Taiwanese Journal of Obstetrics & Gynecology 60 (2021) 311–317

Contents lists available at ScienceDirect

Taiwanese Journal of Obstetrics & Gynecology

journal homepage: www.tjog-online.com

Original Article

Primary dysmenorrhea in adolescents: Association with attention deficit hyperactivity disorder and psychological symptoms

Cihan Kabukçu [a, *], Bürge Kabukçu Başay [b], Ömer Başay [b]

[a] Pamukkale University, Faculty of Medicine, Department of Obstetrics and Gynecology, Denizli, Turkey
[b] Pamukkale University, Faculty of Medicine, Department of Child and Adolescent Psychiatry, Denizli, Turkey

ARTICLE INFO

Article history:
Accepted 29 December 2020

Keywords:
Primary dysmenorrhea
Adolescent
ADHD
Psychiatric symptoms

ABSTRACT

Objective: No prior study has investigated the relation of primary dysmenorrhea (PD) with attention deficit hyperactivity disorder (ADHD) symptoms in adolescent age groups. This study aimed to investigate the relationship of PD with ADHD and psychological symptoms among adolescents. Another objective was to examine the PD related non-psychogenic factors and sleep quality.

Materials and methods: Two hundred nine adolescent girls who applied to policlinics for various reasons were enrolled. All participants completed self-report questionnaires. Questionnaire for sociodemographic data, menstrual pattern and dysmenorrhea in adolescents, Visual analog scale, Pittsburgh Sleep Quality Index, DSM-5 Level 2 Sleep Disorders Scale, Brief Symptom Inventory, and the Turgay Diagnostic and Statistical Manual of Mental Disorders, 4th edition-Based Child and Adolescent Disruptive Behavior Disorders Screening and Rating Scale were used to measure outcomes.

Results: A hundred and four (49.8%) adolescents reported having pain that affects daily activities during menstruation. These adolescents had worse sleep quality, more inattention and hyperactivity-impulsivity problems, and other psychological symptoms of anxiety, depression, somatization, negative self-perception, and hostility in comparison to others ($P < 0.05$). The menstrual pain severity, measured by VAS, was positively correlated with ADHD symptoms and all other psychological parameters ($P < 0.05$).

Conclusion: PD affecting daily-activities may be related to ADHD symptoms and psychiatric distress. Future studies are needed to support the association between ADHD and PD. Assessing the psychiatric problems of adolescents with dysmenorrhea is important.

Introduction

Dysmenorrhea refers to menstrual-related pain, with cramps or discomfort in the lower abdomen or back. The term primary dysmenorrhea (PD) describes the painful menstruation without an identifiable organic pathology. PD is quite prevalent among female adolescents and young women. It affects the quality of life adversely and causes school or work absenteeism [1]. The prevalence of PD among adolescent girls was reported to be % 43–91 [1].

PD is a multi-etiological disorder with no single determining factor. The overproduction of uterine prostaglandins (PG) is the most widely accepted explanation for etiopathogenesis. Enhanced release of PGs causes myometrial hypercontractility, arteriolar vasoconstriction, hypoxia of uterine muscles, and hypersensitization of pain fibers, which altogether leads to pain [1,2]. Various factors have been associated with this gynecological disorder, such as age, body mass index, smoking, alcohol, family history, early menarche age, and heavy menstrual bleeding [2].

PD has also been investigated for its relation to mental health-related factors. A recent systematic review examining the relationship between PD and mental health disorders in adult and adolescent studies demonstrated a significant link between mental disorders and PD [3]. Depression and anxiety were the major psychological disorders whose association with dysmenorrhea was replicated mostly. There are also some reported findings for stress-related diseases and somatic disorders with dysmenorrhea. Additionally, the authors emphasized that the current literature was insufficient and further studies are needed [3]. Attention deficit and

* Corresponding author. Pamukkale Üniversitesi, Tıp Fakültesi, Kadın Hastalıkları ve Dogum Anabilim Dalı, Kınıklı, Denizli, 20070, Turkey.
E-mail addresses: cihankabukcu@yahoo.com (C. Kabukçu), burgekabukcu@yahoo.com (B. Kabukçu Başay), omer_basay@yahoo.com (Ö. Başay).

https://doi.org/10.1016/j.tjog.2021.01.033

hyperactivity disorder (ADHD) is a neurodevelopmental disorder characterized by inattention and hyperactivity-impulsivity. It constitutes one of the most prevalent diagnoses in childhood and adolescence, with a worldwide prevalence of about 5% [4]. We don't know whether there is a link between PD and ADHD. As far as we know, no study has investigated the relation of PD with ADHD symptoms in an adult or adolescent age group in the literature.

It is evident that pain caused by PD contributes to health-related adverse outcomes both in adults and adolescents. However, specifically, data about adolescent PD is still insufficient. In this study, we aimed to investigate the relationship of PD with attention deficit hyperactivity problems and psychological symptoms among adolescents. Additionally, we assessed menstruation-related sleep disturbances to reveal overall sleep quality among adolescents. Another aim of the study was to investigate the PD related non-psychogenic factors among adolescents.

