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Original Article

Prevalence of premenstrual syndrome and its relationship to depression among Korean adolescents: A nationwide cross-sectional study

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ABSTRACT

Objective: To investigate the prevalence of PMS and depressive symptoms and to determine their association among Korean adolescent girls using a nationally representative cross-sectional survey.
Materials and methods: The Korean Study of Women's Health Related Issues (K-Stori)was used. Of the 3000 adolescent girls aged 14–17 years, the study subjects were 2970 girls after menarche. Depressive symptom was assessed with the PHQ-9. Multivariable logistic regression analysis was used to investigate factors associated with depressive symptom.
Results: The prevalence of PMS was 70.5 %. Irritability (43.8 %), abdominal bloating (32.8 %), and breast tenderness (27.5 %) were the most predominant symptoms. The prevalence of depressive symptom was 15.5 %. Girls with PMS were more likely to be depressed than those who did not experience PMS (OR, 1.70; CI, 1.31–2.20). BMI was not associated with depressive symptom. However, a significant association was noted between satisfaction with one's body image and depressive symptom. Ever-smokers were more likely to be depressed than never-smokers (OR, 1.64; CI, 1.10–2.45).
Conclusions: PMS were significantly associated with depressive symptom. PMS should be taken into account in the management of depression. Our study emphasized the significance of a multidisciplinary approach.

Introduction

Premenstrual syndrome (PMS) is a cluster of mood, behavioral, and physical symptoms that occur during the late luteal phase of the menstrual cycle and is relieved after the onset of menstruation [1]. The prevalence of PMS in adolescents is estimated between 14 % and 88 % [2]. Although the peak age of receiving a clinical diagnosis is in the 30s, recent work revealed that 70 % of individuals with PMS had symptom onset in adolescence [3].

Among adolescents aged 14–15 years, 25 % suffer from PMS; 5 % have symptoms and signs severe enough to interfere with their lifestyle [4]. PMS reduces participation in school-related functions, increases absence from school, and reduces opportunities for successful educational, psychosocial, and cognitive development during adolescent growth.

Women with premenstrual symptoms experience a high degree of comorbidity with other mental disorders [2,5]. Depression is the most common mental health problems among adolescent girls [6]. Depressive symptoms in adolescents are often misdiagnosed as behavioral, attention, or substance abuse disorders, or are considered a stage that adolescents go through [7]. In addition, early onset of depression predicts more severe depression in adulthood [8].

Women who gained weight are more likely to be diagnosed with PMS. Obesity and common mental health disorders have their roots in childhood [9]. Previous findings have shown a relationship between body image concerns and the development of psychopathology in adolescence – i.e., anxiety, depression, or social withdrawal [9,10]. During adolescence, body image plays an important role in mental health [11].

The prevalence of depression is similar in girls and boys before puberty; however, after the onset of puberty, depression is twice as

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common in girls as in boys [12]. Many factors could explain the increase in prevalence after puberty, because adolescence is a developmental period characterized by biological and social changes [13,14]. Adolescence is a unique period in human development in terms of both psychological and physiological development [1]. However, most epidemiological studies on PMS have been conducted on adult females, and only a few have examined the occurrence of premenstrual symptoms among adolescents [4].

Therefore, we estimated the prevalence of PMS and depressive symptom among Korean adolescent girls and investigated the relationship between PMS and depressive symptom from the Korean Study of Women's Health Related Issues (K-Stori), a nationally representative cross-sectional survey.

Materials and methods

Data and study population

The Korean Study of Women's Health Related Issues (K-Stori), was a nationwide survey designed to investigate broad health issues among Korean women according to five stages in the life cycle of women. Specific questionnaires were designed for each of the five stages (adolescence, childbearing, pregnancy & post-partum, menopause, and older adult), since life cycle approaches have been found to be effective in understanding and managing health problems and health promotion plans. A pilot study was conducted to determine the feasibility and validity of the survey [15].

