ORIGINAL ARTICLE

JCRPE Journal of Clinical Research in Pediatric Endocrinology

DOI: 10.4274/jcrpe.galenos.2026.2026-2-11
J Clin Res Pediatr Endocrinol 2026;18(3):422-430

# Menstrual Health in Adolescents with Congenital Heart Disease

Demet Aygün Arı[1], Melis Pehlivantürk Kızılkan[1], İlker Ertuğrul[2], Aydın Adıgüzel[3], Mehmet Emre Arı[4], Tevfik Karagöz[2], Orhan Derman[1], Sinem Akgül[1]

[1]Hacettepe University Faculty of Medicine, Department of Pediatrics, Division of Adolescent Medicine, Ankara, Türkiye
[2]Hacettepe University Faculty of Medicine, Department of Pediatrics, Division of Pediatric Cardiology, Ankara, Türkiye
[3]University of Health Sciences Türkiye, Gülhane Training and Research Hospital, Clinic of Pediatrics, Division of Pediatric Cardiology, Ankara, Türkiye
[4]University of Health Sciences Türkiye, Ankara Etlik City Hospital, Clinic of Pediatrics, Division of Pediatric Cardiology, Ankara, Türkiye

**Cite this article as:** Aygün Arı D, Pehlivantürk Kızılkan M, Ertuğrul İ, Adıgüzel A, Arı ME, Karagöz T, Derman O, Akgül S. Menstrual health in adolescents with congenital heart disease. J Clin Res Pediatr Endocrinol. [Epub Ahead of Print] 2026;18(3):422-430

## ABSTRACT

**Objective:** As life expectancy increases in patients with congenital heart disease (CHD), providing appropriate gynecological care has become more important. While the gynecologic and reproductive health concerns of adults with CHD are increasingly recognized, studies focusing on menstrual problems in adolescents with CHD are limited. The aim was to evaluate menstrual characteristics and related symptoms in adolescents with CHD.

**Methods:** Adolescents aged 12-21 years who had experienced menarche at least two years earlier were included. The CHD group was classified as mild, moderate, or severe, based on the European Society of Cardiology guidelines, and healthy adolescents served as controls. Menstrual histories were obtained from all participants. In the CHD group, additional clinical data (diagnosis, surgery/interventions, and medication use) were collected. Menstrual parameters were compared between the CHD and control groups, as well as across CHD subgroups.

**Results:** A total of 108 adolescents with CHD (41 mild, 42 moderate, 25 severe) and 76 healthy controls were enrolled. No significant differences were found between groups in terms of age at menarche, menstrual cycle length, period duration, or daily pad use ($p>0.05$). Dysmenorrhea severity and frequency were similar; however, school absenteeism due to dysmenorrhea was significantly higher in the control group ($p=0.037$). Physical premenstrual symptoms, particularly bloating, anxiety, and mood swings, were more frequent in controls ($p<0.05$). Menstrual education rates from healthcare professionals were low in both groups.

**Conclusion:** Our findings indicate that adolescents with CHD have menstrual characteristics comparable to those of healthy controls. However, despite these similarities, they may differ in their perception and tolerance of menstrual symptoms.

**Keywords:** Congenital heart disease, menstrual dysfunction, premenstrual symptom, premenstrual syndrome

**Corresponding Author:** Demet Aygün Arı, MD, PhD, Hacettepe University Faculty of Medicine, Department of Pediatrics, Division of Adolescent Medicine, Ankara, Türkiye
**E-mail:** demetaygunari@gmail.com **ORCID:** orcid.org/0000-0002-8701-6085
**Conflict of interest:** None declared
**Received:** 24.02.2026 **Accepted:** 22.07.2026 **Epub:** 22.07.2026 **Publication Date:** 08.09.2026

**What is already known on this topic?**

Females with congenital heart disease (CHD) may experience delayed menarche and higher rates of menstrual abnormalities, particularly in complex or cyanotic disease. Although reproductive health guidelines exist for adults with CHD, menstrual health in adolescents remains underexplored.

**What this study adds?**

Adolescents with CHD showed largely similar menstrual characteristics to healthy peers, despite subtle differences in pain and symptom perception. Antiplatelet/anticoagulant therapy tended to be associated with increased menstrual bleeding, highlighting the importance of individualized menstrual counseling in this population.

## Introduction

Congenital heart disease (CHD), the most common major congenital anomaly, is a growing global health concern. Its prevalence is increasing, having been reported as 9.4 per 1,000 live births between 2010 and 2017 (1). Advances in treatment have markedly improved survival, with over 97% of affected children now reaching adulthood, depending on the severity of the lesion (2,3). As life expectancy rises, addressing broader health needs, including menstrual, sexual, and reproductive health, has become increasingly important (4).

Studies have shown that females with CHD tend to experience menarche later than the general population, particularly those with complex or cyanotic heart disease (5,6,7). Furthermore, primary amenorrhea and menorrhagia have been reported more frequently in these patients (6,8). While menstrual patterns in acyanotic patients appear similar to those of the general population, menstrual abnormalities are more commonly observed in patients who remain cyanotic until menarche (5).

In a study of 114 females aged 14-21 years, 83.3% reported at least one menstrual problem. While lesion complexity was not linked to problem frequency, those with more complex CHD were more likely to seek medical care (9).