Materials and methods

The study was designed as a cross-sectional study and conducted in the outpatient clinic of child and adolescent psychiatry department of a university hospital from January 2019 until May 2019. Adolescent girls aged 13–18 years who applied to the outpatient policlinics for various reasons were asked whether they would participate in the study or not. Two hundred thirty-eight volunteer adolescents agreed to participate in the study. All the adolescent girls were informed about the research and the procedures. After eliminating the twenty-nine participants with incomplete study forms, the remaining 209 adolescents made up the study sample. The Institutional Ethics Committee of the Pamukkale University Medical School approved the study (approval number: 600116787/75278). All adolescent girls read and signed informed consent forms declaring that they voluntarily participated in the study. We completed all the study procedures following the Declaration of Helsinki Principles.

Data collection tools

Questionnaire for sociodemographic data, menstrual pattern, and dysmenorrhea in adolescents

This self-report form was developed for the present study by the study authors in the light of the literature, to collect data on the sociodemographic variables, adolescents' daily routines (which could affect dysmenorrhea), height, weight, menstrual pattern, and dysmenorrhea. It includes questions about the age of menarche, cycle pattern, amount of menstrual bleeding, menstrual pain affecting daily life, medication needs, family history of dysmenorrhea, etc. To estimate menstrual blood loss, the quantification was performed using The Pictorial Blood Assessment Chart (PBLAC). PBLAC generates a summative score reflecting menstrual blood loss [5].

Visual analog scale (VAS)

The VAS is a horizontal scale with the descriptors 0 (no pain) on the left and 10 (worst possible pain) on the right. Adolescents scored the amount of pain they feel during menstruation by putting a mark on the corresponding point on VAS [6]. Scores from the VAS are categorized as mild: 1–3; moderate: 4–7; severe: 8–10. Higher points indicate increased levels of pain.

Pittsburgh Sleep Quality Index (PSQI)

PSQI is a 19 item self-rated questionnaire that evaluates sleep quality over the past month [7]. It considers seven domains, and the sum of them gives a global score ranging from 0 to 21, with higher scores indicating the worse quality of sleep. The PSQI was shown to be reliable and valid in the Turkish population [8].

DSM-5 Level 2 Sleep Disorders Scale (DSM-5 Level 2 SDS)

American Psychiatric Association [9] introduced a five-point Likert scale that consists of 8 items evaluating sleep problems over the last seven days. The total score ranges between 8 and 40. Higher scores indicate worse sleep disorder related symptoms. The adolescent self-report form was used in the study. Turkish reliability and validity study was conducted by Erkuran et al. with a Cronbach alpha value of 0.90 [10].

Brief Symptom Inventory

Brief symptom inventory is a 53-item self-report scale, which has been developed by Derogatis to screen the psychological symptoms [11]. The inventory is a five-point Likert style and rated in a range of 0–212, with higher points indicating more considerable psychological distress. Turkish reliability and validity scale revealed five factors; anxiety, depression, hopelessness, negative-self, and somatization [12].

Turgay Diagnostic and Statistical Manual of Mental Disorders, 4th edition (DSM-IV)-Based Child and Adolescent Disruptive Behavior Disorders Screening and Rating Scale (T-DSM-IV-S)

The scale was developed for screening disruptive behavior disorders [13]. The Turkish translation and the validity study of T-DSM-IV-S were made by Ercan et al. [14]. In the present study, the inattention (IA; nine items) and hyperactivity-impulsivity (HI; nine items) subscales (ADHD part) were used. The items are mostly the DSM-IV criteria of ADHD. Adolescents self-rated their symptoms by assigning a severity estimate for each symptom on a 4-point Likert-type scale. Higher scores reflect increases in symptom severity.

Statistical analysis

Data analyses were conducted using the Statistical Package for the Social Sciences (SPSS), version 16.0 for Windows (SPSS Inc., Chicago, IL, USA). Descriptive analyses were defined by numbers and percentages for categorical variables and by means (SD) and medians for continuous variables. The comparison of categorical variables was performed with the Chi-Square test. Kolomogorov - Smirnov Test assessed the normality of the dispersion of data. The between-group comparison of non-normally distributed data was conducted with Mann - Whitney U Test. We used the Spearman Correlation Test to investigate the correlation between non-normally distributed continuous variables. Statistical significance was accepted at $P < 0.05$ level. In cases where the difference in the results of Mann - Whitney U was statistically significant, the effect size (r) was calculated. With this aim, we divided the z value by the square root of the total number of participants in the two groups and interpreted it according to Cohen. Accordingly, 0.50 was considered a high effect, 0.30 medium, and 0.10 small effect.