Per each stage in the female life cycle, 3000 women (total 15,000) were randomly sampled for a reliable and representative research design. For random sampling, a multi-level, stratified, probability-proportional statistics extraction method was used as a sampling framework using the 2010 Population and Housing Census. In order to generalize the survey results, the subjects were selected by random sampling for 16 cities and provinces (seven special and metropolitan cities, and nine provinces). The extraction method was used to stratify recruits by region and dong-eup/municipal district, after which 200 households were sampled. A sample of 15 households was extracted from each sampling area, in which the principle was to survey female household members aged 14–79 years in each sample household. Interviewers visited each of the 15 extracted households. However, for adolescents, the questionnaire was conducted via an online survey to minimize distortion of responses to sensitive health behavior items [15].

This survey was conducted from April 2016 to June 2016. Subjects who did not agree to participate in the survey and those with difficulties communicating were excluded. The survey response rate is 40.4 %. The study was approved by the Institutional Review Board of the National Cancer Center, Korea (Approval no: NCC2016-0062). The details of K-Stori have been described elsewhere [15].

We investigated the health status, behavior, and perceptions of Korean adolescent girls using an online survey. Of the 3000 adolescent girls who participated in the K-Stori survey, the study subjects were 2970 girls aged 14–17 years (middle school, second grade and high school, second grade), after excluding 30 participants before menarche.

Dependent variables

Depressive symptom was defined as the dependent variable of interest. The Patient Health Questionnaire (PHQ-9) is a self-report tool for screening and case finding of major depressive disorder (MDD) [16]. The PHQ-9 is the most commonly used screening instrument for depression in primary care and other clinical settings [17]. It consists of nine items that assess the frequency of depressive symptoms in the past two weeks. Subjects were asked how often, over the last 2 weeks, they have been bothered by each of the depressive symptoms. Response options are "not at all", "several days", "more than half the days", and "nearly every day", scored as 0, 1, 2 and 3, respectively. PHQ-9 scores range from 0 to 27, with scores of ≥ 5, ≥ 10, ≥ 15, representing mild, moderate and severe levels of depression severity [18]. Psychometric properties of the PHQ-9 are well documented [19]. We used the Korean version of the PHQ-9 [20] We defined depressive symptom as mild to severe when the score is ≥ 5 in the nine-item scale [21].

Independent variables

The primary independent variable was premenstrual syndrome. According to the International Classification of Diseases (ICD-10) of the World Health Organization and the American College of Obstetrics and Gynecology (ACOG), PMS was accessed if participants reported at least one of the following emotional and physical symptoms: breast swelling and tenderness, fatigue, bloating, lack of energy, appetite changes, sleep problems, headache, impulsivity, mood lability, depressed mood, anxiety, agitation, social friction, feeling "loss of control," decreased concentration, and irritability [22,23]. Symptoms must be present during the five days preceding menstruation in each of the two consecutive menstrual cycles and must resolve within four days of the onset of menstruation without recurrence of symptoms until at least day 13 of the cycle [24].

Age, body mass index (BMI), satisfaction with body image, smoking and drinking experiences, academic performance, and age at menarche were considered. BMI was calculated using participants' self-reported height and weight. Participants were categorized according to criteria for Asians or generally applied definitions for the Korean population using BMI cut offs of <18.5 kg/m2 (underweight), <23 kg/m2 (normal), ≥ 23 kg/m2 (overweight), and ≥ 25 kg/m2 (obese) [25,26]. To assess adolescents' body satisfaction, we asked the following question: "Are you satisfied with your current body weight or shape?" which can be answered by the options: "satisfied with both weight and shape," "satisfied with weight," "satisfied with shape," or "satisfied with neither weight nor body type."

Statistical analysis

First, we investigated the general characteristics of the study population and the prevalence rates of PMS and depressive symptom. BMI, body satisfaction, health behavior, and menstrual characteristics according to depressive symptom status were compared using the chi-squared test. Multivariable logistic regression analysis was used to investigate factors associated with depressive symptom and whether PMS was associated with depressive symptom. Odds ratios (ORs) and 95 % confidence intervals (95 % CI) were presented as an index of association. All statistical analyses were performed using SAS version 9.4 (SAS Institute, Inc., Cary, NC, USA).

Results

We analyzed the data of 2970 girls aged 14–17 years. The participants' characteristics, including menstruation-related variables, are presented in Table 1. Menarche before the age of 12 years was 27.5 %. The prevalence of PMS, according to ACOG and the ICD-10, was 70.5 %. Among all adolescent girls in our sample, the prevalence of depressive symptom was 15.5 %, regardless of the severity of depressive symptom. There were 12.7 % who had mild depressive symptom, with scores of 5–9; 2.7 % had moderate to severe depressive symptom, defined by a PHQ score ≥ 10.

