.5	13.2 ± 5.5	13.4 ± 5.4	12.7 ± 4.7	13.2 ± 4.6	0.943
Planning	7.7 ± 3.6	8.6 ± 3.5	8.3 ± 3.5	7.8 ± 3.3	7.6 ± 3.1	8.4 ± 3.2	0.190
Sustain attention	8.3 ± 3.2	8.5 ± 3.0	8.5 ± 2.9	8.5 ± 3.0	8.2 ± 2.8	8.2 ± 3.2	0.935
Social cognition	9.9 ± 4.0	9.9 ± 2.9	10.5 ± 3.0	10.0 ± 3.1	10.5 ± 2.7	10.1 ± 3.2	0.464
Cognitive flexibility	10.7 ± 3.6	11.1 ± 3.4	11.2 ± 3.4	11.2 ± 3.2	11.1 ± 2.7	11.3 ± 3.0	0.490
Total cognitive ability task	81.4 ± 26.2	85.7 ± 26.3	82.2 ± 24.7	83.8 ± 24.0	79.6 ± 20.5	82.4 ± 20.3	0.566
Tests of emotional function							
Depressive mood	9.2 ± 8.2	9.6 ± 9.0	10.0 ± 8.8	12.1 ± 10.5	12.1 ± 8.5	12.9 ± 9.7	**0.002** $^{\gamma}$
Aggressive behavior	75.4 ± 20.1	76.6 ± 23.0	77.1 ± 19.4	80.9 ± 19.9	81.2 ± 20.1	83.6 ± 21.7	**0.006** $^{\gamma}$
Tests of sleep pattern							
Insomnia	3.2 ± 5.0	3.4 ± 5.4	3.6 ± 5.5	4.6 ± 6.0	4.8 ± 6.1	5.4 ± 6.2	<**0.001** $^{\gamma}$
Daytime sleepiness	5.5 ± 3.8	6.3 ± 4.0	6.7 ± 3.9	7.0 ± 3.9	7.6 ± 4.1	8.4 ± 6.7	**0.016** $^{\alpha,\beta,\gamma,\delta,\varepsilon,\mu}$
Sleep apnea	0.5 ± 0.5	0.6 ± 0.5	0.6 ± 0.5	0.7 ± 0.5	0.7 ± 0.5	0.8 ± 0.5	**0.003**$^{\alpha,\beta,\gamma}$

α, β, γ, δ, ε and μ by using ANOVA test.
Significant between control and dysmenorrhea (Severe): α.
Significant between control and dysmenorrhea (Very severe): β.
Significant between control and dysmenorrhea (Worst): γ.
Significant between dysmenorrhea (Mild) and dysmenorrhea (Very severe): δ.
Significant between dysmenorrhea (Mild) and dysmenorrhea (Worst): ε.
Significant between dysmenorrhea (Moderate) and dysmenorrhea (Worst): μ.

38]. The present study among Iranian adolescent strongly supports these results. However, Holmlund et al. found no differences in personality between subject with and without dysmenorrhea [39].

Previously it has been shown that both acute and chronic pain can disturb sleep. Additionally, some studies [12–14] though not all [15,40] have found that dysmenorrhea can decrease sleep quality and alter sleep patterns such as REM sleep reduction. Characteristics of sleep has stable across the menstrual cycle in healthy female, but those with menstrual-related problems are more likely to experience sleep disturbance [41]. However, dysmenorrhea may

Table 4
Score at cognitive abilities, emotional function and sleep pattern tests in different group.