Results

The mean age of the participants was 15.47 years (SD 1.42). One hundred twenty-seven (60.5%) participants reported regular menses. The mean menstruation period was 30.49 (SD 11.17) days, and the mean menstrual bleeding duration was 5.75 (SD 1.51) days. A hundred four (49.8%) adolescents answered the question, "*Do you have severe pain that will prevent you from your daily activities during your menstrual period?*" as "*Yes.*" The mean severity of pain was 5.78 (SD 2.45) on the VAS (min = 0, max = 10). One hundred ninety-six (94.7%) adolescents scored

Table 1
Menstruation and dysmenorrhea related descriptive characteristics.

Features	Mean ± SD, *n* (%)
Menstrual features	
Age of menarche (year)	12.41 ± 1.23
The pattern of menstrual cycles	
Regular	127 (60.5)
Irregular	78 (37.1)
Menstrual cycle length (days)	30.49 ± 11.17
Menstrual cycle length	
<21 days	29 (14.1%)
22–35 days	146 (71.2%)
60 days<	22 (10.7%)
Duration of bleeding (days)	5.75 ± 1.51
Dysmenorrhea related features	
Pain that affects daily activities during menstruation ($n = 209$)	
Yes	104 (49.8%)
No	105 (50.2%)
VAS (mean score)	5.22 ± 2.67
Dysmenorrhea severity according to VAS ($n = 196$)	
Mild (1–3)	45 (23%)
Moderate (4–7)	109 (55.6%)
Severe (8–10)	42 (21.4%)
When does dysmenorrhea start?	
2–3 days before the menstruation	65 (39.6%)
In the first 24 h of menstruation	50 (30.5%)
With the menstruation	33 (20.1%)
2–3 days after the menstruation	16 (9.8%)
Use of pain-killer medication during menstruation	
Yes	74 (35.7%)
No	133 (64.3%)

their menstrual pain severity as greater than "0", indicating mild to severe pain. According to VAS, 23% ($n = 45$) of adolescents had mild, 55.6% ($n = 109$) had moderate, and 21.4% ($n = 42$) had severe menstrual pain (mild: 1–3; moderate: 4–7; severe: 8–10). Adolescents' menstruation and dysmenorrhea related characteristics are presented in Table 1.

To find out the factors affecting dysmenorrhea, we divided the adolescents into two groups. The first group was formed by adolescent girls who have dysmenorrhea affecting their daily activities. In contrast, the second group was formed by adolescents who have dysmenorrhea without any effect on daily activities. Closer examination of the results revealed that the dysmenorrhea affecting daily-life group had significantly higher coffee consumption ($\chi^2 = 4.76$; $P = 0.029$) and less regular breakfast ($\chi^2 = 4.99$; $P = 0.026$) compared to the other group. Additionally, this group had more disturbed sleep during menstruation compared to the other group ($\chi^2 = 30.01$; $P < 0.001$) (Table 2).

We also compared the relevant continuous variables between the two groups. The detailed results were summarized in Table 3.

Considering the correlation of VAS scores with continuous variables, we observed a significant inverse correlation between menstrual cycle length and VAS score ($P = 0.012$, $r = -0.183$). Among adolescents in our study, mental health conditions and related factors were evaluated by T-DSM-IV-S and Brief Symptom Inventory. VAS scores were positively correlated with Turgay-ADHD inattention score ($P = 0.004$, $r = 0.200$) and hyperactivity-impulsivity score ($P = 0.001$, $r = 0.242$); BSI-anxiety ($P = 0.001$, $r = 0.229$), depression ($P = 0.002$, $r = 0.216$), somatization ($P < 0.001$, $r = 0.247$), negative self ($P = 0.020$, $r = 0.164$), hostility ($P = 0.004$, $r = 0.203$) and total score ($P = 0.002$, $r = 0.220$). Sleep quality and disorders were examined by Pittsburgh Sleep Quality Index and DSM-5 Level 2 Sleep Disorders Scale and DSM-5 Level 2 SDS total score ($P = 0.005$, $r = 0.197$); and PSQI global score ($P < 0.001$, $r = 0.265$) were positively correlated with VAS scores (Table 4).

Discussion

In this study, we investigated the relationship of PD with ADHD and psychological symptoms among adolescent girls. Additionally, we assessed dysmenorrhea-related sleep quality, daily routines, and menstrual characteristics. Since the pain represents a subjective finding, and the personal expression may differ individually, we used both VAS and daily activity limitations for dysmenorrhea in our study to identify the pain more clearly. We compared adolescent girls in two groups: a group of girls having dysmenorrhea affecting their daily activities and the other group having dysmenorrhea without any effect on daily activities. We found that the daily activities affected group had more psychological symptoms such as anxiety, depression, somatization, negative self-perception, and hostility. They also had more inattention and hyperactivity-impulsivity problems. Also, the overall sleep quality over the last week and the last month was worse in this group. Regarding daily routines, they consumed more coffee and had irregular breakfast habits. Their menstrual cycle length was shorter, but blood loss was higher. The menstrual pain severity, measured by VAS, was positively correlated with age, coffee consumption, menstrual blood loss, ADHD symptoms, all other psychological parameters, and sleep disruptions. VAS score and the length of the menstrual cycle were correlated negatively.

