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# 대한민국 국가대표 여자 선수들의 월경전 증후군 유병률과 위험 요인

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# Prevalence of Premenstrual Syndrome in Korean Female National Athletes and Associated Risk Factors

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**Purpose:** The purpose of this study was to investigate the prevalence of premenstrual syndrome in elite female athletes and the associated factors.

**Methods:** We surveyed elite female athletes in the National Training Center about their experiences of premenstrual syndrome. Premenstrual syndrome was diagnosed using the premenstrual symptoms screening tool. The Mann-Whitney test was applied to determine the association of premenstrual syndrome with differences in age, training time, and body mass index; and the chi-squared test was performed to investigate the association of premenstrual syndrome with differences in alcohol and coffee intake, diet for weight loss, stress fracture, and menstrual regularity.

**Results:** Of the 124 athletes, 18 (14.5%) met the criteria for the diagnosis of premenstrual syndrome. These athletes complained of symptoms such as fatigue/lack of energy (18, 100%), anger/irritability (14, 77.8%), joint/muscle pain (10, 55.6%). There was no significant difference in menarche age, training time, or body mass index between the premenstrual syndrome and non-premenstrual syndrome groups. There was also no significant difference in alcohol or coffee intake, diet for weight, stress fracture, or menstrual regularity between the two groups. The athletes with premenstrual syndrome felt that premenstrual symptoms interfered with their performance, but few of them visited the doctor.

**Conclusion:** Premenstrual syndrome athletes felt that their performance was hampered because their symptoms were not adequately managed. However, none of the factors we investigated showed any association with premenstrual syndrome. Hence more research and proactive management of the premenstrual symptoms of female athletes is recommended.

**Keywords:** Premenstrual syndrome, Female, Athletes, Mental health

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## Introduction

Premenstrual syndrome (PMS) occurs during the luteal phase of the menstrual cycle. Psychological symptoms such as anxiety, tension, insomnia, and physical symptoms such as breast tenderness, abdominal bloating, and headache appear repeatedly during the premenstrual period. These symptoms usually improve within a few days of the onset of menstruation[1]. According to the criteria of International Classification of Diseases 10th revision, PMS can be diagnosed when one or more of the seven symptoms such as mild mental discomfort, abdominal bloating, weight gain, breast tenderness, muscle pain or strain, poor concentration, and appetite changes are experienced and the symptoms are confined to the luteal phase[2].

The symptoms of PMS can range from mild to severe, and they can have a negative impact on daily life. When the symptoms are so severe that they cause difficulties with social functioning, it is defined as premenstrual dysphoric disorder (PMDD)[3].

Many women of childbearing age suffer from PMS. In a survey of 289 female workers in Bucheon, 38% of the subjects met the criteria of American College of Obstetricians and Gynecologists[4]. In a study of 1,688 female high school students in Seoul, 20.1% of the subjects met the criteria for moderate-to-severe PMS and 6.4% met the criteria for PMDD[5].

PMS also affects female athletes. In a study of medium- to long-distance female athletes in Poland, 9.33% of athletes experienced PMDD and 49.33% reported PMS[6]. A study of 232 female athletes in Japan showed a prevalence of 2.9% for PMDD and 8.6% for moderate-to-severe PMS and 44.3% of them reported that the symptoms negatively affected their sports performance[7].

In female athletes, symptoms such as anxiety, nervousness, breast tenderness, and bloating can negatively affect sports performance; therefore, PMS should be closely monitored and managed. To achieve this, we have to know more about the prevalence and impact of PMS in female athletes as there is little published literature about the condition in female athletes in South Korea.

The purpose of this study was to investigate the prevalence of PMS and to find out the factors that are associated with it among female elite athletes. We examined the athletes' subjective perception of the effects of premenstrual symptoms on performance and the management of PMS in elite female athletes.