Table 2 describes the general characteristics, age at menarche, and premenstrual symptoms according to the depressive symptom

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Table 1
Characteristics of adolescent girls included in the analysis (N = 2970).

Variables	No	%
Age (years)		
14	719	24.2
15	741	25.0
16	754	25.4
17	756	25.5
BMI (kg/m2)	20	2.1
Underweight (<18.5)	573	19.3
Normal (18.5≤ <23.0)	2110	71.0
Overweight (23.0≤ <25.0)	200	6.7
Obesity (25.0≤)	87	2.9
Body satisfaction		
Both weight and shape	997	33.6
Weight	375	12.6
Shape	314	10.6
Neither weight nor shape	1284	43.2
Smoking experience		
Ever	167	5.6
Never	2803	94.4
Drinking experience		
Ever	532	17.9
Never	2438	82.1
Academic performance		
Above average	1104	37.2
Average	1369	46.1
Below average	497	16.7
Age at menarche (years)		
<12	818	27.5
12	996	33.5
≥13	1156	38.9
Premenstrual syndrome		
No	875	29.5
Yes	2095	70.5
Depressive symptom (score of PHQ, 0–27)		
None-minimal (<5)	2511	84.6
Mild (5≤ <10)	378	12.7
Moderate (10≤ <15	62	2.1
Moderately severe (15≤ <20)	15	0.5
Severe (20≤)	4	0.1

status. Among girls who experienced PMS, the prevalence of depressive symptom was 17.9 %, while 9.5 % of those without PMS reported depressive symptom. 16.6 % of girls who were not satisfied with both weight and shape had depressive symptom. Girls with drinking or smoking experience were more likely to have more than twice as much depressive symptom as those without drinking or smoking experience (p < 0.001). The prevalence of depressive symptom was not significantly different according to the age at menarche (p = 0.828).

Among girls who experienced PMS, irritability (43.8 %), abdominal bloating (32.8 %), and breast tenderness (27.5 %) were the most predominant symptoms (Table 3). 30.4 % with depressed mood or confusion during two consecutive menstrual cycles had depressive symptom.

Multiple logistic regression analysis showed that body satisfaction, smoking experience, academic performance, and PMS were significantly associated with depressive symptom (Table 4). Girls with PMS were more likely to be depressed than those who did not experience PMS (OR, 1.70; CI, 1.31–2.20). BMI was not associated with PMS. However, a significant association was noted between satisfaction with one's body image and depressive symptom. Depressive symptom prevalence was lower in adolescent girls who were satisfied with their weight or shape than in those who were not. Girls whose academic performance was below average were more depressed than those whose academic performance was average or above average. Ever-smokers were more likely to be depressed than never-smokers (OR, 1.64; CI, 1.10–2.45).

Discussion

The prevalence of PMS according to ACOG and the ICD-10 was 70.5 % in adolescent girls in South Korea. Despite differences in the study population and diagnostic measures, PMS is a common disorder among Asian adolescents. A study from Iran found that 98.2 % of female college students aged 18–27 years had at least one premenstrual symptom [27]. A Turkish study reported that 61.4 % of adolescent girls were affected by PMS [4]. Similarly, Lee et al. found that 76 % of Chinese female undergraduates reported at least one premenstrual symptom [28]. In a study in Thailand, 85.8 % of participants aged 15–18 years reported having at least one of the 10 symptoms of PMS [29]. During teenage years, PMS can complicate the process of puberty, interpersonal relationships, social and academic performance, and health-related quality of life [27]. This study indicates that PMS is common in adolescents; therefore, preventive and management strategies are needed.

Our findings indicated that the prevalence of depressive symptom was 15.5 %, regardless of its severity. There were 12.7 % and 2.7 % of adolescent girls who had mild and moderate to severe depressive symptom, respectively. A previous study estimated that depression affected approximately 8.3 % of older adolescents in the United States [30]. The percentage of youth who reported depressive symptoms was 25.3 % [8]. Previous studies have found an excess of depressed girls and a greater increase in depressive symptoms in girls than in boys in more recent years [14,31].