Although guidelines exist for pregnancy and reproductive health in adults with CHD (10,11,12), gynecologic issues in adolescents remain underexplored (9). The American Heart Association advises obtaining a gynecological history after menarche and emphasizes age-appropriate counseling on sexual health, contraception, and pregnancy from early adolescence (13). Early identification of menstrual problems in this population is essential for timely intervention and appropriate counseling.

The aim of this study was to investigate menstrual problems specific to adolescents with CHD that may arise due to their underlying condition or related treatments.

## Methods

### Participants

This observational, cross-sectional study enrolled CHD patients presenting to a pediatric cardiology clinic over one year and healthy adolescents attending routine visits at the same hospital. Participants were 12-21 years old and at least two years post-menarche. Patients with syndromic heart disease, chronic conditions, or medications affecting menstruation were excluded.

### Data Collection

The age, weight, height, and body mass index of all participants were recorded. A cardiac data form was completed for patients with CHD, and a menstrual data form was filled out for all participants. All procedures were conducted in accordance with the Declaration of Helsinki.

### Cardiac Data Form

The CHD diagnosis of all patients was made by a pediatric cardiologist. CHDs were classified as mild, moderate, or severe based on the severity of the defect, according to the European Society of Cardiology guidelines (12), and were also categorized as cyanotic or acyanotic based on the presence of cyanosis. Electronic medical records were reviewed for cyanosis status and duration, history of interventions or surgery (biventricular or univentricular), and use of anticoagulants, antiplatelets, or other CHD-related medications. When determining the duration of cyanosis, patients were considered cyanotic until the age at which they underwent corrective surgery.

### Menstrual Data Form

Menstrual history of the participants, included age at menarche, menstrual cycle duration (days), menstrual bleeding duration (days), daily menstrual management product count, degree of bleeding during their period which patients classified as light,

moderate, or heavy, and the presence of menstrual overflow. Light bleeding was defined as "needing to change pads/tampons a few times a day, and they're rarely soaked". Moderate bleeding as "needing to change pads/tampons every 3-4 hours, but they don't usually leak or overflow". Heavy bleeding as "having to change pads/tampons every 1-2 hours because they get completely soaked or sometimes passing large clots or have leakage onto my clothes or bedding".

Oligomenorrhea was defined as cycles >45 days within 2-3 years after menarche, or >35 days beyond 3 years (14). Menstrual bleeding lasting 2-7 days was considered normal, and ≥8 days as prolonged (15).

Participants were asked about dysmenorrhea, its severity (on a scale of 1-10), and any treatments received and their effectiveness. Additional questions addressed whether they had received professional information or care for menstrual problems, sexual activity, and contraceptive use. All participants received comprehensive sexual and menstrual counseling.

The presence of premenstrual symptoms was assessed. Physical symptoms questioned included joint or muscle ache, breast tenderness and pain, headache, a sensation of bloating or weight gain, and gastrointestinal symptoms. In addition, emotional symptoms were investigated, asking about anger, anxiety, depressed mood, mood swings, suddenly feeling sad or tearful, crying, irritability, tension, or sense of hopelessness, while behavioral symptoms questioned included decreased interest in usual activities, feelings of lethargy, fatigue, or reduced energy, changes in appetite, either overeating or craving a specific food, changes in sleep pattern (hypersomnia or insomnia), difficulty in concentrating, and feeling overwhelmed or out of control (16).

Participants who met the diagnostic criteria were diagnosed with premenstrual syndrome or premenstrual dysphoric disorder based on self-reported retrospective history. Premenstrual syndrome was diagnosed by the presence of at least one physical, emotional, or behavioral symptom that occurred in the final week before the onset of menses, began to improve within a few days after the onset of menses, and became minimal or absent in the week following menses, in each of the three previous menstrual cycles. Premenstrual dysphoric disorder was diagnosed when five or more symptoms were present during the same timeframe. At least one of the symptoms must be emotional, and at least one must be a behavioral or physical symptom. The symptoms must cause clinically significant distress and should not be better explained by another psychiatric or medical disorder, or attributable to the physiological effects of a substance (17,18).

### Ethical Standards

The authors assert that all procedures contributing to this work comply with the ethical standards of the national research ethics guidelines of Türkiye and with the Helsinki Declaration of 1975, as revised in 2008. This study was approved by the Ethics Committee of Hacettepe University (approval no.: GO 21/1221, date: 16.11.2021). Written informed consent was obtained from all participants and their parents.

### Statistical Analysis

Analyses were conducted using IBM SPSS Statistics, version 27.0 (IBM Corp., Armonk, NY, USA). Continuous variables are summarized as mean±standard deviation or median (Q1-Q3), and categorical variables as frequencies and percentages. Group comparisons were performed using Student's t-test or one-way ANOVA when parametric assumptions were met, and Mann-Whitney U or Kruskal-Wallis tests otherwise. Normality was assessed with the Shapiro-Wilk test. Categorical data were analyzed with the Pearson chi-square test. Correlations were assessed using Spearman's rank correlation. A p value <0.05 was considered statistically significant.

## Results

A total of 108 patients with CHD (41 with mild defects, 42 with moderate defects and 25 with severe defects) and 76 healthy adolescents were included in the study. The mean age was 16.32±2.40 years in the CHD group and 16.14±2.61 years in the control group (p=0.630). There were no differences in age, weight, height, and body mass index at admission between the CHD subgroups and the control group (Table 1).