Dysmenorrhea is a significant gynecologic problem among teenage girls. Most of the adolescents report pain during their menstruation. A population-based study showed that 93% of adolescents experience pain during menstruation [15]. Consistent with others' findings, we found that 94.7% of the adolescents marked the menstrual pain as higher than "0" on VAS, indicating the presence of mild to severe pain. Among adolescents complaining of menstrual pain, 23% reported mild, 55.6% moderate, and 21.4% reported severe menstrual pain. Previous studies reported similar ratios for the severity of menstrual pain [15,16]. The mean pain severity of VAS in the current study was 5.22 (SD 2.67), which was very close to the findings (5.78, SD 2.45) of another research from the same country [17]. In the present study, almost half of the participants (49.8%) stated that they had severe menstrual pain limiting their daily activities. It was previously reported that moderate or severe dysmenorrhea might affect daily activities, including school attendance and social lives [18]. Several authors have shown higher ratios for dysmenorrhea impacting daily activities, being present in 65%–69.7% of women [17,19]. The subjectivity of pain perception can explain the differences in percentages. Beyond subjectivity, participants from different cultures and different age groups with varied lifestyles may have different perceptions affecting the pain. Even so, it is evident that dysmenorrhea affects daily life adversely in many adolescents and young women.

A novel finding of our study was the correlation of ADHD symptoms with dysmenorrhea. Our study constitutes the first analysis of the relation between dysmenorrhea and ADHD symptoms to the best of our knowledge. The adolescents with dysmenorrhea affecting daily life had statistically significantly more symptoms of inattention and hyperactivity-impulsivity. Moreover, as the severity of menstrual pain increased, the severity of ADHD symptoms increased. It has been previously known that pain has a disruptive and interfering effect on attention [20]. Two studies reported dysmenorrhea periods are related to inattentiveness and worsening in attention performance [21,22]. However, what we report here not only refers to the attentional interference caused by a painful menstruation period. We propose that there may be a relationship between ADHD and PD. ADHD is a multifactorial neurodevelopmental disorder, and abnormal brain development takes a role in its pathophysiology [4,23]. The dopamine deficit hypothesis and the presence of dopaminergic dysregulation

Table 2
The comparison of categorical variables according to dysmenorrhea.

Variables	Dysmenorrhea affecting daily-life			
	Yes ($n = 104$) n (%)	No ($n = 105$) n (%)	Total ($n = 209$) n (%)	χ^2, P
Cigarette smoking				
Yes	25 (24.3)	16 (15.4)	41 (19.8)	$\chi^2 = 0.57$
No	78 (75.7)	88 (84.6)	166 (80.2)	0.109
Alcohol consumption				
Yes	8 (7.7)	5 (4.8)	13 (6.3)	$\chi^2 = 0.73$
No	96 (92.3)	99 (95.2)	195 (93.7)	0.390
Coffee consumption				
Yes	68 (65.4)	53 (50.5)	121 (57.9)	$\chi^2 = 4.76$
No	36 (34.6)	52 (49.5)	88 (42.1)	**0.029**
Sports/exercises				
Yes	22 (21.4)	23 (22.1)	45 (21.7)	$\chi^2 = 0.17$
No	81 (78.6)	81 (77.9)	162 (78.3)	0.895
Breakfast				
Yes	50 (48.1)	66 (63.5)	116 (55.8)	$\chi^2 = 4.99$
No	54 (51.9)	38 (36.5)	92 (44.2)	**0.026**
Ready-to-eat food/fast food				
Rarely	53 (51.0)	42 (40.8)	95 (45.9)	$\chi^2 = 3.32$
2–3 days a week	31 (29.8)	43 (41.7)	74 (35.7)	0.190
Everyday	20 (19.29)	18 (17.5)	38 (18.4)	
Are periods regular?				
Yes	62 (60.2)	65 (63.7)	127 (62.0)	$\chi^2 = 0.27$
No	41 (39.8)	37 (36.3)	78 (38.0)	0.603
Dysmenorrhea history in the family				
Yes	49 (48.0)	54 (53.5)	103 (50.7)	$\chi^2 = 0.59$
No	53 (52.0)	47 (46.5)	100 (49.3)	0.439
Sleep disturbance during menses				
Yes	59 (57.3)	21 (20.2)	80 (38.6)	$\chi^2 = 30.01$
No	44 (42.7)	83 (79.8)	122 (61.4)	<**0.001**

Chi-square test.
Statistically significant P values are shown in bold.

Table 3
The comparison of continuous variables according to dysmenorrhea.