This study demonstrated that 17.9 % of girls with PMS reported depressive symptom, while 9.5 % of those without PMS reported depressive symptom. PMS was significantly associated with depressive symptom. Common disorders that may co-occur with PMS include depression, bipolar disorder, and generalized anxiety disorder. Estimates of lifetime comorbidity between PMS and major depression ranged from 30 to 70 % [32]. The medical history of adolescent girls with presumed PMS should be investigated for conditions such as depression [33]. Mood fluctuations in adolescence are less likely to be considered an effect of PMS. This study highlights the significance of a multidisciplinary approach to PMS treatment and monitoring. Further studies on PMS and psychiatric disorders will help formulate an adequate treatment for this common illness in adolescent girls.

Body dissatisfaction has been consistently identified as a risk factor for the development of depression [34]. Compared with both weight and shape satisfaction (reference group), the prevalence of depressive symptom in girls with both body shape and body weight dissatisfaction was 1.3 times higher. Body dissatisfaction has been linked to the development of depression in adolescent girls, and is hypothesized to be one of the factors responsible for gender differences in adolescence [6]. Girls generally feel more dissatisfied with their bodies following puberty, partly because of increased body fat [35]. However, our study showed no association between mental health and BMI. Another study revealed that being overweight was an insufficient cause of psychological and social problems [35].

Early menarche was not associated with depressive symptom. These results were inconsistent with those of a previous study that suggested a significant association between the onset of puberty and depressive symptoms [36]. However, this association is inconsistent. A previous study reported that the association between the onset of puberty and depressive symptoms was significant predominantly in white youth [37]. Therefore, it is necessary to evaluate the role of puberty in depression among various ethnic and cultural groups.

Table 2
Characteristics of adolescent girls according to their depressive symptom status.

Variables	No depressive symptom (None-minimal)		Depressive symptom (Mild-severe)		p value
	No.	%	No.	%	
Total participants	2511	84.6	459	15.5	
Age (years)					
14	620	86.2	99	13.8	0.3097
15	622	83.9	119	16.1	
16	625	82.9	129	17.1	
17	644	85.2	112	14.8	
BMI (kg/m2)					
Underweight (<18.5)	491	85.7	82	14.3	0.1607
Normal (18.5≤ <23.0)	1788	84.7	322	15.3	
Overweight/Obesity (23.0≤)	232	80.8	55	19.2	
Body satisfaction					
Both weight and shape	884	88.7	113	11.3	<0.0001
Weight	305	81.3	70	18.7	
Shape	251	79.9	63	20.1	
Neither weight nor shape	1071	83.4	213	16.6	
Smoking experience					
Ever	111	66.5	56	33.5	<0.0001
Never	2400	85.6	403	14.4	
Drinking experience					
Ever	411	77.3	121	22.7	<0.0001
Never	2100	86.1	338	13.9	
Academic performance					
Above average	961	87.0	143	13.0	<0.0001
Average	1182	86.3	187	13.7	
Below average	368	74.0	129	26.0	
Age at menarche (years)					
<12	692	84.6	126	15.4	0.828
12	847	85.0	149	15.0	
≥13	972	84.1	184	15.9	
Premenstrual syndrome					
No	792	90.5	83	9.5	<0.0001
Yes	1719	82.1	376	17.9	

Table 3
Physical and emotional symptoms of PMS.

	Girls with PMS (n = 2095)		No depressive symptom (n = 1719)		Depressive symptom (n = 376)		p value
	No	%	No.	%	No.	%	
Physical symptoms							
Breast tenderness	818	27.5	677	82.8	141	17.2	0.0975
Abdominal bloating	973	32.8	819	84.2	154	15.8	0.6948
Headache	365	12.3	263	72.1	102	27.9	<0.0001
Swelling of extremities	105	3.5	74	70.5	31	29.5	<0.0001
Emotional symptoms							
Depressed mood	425	14.3	296	69.6	129	30.4	<0.0001
Angry outbursts	472	15.8	339	71.8	133	28.2	<0.0001
Irritability	1302	43.8	1068	82.0	234	18.0	0.0008
Anxiety	254	8.6	184	72.4	70	27.6	<0.0001
Confusion	112	3.8	78	69.6	34	30.4	<0.0001
Social withdrawal	315	10.6	221	70.2	94	29.8	<0.0001