There were also no significant differences between the CHD and control groups in terms of age at menarche, length or period or menstrual cycle, and number of menstrual products used per day (p>0.05 for all comparisons). When subgroups were compared, only the menstrual cycle duration was slightly longer in the moderate CHD group compared to the mild CHD group (p=0.013). There were no significant differences in the frequencies of oligomenorrhea and prolonged menstruation between the CHD and control groups (Table 1).

Menstrual blood loss did not differ between CHD and control groups (p=0.237). Menstrual overflow was significantly more frequent in controls compared to the CHD group and subgroups (p=0.002 and p=0.017, respectively). Details are shown in Table 1.

Of the 108 patients with CHD, 17 (15.7%) were using anticoagulants or antiplatelets. In the CHD group, patients using antiplatelet/anticoagulant therapy had a menstrual cycle length

**Table 1.** Menstrual data of the participants

| | Mild CHD[a] (n=41) | Moderate CHD[b] (n=42) | Severe CHD[c] (n=25) | CHD total (n=108) | Control[d] (n=76) | Subgroups | Groups |
|---|---|---|---|---|---|---|---|
| | Mean±SD | Mean±SD | Mean±SD | Mean±SD | Mean±SD | $p_1$ | $p_2$ |
| Age | 15.63±1.64 | 17.05±2.60 | 16.21±2.80 | 16.32±2.40 | 16.14±2.61 | 0.070 | 0.630 |
| Weight | 53.78±7.74 | 53.12±12.12 | 53.32±12.36 | 53.42±10.64 | 56.10±9.04 | 0.356 | 0.075 |
| Height | 161.22±6.68 | 158.90±6.12 | 160.36±8.58 | 160.12±6.97 | 162.10±5.88 | 0.083 | **0.044** |
| BMI | 20.78±3.38 | 20.96±4.13 | 20.64±3.88 | 20.82±3.77 | 21.33±3.33 | 0.792 | 0.342 |
| | Median (IQR) | Median (IQR) | Median (IQR) | Median (IQR) | Median (IQR) | $p_1$ | $p_2$ |
| Menarche age (years) | 12.5 (11.75-13) | 13 (12-13.5) | 13 (11.75-13) | 12.83 (12-13) | 12.83 (12-13) | 0.181 | 0.532 |
| Length of menstrual cycle (days) | 30 (28-30) | 30 (30-33.5) | 30 (30-31.5) | 30 (30-30) | 30 (28-30.75) | **0.013**[a-b] | 0.383 |
| Period length (days) | 7 (5-7) | 6 (5-7) | 6 (4.5-7) | 6 (5-7) | 6 (5-7) | 0.686 | 0.760 |
| Number of pads per day | 3 (3-4) | 3 (2-5) | 3 (2-5) | 3 (2-4) | 3 (2-4) | 0.941 | 0.737 |
| Dysmenorrhea score | 6 (4.5-8) | 5 (0-7) | 6 (4-8) | 6 (3.25-8) | 6 (3.25-8) | 0.241 | 0.527 |
| | n (%) | n (%) | n (%) | n (%) | n (%) | $p_1$ | $p_2$ |
| Amount of blood loss<br>Light/moderate<br>Heavy | <br>33 (80.5%)<br>8 (19.5%) | <br>35 (83.3%)<br>7 (16.7%) | <br>22 (88%)<br>3 (12%) | <br>90 (83.3%)<br>18 (16.7%) | <br>58 (76.3%)<br>18 (23.7%) | 0.582 | 0.237 |
| Menstrual overflow<br>No<br>Rarely/yes | <br>28 (68.3%)<br>13 (31.7%) | <br>27 (64.3%)<br>15 (35.7%) | <br>19 (76%)<br>6 (24%) | <br>74 (68.5%)<br>34 (31.5%) | <br>35 (46.1%)<br>41 (53.9%) | **0.017** | **0.002** |
| Oligomenorrhea | 1 (2.4%) | 6 (14.3%) | 5 (20%) | 12 (11.1%) | 5 (6.6%) | | 0.296 |
| Prolonged menstruation | 3 (7.3%) | 6 (14.3%) | 4 (16%) | 13 (12.0%) | 9 (11.8%) | | 0.968 |
| Dysmenorrhea | 37 (90.2%) | 29 (69%) | 22 (88%) | 88 (81.5%) | 65 (85.5%) | **0.043*** | 0.470 |
| Treatment for dysmenorrhea<br>No<br>Acetaminophen<br>NSAIDs | <br>17 (45.9%)<br>13 (35.1%)<br>7 (18.9%) | <br>12 (41.4%)<br>11 (37.9%)<br>6 (20.7%) | <br>9 (40.9%)<br>10 (45.5%)<br>3 (13.6%) | <br>38 (43.2%)<br>34 (38.6%)<br>16 (18.2%) | <br>34 (52.3%)<br>16 (24.6%)<br>15 (23.1) | 0.645 | 0.187 |
| School absenteeism | 6 (16.2%) | 9 (31%) | 4 (18.2%) | 19 (21.6%) | 24 (36.9%) | 0.099 | **0.037** |
| Menstrual education | 5 (12.2%) | 5 (11.9%) | 1 (4.0%) | 11 (10.2%) | 12 (15.8%) | 0.490 | 0.258 |
| Doctor visit for menstrual problems | 7 (17.1%) | 8 (19.0%) | 6 (24.0%) | 21 (19.4%) | 21 (27.6%) | 0.547 | 0.193 |