Variables	Dysmenorrhea affecting daily-life				
	Yes Median (25–75th)	No Median (25–75th)	Z	P	Effect size (r)
Age (year)	16 (14.25–17)	15 (14–17)	2.429	**0.015**	0.17
Age of menarche (year)	12.5 (11–13)	13 (12–13)	0.538	0.591	
Duration of bleeding (days)	5.5 (5–7)	6 (5–7)	0.154	0.878	
Menstrual cycle length (days)	29.5 (24.25–30)	30 (28–30)	2.295	**0.022**	0.16
Amount of menstrual bleeding[a]	61.5 (37.5–131.5)	50 (25–78)	2.504	**0.012**	0.17
VAS score	7 (6–8)	4 (2–5)	9.525	<**0.001**	0.67
T-DSM-IV-S (DSM-IV-ADHD)					
Inattention	11 (6.5–18)	8 (3–13)	3.464	**0.001**	0.24
Hyperactivity/Impulsivity	7 (3.5–13.5)	3 (1–8.5)	4.208	<**0.001**	0.29
Brief Symptom Inventory					
Anxiety	24 (14–34.5)	17 (7.5–28)	3.351	**0.001**	0.23
Depression	28 (16–39)	20 (8–32.5)	3.109	**0.002**	0.21
Somatization	12 (7–19.5)	8 (2.5–13)	4.218	<**0.001**	0.29
Negative self	22 (13–29)	14 (6–32)	2.903	**0.004**	0.20
Hostility	14 (8.5–21)	10 (5–18)	3.280	**0.001**	0.22
Total score	100 (57.5–147.5)	64 (31.5–115.5)	3.479	**0.001**	0.24
DSM-5 Level 2 SDS total score	24 (18–28)	20 (13–25.5)	2.919	**0.004**	0.20
PSQI global score	8 (5–11)	6 (3–8)	4.043	<**0.001**	0.28

IQR: Inter-Quartile Range, VAS: Visual Analog Scale, T-DSM-IV-S: Turgay Diagnostic and Statistical Manual of Mental Disorders, 4th edition (DSM-IV)-Based Child and Adolescent Disruptive Behavior Disorders Screening and Rating Scale, ADHD: Attention deficit hyperactivity disorder, DSM-5 Level 2 SDS: DSM-5 Sleep Disorders Scale, PSQI: Pittsburgh Sleep Quality Index.
Statistically significant P values are shown in bold.
[a] The Pictorial Blood Assessment Chart (PBLAC) was used to calculate the menstrual bleeding score.

have been widely accepted in the etiopathogenesis of ADHD [24,25]. Dopamine is involved in pain processing [26]. Moreover, several studies reported increased prevalence and sensitivity of pain in ADHD patients [27,28]. Decreased dopaminergic activity in ADHD might eventually create a vulnerability for experiencing more painful menstruation. Another explanation for the relationship may be over androgens. Hyperandrogenism has also been suggested to play a role in the etiopathogenesis of ADHD [29]. Androgen receptor variation has been shown in ADHD [30]. It has been suggested that elevated androgens were related to menstrual

Table 4
Factors assessed in relation to VAS.

Variables	VAS			
	Mean ± SD	Range	Spearman *r*	*P*
Age (year)			0.204**	**0.003**
Age of menarche	12.41 ± 1.23	9–15	−0.104	0.141
BMI	21.76 ± 4.65	13.70–38.39	−0.012	0.864
Menstrual cycle length (days)	30.49 ± 11.17	11–90	−0.183*	**0.012**
Duration of bleeding (days)	5.75 ± 1.51	2–11	0.090	0.198
Amount of menstrual bleeding[a]	83.82 ± 91.90	3–720	0.247**	**0.001**
T-DSM-IV-S (DSM-IV-ADHD)				
Inattention	10.76 ± 7.25	0–27	0.200**	**0.004**
Hyperactivity/Impulsivity	7.18 ± 6.87	0–27	0.242**	**0.001**
Brief Symptom Inventory				
Anxiety	21.70 ± 14.13	0–92	0.229**	**0.001**
Depression	23.48 ± 14.14	0–48	0.216**	**0.002**
Somatization	11.49 ± 8.61	0–36	0.247**	**<0.001**
Negative self	19.90 ± 13.88	0–88	0.164*	**0.020**
Hostility	12.79 ± 7.47	0–28	0.203**	**0.004**
Total score	89.39 ± 53.82	0–288	0.220**	**0.002**
DSM-5 Level 2 SDS total score	21.80 ± 7.61	8–40	0.197**	**0.005**
PSQI global score	6.76 ± 3.59	0–16	0.265**	**<0.001**

VAS: Visual Analog Scale, BMI: Body mass index, T-DSM-IV-S: Turgay Diagnostic and Statistical Manual of Mental Disorders, 4th edition (DSM-IV)-Based Child and Adolescent Disruptive Behavior Disorders Screening and Rating Scale, ADHD: Attention deficit hyperactivity disorder, DSM-5 Level 2 SDS: DSM-5 Sleep Disorders Scale, PSQI: Pittsburgh Sleep Quality Index.
*Correlation is significant at the 0.05 level (2-tailed).
**Correlation is significant at the 0.01 level (2-tailed).
Statistically significant *P* values are shown in bold.
[a] The Pictorial Blood Assessment Chart (PBLAC) was used to calculate the menstrual bleeding score.

problems such as menstrual irregularities [31]. The endometrium is a target for androgen action either directly by the androgen receptor or indirectly by estrogen receptor after aromatization to estrogen [32]. The linkage between dysmenorrhea and ADHD symptoms that we report may raise a question of a possible biological mechanism related to both conditions through dopamine deficiency or elevated androgens. Future studies should be conducted to investigate the possible association of ADHD and PD in conjunction with dopaminergic systems or androgens.