Previous studies have demonstrated an association between smoking and dysmenorrhea. Dysmenorrhea is associated with smoking in younger adolescents [38]. The Australian Longitudinal Study on Women's Health showed that 18–23-year-old smokers and ex-smokers had an increased risk of menstrual symptoms compared to nonsmokers [39]. Smoking cessation efforts that inform adolescents of this possible relationship may help them smoke less. Our study suggests that smoking is associated with depressive symptom among girls. A significant dose-response relationship was observed between the level of smoking and depressive symptoms among girls. Furthermore, adolescents who stopped smoking had a lower risk of developing depressive symptoms than those who continued to smoke [40].

These findings have implications for the prevention of depression as well as for intervention and future research. An increases in depressive symptoms and smoking behaviors in commonly observed during the pubertal years [38]. Adolescent cigarette smoking may have marked health consequences in terms of depressive symptoms. Future studies should focus on ways to reduce smoking in adolescents to prevent depression among them.

In summary, the findings suggest that PMS and depressive symptom are more likely to co-occur among adolescent girls in South Korea. Furthermore, it emphasizes the importance of body image and smoking status, which influence depressive symptom among adolescents. Our findings highlight the importance of early interventions that target both PMS and depressive symptom in

Table 4
Premenstrual syndrome and depressive symptom in adolescent girls.

Variables	Depressive symptom		
	OR	(95 % CI)	
Age (years)			
14	1.00 (Reference)		
15	1.10	0.81	1.49
16	1.10	0.81	1.49
17	0.87	0.63	1.18
BMI (kg/m2)			
Underweight (<18.5)	1.01	0.76	1.33
Normal (18.5≤ <23.0)	1.00 (Reference)		
Overweight/Obesity (23.0≤)	1.12	0.79	1.58
Body satisfaction			
Both weight and shape	1.00 (Reference)		
Weight	1.55	1.10	2.17
Shape	1.64	1.14	2.35
Neither weight nor shape	1.30	0.99	1.69
Smoking experience			
Ever	1.64	1.10	2.45
Never	1.00 (Reference)		
Drinking experience			
Ever	1.19	0.90	1.57
Never	1.00 (Reference)		
Academic performance			
Above average	1.00 (Reference)		
Average	1.17	0.92	1.49
Below average	1.83	1.38	2.44
Age at menarche (years)			
<12	1.00 (Reference)		
12	1.17	0.89	1.53
≥13	1.15	0.89	1.50
Premenstrual syndrome			
No	1.00 (Reference)		
Yes	1.70	1.31	2.20

adolescence to minimize negative outcomes later in adulthood. Understanding the prevalence of puberty-related variables and depression among racial/ethnic groups may be critical for identifying and treating depression in adolescent girls.

This study has some limitations. First, although our study was based on national population-based data, this survey was conducted using a self-report questionnaire; therefore, we may have considered the response bias of participants to influence the results. Second, the depressive symptom variable in this study was not diagnosed by clinicians. We used a questionnaire to assess depressive symptoms rather than a diagnosis, as is common in many epidemiological studies. The PHQ-9 has been confirmed as an efficient criterion-based screening tool for the detection and management of depressive disorders. Third, we cannot infer the direction of causal relationship between the factors and PMS due to the cross-sectional design of the study. Future research could investigate that a codevelopmental and bidirectional association between PMS and depression from longitudinal data. Fourth, we could not reflect the severity of PMS and other confounding factors such as socioeconomic status, family history of mental health disorders, and other relevant factors that may influence the relationship between premenstrual syndrome and depressive symptoms. Finally, K-Stori is a nationally representative study in which the weights of individuals were determined considering the sampling ratio and response rates. However, in this study, we used a subset of K-Stori subjects and focused on association between variables, rather than representativeness. Therefore, the results may include a selection bias due to a low response rate (40.4 %).

Informed consent

All participants gave written informed consent to participate. For adolescents, parental consent was obtained.

Ethical approval

We follow the ethical standards for human experimentation established in the Declaration of Helsinki. This study was approved from the Institutional Review Board for Clinical Research (Approval no: NCC2016-0062).

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Declaration of competing interest

The authors declare that they have no competing interests.

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