$p_1$: Comparison among mild CHD, moderate CHD, severe CHD, and control groups
$p_2$: Comparison between CHD (total) and control groups
*The frequency of dysmenorrhea in patients in the moderate CHD group was significantly lower than the others (p=0.043)
a: mild congenital heart disease, b: moderate congenital heart disease, c: severe congenital heart disease, d: healthy controls
CHD: congenital heart disease; IQR: interquartile range; NSAIDs: non-steroidal anti-inflammatory drugs; SD: standard deviation

of 30 (30-31.5) days, a period duration of 7 (5-7.5) days, and used 4 (3-5.5) menstrual products per day, whereas in those not using such medication, these values were 30 (30-30), 6 (5-7), and 3 (2-4), respectively. No significant differences in menstrual cycle length (p=0.724), period length (p=0.146), or number of daily menstrual products (p=0.084) were found between CHD patients who were and were not taking antiplatelet/anticoagulants. Prolonged menstruation was present in four (23.5%) patients who were using antiplatelet/anticoagulant medications, compared to nine (9.9%) patients who were not using these medications [odds ratio (OR)=2.80; 95% confidence interval (CI)=0.75-10.44; Fisher's exact p=0.122]. Among those using antiplatelet/anticoagulant therapy, bleeding was classified as heavy by four (23.5%) and light/moderate by 13 (76.5%) patients. In those not using such therapy, 14 (15.4%) had heavy bleeding, while 77 patients (84.6%) had light/moderate bleeding (OR=1.69; 95% CI=0.48-5.95; Fisher's exact p=0.478). Additionally, menstrual overflow occurred in eight patients (47.1%) using antiplatelet/anticoagulants, compared to 26 patients (28.6%) in the non-user group (OR=2.22; 95% CI=0.77-6.39; p=0.132).

In the CHD group, 88 patients (81.5%) reported dysmenorrhea and this number was 65 (85.5%) in the control group (p=0.470). When comparing the control group with the CHD subgroups, the frequency of dysmenorrhea was significantly lower in

the moderate CHD group than in the other groups (p=0.043); however, there was no significant difference in dysmenorrhea scores between the groups (p=0.241).

The rates of receiving treatment for dysmenorrhea and the types of medications used are presented in Table 1. Forty-five of the patients (90%) in the CHD group and 30 (96.8%) in the control group who used analgesics for dysmenorrhea had benefited from the treatment (p=0.258). Ten participants from each group reported using herbal tea for dysmenorrhea relief, with perceived benefit (p=0.589).

In the past year, 19 CHD patients (21.6%) and 24 controls (36.9%) reported school absenteeism due to dysmenorrhea (p=0.037), with no significant difference between CHD subgroups (p=0.099). Menstrual education was received by 11 CHD patients (10.2%) and 12 controls (15.8%) (p=0.258), and 21 CHD patients (19.4%) versus 21 controls (27.6%) consulted a healthcare professional for menstrual issues (p=0.193) (Table 1).

Only one participant in the control group admitted being sexually active. There were no patients using contraception in the CHD and control groups.

No significant differences were observed in the number of premenstrual symptoms between CHD and control groups (p=0.089) or among CHD subgroups (p=0.128) (Table 2). However, bloating, anxiety, and mood swings were more frequent in the control group than CHD group (p=0.013, p=0.022, and p=0.020, respectively), while other symptoms showed no significant difference. In addition, premenstrual syndrome and premenstrual dysphoric disorder prevalence was comparable between groups (p=0.304, p=0.940, respectively) (Table 3).

When CHD patients were divided into two groups, cyanotic and acyanotic, there were 28 patients with cyanotic CHD and 80 patients with acyanotic CHD. Seven (11.5%) of the 61 patients who underwent surgery had univentricular physiology, while the remaining 54 had biventricular physiology. Among the patients with cyanotic CHD, five (17.9%) had persistent cyanosis. The mean duration of cyanosis was 1.66±5.0 years. The mean age at menarche was 12.92±1.16 years in patients who remained cyanotic until menarche (n=6), and 12.77±1.46 years in those who were cyanotic at birth but underwent corrective surgery during childhood (n=22) (p=0.826). The menstrual cycle was significantly longer in the cyanotic CHD group compared to the acyanotic group (p=0.034), however, it remained within the normal range in all groups. The comparison of menstrual data based on cyanosis status is presented in Table 4. Spearman correlation analysis revealed no significant association between the duration of cyanosis and age at menarche (ρ=0.162, p=0.410, n=28), menstrual cycle length (ρ=0.021, p=0.915, n=28), menstrual period length (ρ=0.181, p=0.357, n=28), or the number of pads used per day (ρ=-0.084, p=0.671, n=28). Likewise, no significant correlations were found between cyanosis duration and the number of premenstrual symptoms (ρ=-0.029, p=0.885, n=28), physical (ρ=-0.254, p=0.192, n=28), emotional (ρ=0.030, p=0.881, n=28), or behavioral symptoms (ρ=0.082, p=0.677, n=28).