Heightened pain reactivity and enhanced pain perception, which extends beyond the menstruation periods, have been documented in dysmenorrhea [2,33]. Women with primary dysmenorrhea have persistent central changes, possibly as a result of prolonged nociceptive inputs to the central nervous system [3]. It has been suggested that negative emotions, such as anxiety or depression, can aggravate pain sensitivity, which is also true in dysmenorrheic patients [3]. The relation between psychopathology and pain has been previously demonstrated in the literature. Iacowides et al. stated that pain exacerbates psychological distress, and psychological distress exacerbates pain, emphasizing a two-sided interaction [2]. Painful menstrual cycles can indirectly cause negative emotions by adversely affecting social interactions, academic performance, or quality of life. On the other side, depression and anxiety increase the incidence of dysmenorrhea [3]. In the current study, adolescents with dysmenorrhea affecting daily life were found to have statistically significantly worse symptom scores in all assessed areas of psychopathology. As well, the severity of dysmenorrhea on VAS was correlated with psychiatric symptom severity. The association of anxiety, depression, and somatic disorders with adolescent dysmenorrhea has been reported previously [3]. We here also found more negative self-perception and hostile feelings in dysmenorrheic adolescents. Mou et al. reported that adolescents' loneliness experience and interpersonal problems were correlated with the frequency and severity of dysmenorrhea [34]. These findings support that adolescents with dysmenorrhea are prone to have psychiatric symptomatology. However, it is still uncertain whether dysmenorrhea causes a predisposition to psychiatric distress, or the explanation is vice versa.

The relationship between pain and sleep is also bidirectional and interactive [2]. It is known that sleep problems are present in some clinical conditions that are characterized by increased pain sensitivity, such as fibromyalgia or somatization disorders and PD [2,3,35]. Besides, pain sensitivity is increased in people with sleep disorders [35]. As a two-sided relationship, it has been suggested that pain disrupts sleep in people with pain disorders, and pain perception is influenced in sleep disorders [2]. It is thought that sleep quality and efficiency are disturbed by menstrual pain, and the consequent fatigue may intensify the negative effect of pain on daily activities [36]. Also, disturbed sleep during menstruation may augment pain sensitivity [2]. In the current study, we found that adolescents with dysmenorrhea affecting daily activities had more disturbed sleep during menstruation. This is an expected finding in light of previous literature. We also found that participants with dysmenorrhea had worse sleep quality over the last week and the last month, showing that they suffer from sleep problems independent from the menstruation period. Menstrual pain severity in VAS was correlated with sleep quality in our study. These results support a further relationship between dysmenorrhea and sleep, which extends beyond the menstruation period. Finan and Smith suggested that overlapping mechanisms in the central nervous system may underlie the development and interplay of sleep and pain disorders by common neurobiological pathways [35]. Our findings are in line with results reported by other publications in the literature. However, this topic needs further investigation.

In the current study, adolescents in the group with dysmenorrhea affecting daily life activities were older, had shorter menstrual cycle length, and had a higher menstrual flow. The severity of menstrual pain was positively correlated with age and the amount of menstrual blood loss and negatively correlated with the men-

strual cycle's length. There are both supporting and opposing data to our findings in the literature. Habibi et al. found dysmenorrhea was associated with shorter cycle lengths, consistent with our data [37]. Conversely, two other studies reported more menstrual pain among women with longer duration of menstrual cycles [38,39]. Heavy menstrual flow was reported in dysmenorrheic groups parallel to our research [37]. In contrast to our findings, age was shown to be negatively correlated with dysmenorrhea in adult and adolescent studies [37,40]. In our study, the age of the participants was in a narrow age range and younger.

The current study has some limitations. Firstly, the study did not include a society based group, so results cannot be generalized. Additional studies, including community-based and clinical samples, should be carried out to validate our findings and provide more detailed insights into the topic. The second limitation concerns information bias. Since universal defining criteria for dysmenorrhea was not present, the study was based mainly on the adolescents' self-reports of painful menstruation. However, it should be noted that this is the most widely used method in other published relevant studies. In our study, we did not rule out a probable underlying organic pathology to distinguish between primary dysmenorrhea and secondary dysmenorrhea by gynecologic examination. Even so, we asked the adolescents any medical history, previous obstetrics clinic referral, or a gynecologic complaint. None of the participants stated such a condition. Similarly, in many published studies, the participants did not receive a pelvic examination or receive an ultrasound to determine secondary dysmenorrhea. Lastly, the study was designed as a cross-sectional study. Prospective follow-up studies may provide better information on the maturational alterations of adolescents.