	Normal n = 148(16.5%)	PMS n = 134(14.9%)	Dysmenorrhea n = 322(35.9%)	PMS+ Dysmenorrhea n = 293(32.7%)	P-value
Test of cognitive abilities					
Memory	14.6 ± 8.3	13.3 ± 7.3	14.3 ± 7.5	14.6 ± 8.0	0.585
Inhibitory control and selective attention	15.5 ± 6.8	14. 8 ± 5.4	16.4 ± 5.8	15.9 ± 6.0	0.170
Decision making	13.0 ± 6.1	13.0 ± 5.3	13.4 ± 5.3	13.4 ± 5.5	0.842
Planning	7.8 ± 3.7	7.5 ± 3.5	8.2 ± 3.4	8.2 ± 3.6	0.284
Sustain attention	8.5 ± 3.1	8.0 ± 3.0	8.6 ± 2.9	8.5 ± 3.1	0.559
Social cognition	10.1 ± 3.6	10.6 ± 4.8	10.4 ± 3.0	10.2 ± 3.0	0.331
Cognitive flexibility	11.4 ± 3.9	10.7 ± 3.2	11.4 ± 3.0	11.2 ± 3.4	0.051
Total cognitive ability task	80.5 ± 28.0	79.0 ± 23.1	84.0 ± 23.2	83.4 ± 25.0	0.270
Tests of emotional function					
Depressive mood	8.0 ± 7.8	10.6 ± 9.3	12.0 ± 10.0	10.9 ± 9.2	0.002 $^{\alpha,\gamma}$
Aggressive behavior	73.1 ± 19.5	72.6 ± 18.4	81.3 ± 19.6	78.0 ± 20.8	<0.001 $^{\beta,\gamma}$
Tests of sleep pattern					
Insomnia	3.0 ± 4.9	4.0 ± 6.0	4.2 ± 5.7	4.2 ± 5.8	0.287
Daytime sleepiness	5.6 ± 3.8	6.1 ± 3.9	7.3 ± 4.0	6.7 ± 4.1	0.001$^{\gamma}$
Sleep apnea	0.4 ± 0.5	0.5 ± 0.5	0.7 ± 0.5	0.6 ± 0.5	<0.001 $^{\alpha,\beta,\gamma}$

α, β and γ by using ANOVA test.
α: Significant between control and (PMS+ Dysmenorrhea).
β: Significant between PMS and (PMS+ Dysmenorrhea).
γ:Significant between control and dysmenorrhea.

lead to psychiatric disorders. Women with polycystic ovary syndrome significantly increased risk for psychiatric disorders including depression [42]. Therefore, mental health problems and dysmenorrhea may be interrelated bidirectional, and affect each other.

We have evaluated cognitive abilities, emotional function tests and sleep pattern in PMS subjects compared to dysmenorrhea and normal participants. We found that subjects with PMS did not show significant differences compared to the control group. In line with our observations, there is no comprehensive studied but there are several reports. Few reported no differences [43], although some studies shows this differences only in isolated tasks [44,45]. In particular Keenan and colleagues evaluated several neuropsychological tasks, PMS women were found to only have verbal learning task impairment versus a group of control women independent to menstrual cycle phase [46]. Another well-controlled study that assessed a range of tasks, have been observed that PMS women showed more psychomotor slowing in the luteal phase compared to normal women [47]. Another large sample size study assessed a relatively full series of neurocognitive tasks, reported no differences in performance between women with PMS and without PMS [48]. Also, in several studies, sleep pattern was not reported with differences between PMS and non-PMS subjects which is consistent with our results [49,50].

The present study has several strengths. Firstly, large sample size and population based study. Secondly; our classification of dysmenorrhea is generally accepted. Thirdly, we also compared the result with PMS group to confirm our conclusion. A major limitation of our study is recall bias, as all of the variables related to menstruation were taken by recall method. Cross-sectional design and retrospective data cannot assess causality.

In spite of these shortcomings, we feel it appropriate to conclude that our results indicate some degree of depression, aggression, daytime sleepiness and sleep apnea in subjects with dysmenorrhea. Thus, it is important to identify factors related to dysmenorrhea, and to manage the modifiable factors, to prevent of dysmenorrhea and related symptoms and disorders among adolescents. This study was noteworthy from the perspective of public health, since dysmenorrhea is common among adolescents. Future research of the relationships between dysmenorrhea and mental health problems is warranted in other populations and different ethnic groups.

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Disclosure statement

The authors have no conflicts of interest to declare.

Author contributions

A.B. performed all analyses and drafted the manuscript. A.B., A. A, M.Gh., H.S., S.E., and A.M. coordinated the fieldwork of the study. SJ.MM., H.H., G.A. F,and H.B. provided methodological feedback. A. B, A.A and M.Gh. M.H supervised the overall research project and helped to draft the manuscript. All of the authors have read and approved the final manuscript.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at **http://dx.doi.org/10.1016/j.ejogrb.2017.06.030**.

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