## Discussion

This study evaluated menstrual characteristics and associated symptoms among adolescents with CHD and compared them to healthy peers. Contrary to our initial hypothesis, the findings revealed no significant differences between groups in terms of age at menarche, cycle length, duration of menstruation, or dysmenorrhea severity and frequency. These results suggest that the presence and severity of CHD may not substantially alter basic menstrual patterns in adolescents who have reached menarche.

One interpretation for these findings is that adolescents with CHD, particularly those with well-managed or surgically corrected lesions, may experience relatively stable overall health and endocrine function, mitigating potential menstrual disruptions. Moreover, consistent cardiology follow-up may promote better general health awareness and lifestyle regulation, which could buffer against menstrual irregularities. In a study of adolescents and adults with CHD, mean menarche age was 13 years in simple cases and 14.5 years in complex cases, both later than the general

**Table 2.** Comparison of premenstrual symptom counts

| | Mild CHD (n=41) | Moderate CHD (n=42) | Severe CHD (n=25) | CHD Total (n=108) | Control (n=76) | Subgroups | Groups |
|---|---|---|---|---|---|---|---|
| | Median (IQR) | Median (IQR) | Median (IQR) | Median (IQR) | Median (IQR) | $p_1$ | $p_2$ |
| Number of premenstrual symptoms | 8 (4.5-10) | 5.5 (2-10.25) | 7 (2.5-11) | 7 (3-10) | 7.5 (4-11) | 0.128 | 0.089 |
| Number of physical symptoms | 2 (1-3) | 1 (0-3) | 1 (0-2) | 1 (0-2.75) | 2 (1-3) | 0.061 | **0.049** |
| Number of emotional symptoms | 2 (1-5) | 3 (0-4.25) | 3 (1-5.5) | 3 (1-5) | 3.5 (1.25-6) | 0.197 | 0.057 |
| Number of behavioral symptoms | 3 (1-5) | 2 (1-3.25) | 2 (0-3.5) | 2 (1-4) | 2 (1-4) | 0.107 | 0.603 |

$p_1$: comparison among mild CHD, moderate CHD, severe CHD, and control groups
$p_2$: comparison between CHD (total) and control groups
CHD: congenital heart disease; IQR: interquartile range

**Table 3.** Comparison of premenstrual symptoms between control and CHD groups

| | Control (n=76) | | CHD (n=108) | | |
|---|---|---|---|---|---|
| | n (%) | | n (%) | | |
| | + | - | + | - | p value |
| **Physical symptoms** | | | | | |
| Abdominal pain | 65 (85.5%) | 11 (14.5%) | 88 (81.5%) | 20 (18.5%) | 0.470 |
| Joint/muscle ache | 35 (46.1%) | 41 (53.9%) | 49 (45.4%) | 59 (54.6%) | 0.927 |
| Breast tenderness | 28 (36.8%) | 48 (63.2%) | 27 (25%) | 81 (75%) | 0.084 |
| Breast pain | 17 (22.4%) | 59 (77.6%) | 18 (16.7%) | 90 (83.3%) | 0.332 |
| Headache | 27 (35.5%) | 49 (64.5%) | 30 (27.8%) | 78 (72.2%) | 0.263 |
| Bloating | 33 (43.4%) | 43 (56.6%) | 28 (25.9%) | 80 (74.1%) | **0.013** |
| GI symptoms | 13 (17.1%) | 63 (82.9%) | 18 (16.7%) | 90 (83.3%) | 0.938 |
| **Emotional symptoms** | | | | | |
| Anger | 48 (63.2%) | 28 (36.8%) | 61 (56.5%) | 47 (43.5%) | 0.364 |
| Anxiety | 27 (35.5%) | 49 (64.5%) | 22 (20.4%) | 86 (79.6%) | **0.022** |
| Depressed mood | 40 (52.6%) | 36 (47.4%) | 43 (39.8%) | 65 (60.2%) | 0.085 |
| Mood swings | 42 (55.3%) | 34 (44.7%) | 41 (38%) | 67 (62%) | **0.020** |
| Crying | 31 (40.8%) | 45 (59.2%) | 37 (34.3%) | 71 (65.7%) | 0.366 |
| Irritability | 27 (35.5%) | 49 (64.5%) | 36 (33.3%) | 72 (66.7%) | 0.758 |
| Tension | 40 (52.6%) | 36 (47.4%) | 55 (50.9%) | 53 (49.1%) | 0.820 |
| Sense of hopelessness | 20 (26.3%) | 56 (73.7%) | 23 (21.3%) | 85 (78.7%) | 0.428 |
| **Behavioral symptoms** | | | | | |
| Decreased interest in usual activities | 20 (26.3%) | 56 (73.7%) | 34 (31.5%) | 74 (68.5%) | 0.449 |
| Feelings of fatigue/lack of energy | 48 (63.2%) | 28 (36.8%) | 61 (56.5%) | 47 (43.5%) | 0.364 |
| Change in appetite | 29 (38.2%) | 47 (61.8%) | 37 (34.3%) | 71 (65.7%) | 0.587 |
| Food cravings | 41 (53.9%) | 35 (46.1%) | 54 (50%) | 54 (50%) | 0.598 |
| Sleep problems | 18 (23.7%) | 58 (76.3%) | 31 (28.7%) | 77 (71.3%) | 0.448 |
| Difficulty in concentrating | 25 (32.9%) | 51 (67.1%) | 35 (32.4%) | 73 (67.6%) | 0.945 |
| Feelings of being out of control | 18 (23.7%) | 58 (76.3%) | 18 (16.7%) | 90 (83.3%) | 0.237 |
| PMS | 25 (32.9%) | 51 (67.1%) | 28 (25.9%) | 80 (74.1%) | 0.304 |
| PMDD | 8 (10.5%) | 68 (89.5%) | 11 (10.2%) | 97 (89.8%) | 0.940 |