Conclusively, we searched the relationship of dysmenorrhea with psychological symptoms, sleep quality, daily-routines, and menstrual characteristics in a population of adolescents. The study has some important implications: The adolescents who refer to child psychiatry outpatients are expected to have a wide range of psychiatric issues. Sometimes adolescents with severe psychopathology, at other times, adolescents with transient and developmental stage-specific mild mental difficulties apply to outpatient clinics to receive support and treatment. So, we believe that demonstrating the relation of psychiatric problems with PD in such a population is important to elucidate the evidence. Secondly, we showed a possible association of ADHD symptoms with PD for the first time. There may be a common biological mechanism related to the two conditions, which should be supported by future studies. These findings reveal the importance of assessing the mental status of adolescents with dysmenorrhea and referring them to child and adolescent psychiatry policlinics in cases of need. Thirdly, we consider that we contributed to the adolescent dysmenorrhea literature on the possible relations of PD with daily-life habits and menstrual characteristics. As we have mentioned previously, adolescence is a specific time for maturation, and the literature has conflicting data in the area. Methodological differences and the subjectivity of the topic mostly account for the inconsistencies between studies. Also, cultural and ethnic varieties may significantly influence the research findings. It has been known that cultural patterns of behavior may be a determining factor in pain perception. So, we believe the evaluation of PD among adolescents in different cultures is critical to better understand the topic and to provide high-quality care for these adolescents.

Funding

This research did not receive any specific grant from any funding agency, commercial or not-for-profit sectors.

Declaration of competing interest

The authors declare that they have no conflict of interest.

References

[1] Sultan C, Gaspari L, Paris F. Adolescent dysmenorrhea. Endocr Dev 2012;22:171–80.
[2] Iacovides S, Avidon I, Baker FC. What we know about primary dysmenorrhea today: a critical review. Hum Reprod Update 2015;21:762–78.
[3] Bajalan Z, Moafi F, MoradiBaglooei M, Alimoradi Z. Mental health and primary dysmenorrhea: a systematic review. J Psychosom Obstet Gynaecol 2019;40:185–94.
[4] Association AP. Diagnostic and statistical manual of mental disorders (DSM-5®). American Psychiatric Pub; 2013.
[5] Higham JM, O'Brien PM, Shaw RW. Assessment of menstrual blood loss using a pictorial chart. Br J Obstet Gynaecol 1990;97:734–9.
[6] Carlsson AM. Assessment of chronic pain. I. Aspects of the reliability and validity of the visual analogue scale. Pain 1983;16:87–101.
[7] Buysse DJ, Reynolds 3rd CF, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatry Res 1989;28:193–213.
[8] Ağargün MY, Kara H, Anlar Ö. The validity and reliability of the Pittsburgh Sleep Quality Index. Turk Psikiyatr Derg 1996;7:107–15.
[9] American Psychiatric Association. Available at: https://www.psychiatry.org/psychiatrists/practice/dsm/educational-resources/assessment-measures. [Accessed 27 December 2020].
[10] Erkuran HÖ, Sapmaz ŞY, Herdem A, Öztürk M, Bilaç Ö, Önen Ö, et al. DSM-5 Level 2 Sleep Disorders Scale validity and reliability of Turkish form (form for children aged 11-17 years and parent form for children aged 6-17 years). Noro Psikiyatr Ars 2018;55:256–60.
[11] Derogatis LR, Spencer N. The brief symptom index; Administration, scoring and procedure manual. Baltimore: Johns Hopkins University Press; 1982.
[12] Sahin NH, Durak Batigün A, Uğurtaş S. The validity, reliability and factor structure of the Brief Symptom Inventory (BSI). Türk Psikiyatri Derg 2002;13:125–35.
[13] Turgay A. Disruptive behavior disorders. Integrative Therapy Institute Publication: child and adolescent screening and rating scales for children, adolescents, parents and teachers. West Bloomfield (Michigan); 1994.
[14] Ercan ES, Amado S, Somer O, Çıkoğlu S. Development of a test battery for the assessment of attention deficit hyperactivity disorder. Turk J Child Adolesc Psychiatry 2001;8:132–44.
[15] Parker MA, Sneddon AE, Arbon P. The menstrual disorder of teenagers (MDOT) study: determining typical menstrual patterns and menstrual disturbance in a large population-based study of Australian teenagers. BJOG 2010;117:185–92.
[16] Hu Z, Tang L, Chen L, Kaminga AC, Xu H. Prevalence and risk factors associated with primary dysmenorrhea among Chinese female university students: a cross-sectional study. J Pediatr Adolesc Gynecol 2020;33:15–22.
[17] Aktaş D. Prevalence and factors affecting dysmenorrhea in female university students: effect on general comfort level. Pain Manag Nurs Off J Am Soc Pain Manag Nurses 2015;16:534–43.
[18] Potur DC, Bilgin NC, Komurcu N. Prevalence of dysmenorrhea in university students in Turkey: effect on daily activities and evaluation of different pain management methods. Pain Manag Nurs Off J Am Soc Pain Manag Nurses 2014;15:768–77.
[19] Ortiz MI. Primary dysmenorrhea among Mexican university students: prevalence, impact and treatment. Eur J Obstet Gynecol Reprod Biol 2010;152:73–7.
[20] Eccleston C, Crombez G. Pain demands attention: a cognitive-affective model of the interruptive function of pain. Psychol Bull 1999;125:356–66.
[21] Aziato L, Dedey F, Clegg-Lamptey JNA. The experience of dysmenorrhoea among Ghanaian senior high and university students: pain characteristics and effects. Reprod Health 2014;11:58.
[22] Keogh E, Cavill R, Moore DJ, Eccleston C. The effects of menstrual-related pain on attentional interference. Pain 2014;155:821–7.
[23] Mullin AP, Gokhale A, Moreno-De-Luca A, Sanyal S, Waddington JL, Faundez V. Neurodevelopmental disorders: mechanisms and boundary definitions from genomes, interactomes and proteomes. Transl Psychiatry 2013;3:e329.
[24] Swanson JM, Kinsbourne M, Nigg J, Lanphear B, Stefanatos GA, Volkow N, et al. Etiologic subtypes of attention-deficit/hyperactivity disorder: brain imaging, molecular genetic and environmental factors and the dopamine hypothesis. Neuropsychol Rev 2007;17:39–59.
[25] Tripp G, Wickens JR. Neurobiology of ADHD. Neuropharmacology 2009;57:579–89.
[26] Jääskeläinen SK, Rinne JO, Forssell H, Tenovuo O, Kaasinen V, Sonninen P, et al. Role of the dopaminergic system in chronic pain – a fluorodopa-PET study. Pain 2001;90:257–60.
[27] Stray LL, Kristensen Ø, Lomeland M, Skorstad M, Stray T, Tønnessen FE. Motor regulation problems and pain in adults diagnosed with ADHD. Behav Brain Funct 2013;9:18.
[28] Treister R, Eisenberg E, Demeter N, Pud D. Alterations in pain response are partially reversed by methylphenidate (Ritalin) in adults with attention deficit hyperactivity disorder (ADHD). Pain Pract 2015;15:4–11.