CHD: congenital heart disease, GI: gastrointestinal, PMDD: premenstrual dysphoric disorder, PMS: premenstrual syndrome

**Table 4.** Comparison of menstrual data among cyanotic, acyanotic, and control groups

| | Cyanotic CHD[a] | Acyanotic CHD[b] | Control[c] | |
|---|---|---|---|---|
| | Median (IQR) | Median (IQR) | Median (IQR) | p |
| Menarche age (years) | 13 (12-13.38) | 12.5 (12-13) | 12.83 (12-13) | 0.648 |
| Length of menstrual cycle (days) | 30 (30-38.75) | 30 (28-30) | 30 (28-30.75) | **0.034**[a-b] |
| Period length (days) | 6.5 (5-7) | 6 (5-7) | 6 (5-7) | 0.949 |
| Number of pads per day | 3 (2-5) | 3 (2-4) | 3 (2-4) | 0.820 |

a: cyanotic congenital heart disease, b: acyanotic congenital heart disease, c: healthy controls
CHD: congenital heart disease, IQR: interquartile range

average of 12.8 years (8). Similarly, a study in adults showed that the average age at menarche was 12.5 years in the control group, whereas it was 13.1 years in women with acyanotic CHD, and 13.9 years in those who remained cyanotic until menarche (5). In a more comprehensive and recent study evaluating 1,593 patients, individuals with cyanotic and acyanotic CHD were compared without a control group. While the average age at menarche in the same population was reported as 13.15 years, it was found to be 13.3 years in patients with CHD and 13.5 years in those with cyanotic CHD, regardless of surgical status. This was attributed to an increased incidence of primary amenorrhea in the cyanotic CHD group. It was also noted that patients who remained cyanotic until menarche reached menarche at an age similar to those who were cyanotic at birth but had undergone surgical correction during childhood (6). In the present study, although the mean age at menarche was higher in the cyanotic CHD group compared to the acyanotic CHD and control groups, this was not statistically significant. Moreover, there was no difference in age at menarche between those who remained cyanotic until menarche and those who were cyanotic at birth but underwent surgical correction. No correlation was found between duration of cyanosis and age at menarche. However, since our study included only adolescents who had experienced menarche at least two years prior, we were unable to capture data from those with delayed menarche or primary amenorrhea, which may partly explain discrepancies with findings from adult studies.

Although the difference was not significant, oligomenorrhea was observed more frequently in the CHD group compared to the control group and was most common in the severe CHD group. A study evaluating adults with CHD without a control group reported that oligomenorrhea was common among women with CHD, although there was a lack of comparative data from the general population (6). It remains unclear whether these abnormal menstrual patterns represent a chronic anovulatory state, dysfunction of the hypothalamic-pituitary-ovarian axis, or disturbed uterine hemostasis secondary to chronic hypoxemia or erythrocytosis-induced hyperviscosity commonly seen in cyanotic CHD. Apart from the heart condition, multiple childhood surgeries may affect the biological processes that control the menstrual cycle (5,7,19).

The frequency of menstrual overflow was higher among controls compared to both the overall CHD group and its subgroups. However, given the subjective nature of this symptom and the observation that some participants who reported normal menstrual product usage and low bleeding volume still described overflow, this difference was not considered clinically meaningful. The prevalence of prolonged menstruation was comparable between the CHD and control groups, although the highest rate was noted in the severe CHD subgroup, without reaching statistical significance. When CHD patients using anticoagulant/antiplatelet medications were compared to those not receiving such treatment, trends toward longer bleeding duration, greater daily menstrual product use, and increased rates of prolonged menstruation, heavy menstrual bleeding, and menstrual overflow were observed. However, none of these differences were significant. Given the relatively small number of patients receiving these medications, these findings should be interpreted with caution, as the study may have been underpowered to detect potential differences. A previous study involving both adolescents and adults with CHD similarly reported higher rates of menorrhagia in patients with complex lesions, but found no significant association with warfarin use (8). While our findings suggest a possible link between medication use and increased menstrual volume and duration, they remain inconclusive, and further research with larger cohorts is needed to clarify these associations.

Interestingly, physical premenstrual symptoms, such as bloating, mood swings, and anxiety, were more frequently reported in the control group. This unexpected pattern raises questions about symptom perception and reporting, which may differ in adolescents with chronic conditions (20). One possible explanation is that adolescents with CHD, who often experience more serious health concerns, may underreport or place less emphasis on menstrual discomfort relative to their peers. Alternatively, they may have developed higher symptom tolerance or different coping strategies over time. However, these interpretations remain speculative, as pain perception, coping mechanisms, and quality of life were not directly assessed in this study. In this context, to the best of our knowledge, while previous studies have focused on menstrual problems in adolescents with CHD and on reproductive and sexual health in adult patients, no studies have specifically evaluated premenstrual symptoms other than dysmenorrhea. Our findings therefore suggest that the frequency of premenstrual symptoms, premenstrual syndrome, and premenstrual dysphoric disorder in adolescents with CHD is comparable to that of healthy peers.

The frequency and severity scores of dysmenorrhea were similar between the CHD and control groups. Similarly, the rates of receiving treatment and response to treatment did not differ significantly. However, school absenteeism due to dysmenorrhea was higher in the control group, which may further support our hypothesis concerning the potential underreporting or downplaying of menstrual symptoms by adolescents with CHD. It may also reflect differences in family or school-based support systems, individual pain thresholds, or prioritization of symptoms relative to overall health burdens. In a study evaluating menstrual problems in adolescents and young adults with CHD, dysmenorrhea was reported at a similar rate to that of the general population, consistent with our findings (9).

Despite these findings, the low rates of menstrual health education reported in both groups are concerning. This underscores the need for integrating reproductive health discussions into routine care, particularly for adolescents with chronic medical conditions like CHD, who may have unique risks or needs related to contraception, anticoagulation, or pregnancy counseling.

### Study Limitations

This study has several limitations. The cross-sectional design precludes causal inference, and symptom data relied on self-report, which may be influenced by recall or reporting bias. Premenstrual symptoms, premenstrual syndrome or premenstrual dysphoric disorder were assessed based on retrospective self-report rather than prospective daily symptom recording, as recommended by diagnostic guidelines. Therefore, the findings may be subject to recall bias and should be interpreted with caution. Although prospective daily symptom tracking is considered the gold standard, its implementation in adolescent populations may be limited by adherence and feasibility challenges (21). The sample size, particularly in subgroup analyses by CHD severity and in patients receiving anticoagulant/antiplatelet therapy, was relatively small, limiting statistical power. As a result, some clinically meaningful differences, especially in bleeding-related outcomes, may not have been detected. Furthermore, psychosocial factors influencing menstrual experiences were not comprehensively assessed. Nevertheless, we believe our study to be the first to evaluate premenstrual symptoms, premenstrual syndrome, and premenstrual dysphoric disorder in adolescents with CHD, which adds to its significance.

## Conclusion

In conclusion, our study demonstrated that adolescents with CHD exhibited menstrual characteristics similar to those of their healthy peers, though their perception of pain and symptoms may differ. Although not statistically significant, we observed that as the CHD becomes more complex, the age at menarche tends to be later, and the frequencies of oligomenorrhea and prolonged menstruation increased. In addition, the use of antiplatelet or anticoagulant therapy appears to be associated with increased menstrual bleeding. Therefore, while each patient should be evaluated individually, based on diagnosis, duration of cyanosis, and surgical history, we believe it is important that all CHD patients are educated on the characteristics of normal menstruation and on disease-specific risks, as this is an essential component of their overall care and follow-up.

**Ethics**

**Ethics Committee Approval:** This study was approved by the Ethics Committee of Hacettepe University (approval no.: GO 21/1221, date: 16.11.2021).

**Informed Consent:** Written informed consent was obtained from all participants and their parents.

**Footnotes**

**Authorship Contributions**

Concept: Demet Aygün Arı, Melis Pehlivantürk Kızılkan, İlker Ertuğrul, Tevfik Karagöz, Orhan Derman, Sinem Akgül, Design: Demet Aygün Arı, Melis Pehlivantürk Kızılkan, İlker Ertuğrul, Tevfik Karagöz, Orhan Derman, Sinem Akgül, Data Collection or Processing: Demet Aygün Arı, İlker Ertuğrul, Aydın Adıgüzel, Mehmet Emre Arı, Tevfik Karagöz, Orhan Derman, Sinem Akgül, Analysis or Interpretation: Demet Aygün Arı, Melis Pehlivantürk Kızılkan, Aydın Adıgüzel, Mehmet Emre Arı, Sinem Akgül, Literature Search: Demet Aygün Arı, Mehmet Emre Arı, Writing: Demet Aygün Arı, Melis Pehlivantürk Kızılkan, Mehmet Emre Arı, Sinem Akgül.