[29] Mueller SC, Ng P, Sinaii N, Leschek EW, Green-Golan L, VanRyzin C, et al. Psychiatric characterization of children with genetic causes of hyperandrogenism. Eur J Endocrinol 2010;163:801–10.
[30] Comings DE, Chen C, Wu S, Muhleman D. Association of the androgen receptor gene (AR) with ADHD and conduct disorder. Neuroreport 1999;10:1589–92.
[31] Van Anders SM, Watson NV. Menstrual cycle irregularities are associated with testosterone levels in healthy premenopausal women. Am J Hum Biol Off J Hum Biol Counc 2006;18:841–4.
[32] Jabbour HN, Kelly RW, Fraser HM, Critchley HOD. Endocrine regulation of menstruation. Endocr Rev 2006;27:17–46.
[33] Payne LA, Rapkin AJ, Seidman LC, Zeltzer LK, Tsao JC. Experimental and procedural pain responses in primary dysmenorrhea: a systematic review. J Pain Res 2017;10:2233–46.
[34] Mou L, Lei W, Chen J, Zhang R, Liu K, Liang X. Mediating effect of interpersonal relations on negative emotions and dysmenorrhea in female adolescents. Gen psychiatry 2019;32:e100008.
[35] Finan PH, Smith MT. The comorbidity of insomnia, chronic pain, and depression: dopamine as a putative mechanism. Sleep Med Rev 2013;17:173–83.
[36] Driver HS, Baker FC. Menstrual factors in sleep. Sleep Med Rev 1998;2:213–29.
[37] Habibi N, Huang MSL, Gan WY, Zulida R, Safavi SM. Prevalence of primary dysmenorrhea and factors associated with its intensity among undergraduate students: a cross-sectional study. Pain Manag Nurs Off J Am Soc Pain Manag Nurses 2015;16:855–61.
[38] Fernández-Martínez E, Onieva-Zafra MD, Parra-Fernández ML. Lifestyle and prevalence of dysmenorrhea among Spanish female university students. PLoS One 2018;13:e0201894.
[39] Harlow SD, Park M. A longitudinal study of risk factors for the occurrence, duration and severity of menstrual cramps in a cohort of college women. Br J Obstet Gynaecol 1996;103:1134–42.
[40] Lindh I, Ellström AA, Milsom I. The effect of combined oral contraceptives and age on dysmenorrhoea: an epidemiological study. Hum Reprod 2012;27:676–82.