**Financial Disclosure:** The authors declared that this study received no financial support.

## References

1. Liu Y, Chen S, Zühlke L, Black GC, Choy MK, Li N, Keavney BD. Global birth prevalence of congenital heart defects 1970-2017: updated systematic review and meta-analysis of 260 studies. Int J Epidemiol. 2019;48:455-463.
2. Mandalenakis Z, Giang KW, Eriksson P, Liden H, Synnergren M, Wåhlander H, Fedchenko M, Rosengren A, Dellborg M. Survival in children with congenital heart disease: have we reached a peak at 97? J Am Heart Assoc. 2020;9:e017704. Epub 2020 Nov 6
3. Çetiner N, Çeliker A. Evaluation of the relationship between cardiopulmonary exercise test findings and clinical status in children and adolescents with congenital heart disease. Turk J Pediatr. 2022;64:1041-1049.
4. Akça Sümengen A, İsmailoğlu AV, İsmailoğlu P, Gümüş T, Çeliker A, Namlısesli D, Poyraz E, Özçevik Subaşı D, Zeren Erdem C, Çakır GN. The effect of 3D modeling on family quality of life, surgical success, and patient outcomes in congenital heart diseases: objectives and design of a randomized controlled trial. Turk J Pediatr. 2024;66:237-250. Epub 2024 May 23.
5. Canobbio MM, Rapkin AJ, Perloff JK, Lin A, Child JS. Menstrual patterns in women with congenital heart disease. Pediatr Cardiol. 1995;16:12-15.
6. Drenthen W, Hoendermis ES, Moons P, Heida KY, Roos-Hesselink JW, Mulder BJ, Van Dijk AP, Vliegen HW, Sollie KM, Berger RM, Lely AT, Canobbio MM, Pieper PG. Menstrual cycle and its disorders in women with congenital heart disease. Congenit Heart Dis. 2008;3:277-283.
7. Vigl M, Kaemmerer M, Niggemeyer E, Nagdyman N, Seifert-Klauss V, Trigas V, Bauer U, Schneider KT, Berger F, Hess J, Kaemmerer H. Sexuality and reproductive health in women with congenital heart disease. Am J Cardiol. 2010;105:538-541.
8. Khajali Z, Ziaei S, Maleki M. Menstrual disturbances in women with congenital heart diseases. Res Cardiovasc Med. 2016;5:e32512. Epub 2016 Jul 20.
9. Leroy-Melamed M, Katz A, Shew ML. Menstrual dysfunction and treatment among adolescents with congenital heart disease. J Pediatr Adolesc Gynecol. 2020;33:686-690.

10. Canobbio MM, Warnes CA, Aboulhosn J, Connolly HM, Khanna A, Koos BJ, Mital S, Rose C, Silversides C, Stout K. American Heart Association Council on Cardiovascular and Stroke Nursing, American Heart Association Council on Clinical Cardiology, American Heart Association Council on Cardiovascular Disease in the Young, American Heart Association Council on Functional Genomics and Translational Biology, American Heart Association Council on Quality of Care and Outcomes Research. Management of pregnancy in patients with complex congenital heart disease: a scientific statement for healthcare professionals from the American Heart Association. Circulation. 2017;135:e50-e87.

11. Stout KK, Daniels CJ, Aboulhosn JA, Bozkurt B, Broberg CS, Colman JM, Crumb SR, Dearani JA, Fuller S, Gurvitz M, Khairy P, Landzberg MJ, Saidi A, Valente AM, Van Hare GF. 2018 AHA/ACC guideline for the management of adults with congenital heart disease: executive summary: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. J Am Coll Cardiol. 2019;73:1494-1563. Epub 2018 Aug 16.

12. Baumgartner H, De Backer J, Babu-Narayan SV, Budts W, Chessa M, Diller GP, Lung B, Kluin J, Lang IM, Meijboom F, Moons P, Mulder BJM, Oechslin E, Roos-Hesselink JW, Schwerzmann M, Sondergaard L, Zeppenfeld K, European Society of Cardiology. 2020 ESC Guidelines for the management of adult congenital heart disease. Eur Heart J. 2021;42:563-645.

13. Sable C, Foster E, Uzark K, Bjornsen K, Canobbio MM, Connolly HM, Graham TP, Gurvitz MZ, Kovacs A, Meadows AK, Reid GJ, Reiss JG, Rosenbaum KN, Sagerman PJ, Saidi A, Schonberg R, Shah S, Tong E, Williams RG, Young AH. Best practices in managing transition to adulthood for adolescents with congenital heart disease: the transition process and medical and psychosocial issues: a scientific statement from the American Heart Association. Circulation. 2011;123:1454-1485.

14. Peña AS, Witchel SF, Hoeger KM, Oberfield SE, Vogiatzi MG, Misso M, Garad R, Dabadghao P, Teede H. Adolescent polycystic ovary syndrome according to the international evidence-based guideline. BMC Med. 2020;18:72. Epub 2020 Mar 24.

15. American College of Obstetricians and Gynecologists Committee on Adolescent Health Care. Committee Opinion No. 651: Menstruation in Girls and Adolescents: Using the Menstrual Cycle as a Vital Sign. Obstet Gynecol. 2015;126:e143-e146.

16. Tiranini L, Nappi RE. Recent advances in understanding/management of premenstrual dysphoric disorder/premenstrual syndrome. Fac Rev. 2022;11:11. Epub 2022 Apr 28.

17. American College of Obstetricians and Gynecologists. Management of premenstrual disorders: ACOG clinical practice guideline no. 7. Obstet Gynecol. 2023;142:1516-1533.

18. American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 5th ed. Arlington, VA: American Psychiatric Publishing; 2013.

19. Canobbio MM, Perloff JK, Rapkin AJ. Gynecological health of females with congenital heart disease. Int J Cardiol. 2005;98:379-387.

20. Haines C, Loades M, Davis C. Illness perceptions in adolescents with chronic fatigue syndrome and other physical health conditions: Application of the common sense model. Clin Child Psychol Psychiatry. 2019;24:546-563.

21. Akbulut Ö, Jafari L, Aygün Arı D, Pehlivantürk Kızılkan M, Derman O, Akgül S. Prevalence of premenstrual syndrome in adolescent girls. Turk J Pediatr. 2024;66:340-345.