**Table 1.** General characteristics of the participants

| Sports | Participant (n) | Age (yr) | Weight (kg) | Height (cm) | Body mass index (kg/m$^2$) |
|---|---|---|---|---|---|
| Artistic gymnastics | 3 | 18.3±1.5 | 45.0±2.7 | 151.7±3.8 | 19.7±1.2 |
| Diving | 4 | 21.5±1.3 | 51.0±1.2 | 156.5±4.4 | 21.0±1.2 |
| Wrestling | 11 | 27.0±4.2 | 60.0±13.0 | 164.1±4.2 | 22.2±4.4 |
| Rhythmic gymnastics | 3 | 16.3±0.6 | 44.3±2.5 | 163.0±3.0 | 16.7±0.6 |
| Bowling | 7 | 29.0±3.5 | 70.3±5.9 | 161.7±3.4 | 26.7±1.9 |
| Sepak takraw | 12 | 27.3±3.1 | 58.2±7.9 | 167.3±8.1 | 20.7±1.9 |
| Softball | 17 | 26.1±4.8 | 65.9±12.2 | 165.5±5.4 | 23.9±3.3 |
| Swimming | 1 | 22.0 | 55.0 | 164.0 | 20.0 |
| Squash | 3 | 26.0±1.0 | 62.3±8.3 | 167.3±8.3 | 22.0±1.0 |
| Artistic swimming | 11 | 17.3±1.6 | 51.6±3.9 | 164.8±4.9 | 18.8±0.9 |
| Archery | 6 | 26.17±6.05 | 57.3±7.0 | 167.7±4.8 | 20.5±1.8 |
| Weight lifting | 8 | 22.6±3.4 | 81.6±23.7 | 165.1±6.7 | 29.5±6.2 |
| Wushu | 3 | 22.3±2.3 | 55.3±1.5 | 162.7±4.5 | 21.0±1.0 |
| Judo | 7 | 23.9±2.3 | 60.7±7.7 | 162.6±5.3 | 22.9±1.5 |
| Rowing | 4 | 24.8±2.5 | 65.8±7.3 | 176.0±5.7 | 21.3±2.5 |
| Taekwondo | 6 | 22.2±2.9 | 59.8±6.7 | 173.0±6.1 | 20.2±1.7 |
| Field hockey | 18 | 25.9±3.1 | 57.7±4.1 | 163.3±4.2 | 21.8±1.6 |
| Total | 124 | 24.4±4.7 | 60.5±12.3 | 164.9±6.5 | 22.2±3.8 |

Values are presented as mean±standard deviation.

## Methods

### 1. Participants

This was a cross-sectional observational study. We surveyed female athletes training at the Jincheon National Training Center in 2019. The study was performed according to the Declaration of Helsinki. All participants were fully informed about the purpose of the study, and the participants who agreed to the study were included in this study. We obtained written consent from the participants. We excluded athletes from the study if they did not wish to participate, if they had gynecological or endocrine disorders, or if they were under care for psychological disorders. This study was approved by the Institutional Review Board of Bundang Jesaeng Hospital for research ethics (No. DMC 2019-04-002).

### 2. Measurement

In this study, the premenstrual symptoms screening tool (PSST) was used to identify PMS symptoms in female elite athletes. It is a simple and useful questionnaire that can screen for PMS and determine its severity (Supplementary Table 1)[8].

To find out the factors affecting PMS, we asked questions about the athletes' body mass index (BMI), menarche age, the regularity of menstrual cycle, training time, alcohol, caffeine intake, and diet for weight control. We also asked about the occurrence of stress fractures to investigate any relationship to PMS and about subjective perceptions of the effects of PMS on their athletic performance.

### 3. Data analysis

The Mann-Whitney test was performed to determine the relationship of menstrual age, current age, training time, and BMI with the presence of PMS. The chi-square test was performed to find out the differences in the prevalence of PMS between sports categories and to investigate whether differences in alcohol and coffee intake, diet for weight loss, or regularity of menstrual cycle correlated with the presence of PMS. The chi-square test was also used to determine if any relationship between stress fractures and the presence of PMS existed, especially related to the physical symptoms.

Frequency analysis was performed on each item of the PSST to identify the emotional and physical symptoms that athletes complained of before menstruation. In addition, frequency analysis was performed to find out about subjective perceptions of the effect the premenstrual symptoms had on performance and whether the athletes tended to visit the doctors for this reason. A p-value of $<0.05$ was considered statistically significant, and data were analyzed using IBM SPSS ver. 24.0 (IBM Corp., Armonk, NY, USA).

## Results

### 1. Study participants

Of the 169 female athletes, 124 agreed to participate in the

Table 2. Premenstrual syndrome (PMS) according to the sports category

| Category | Non-PMS | Moderate-to-severe PMS | Total |
|---|---|---|---|
| Ball | | | |
| Bowling | 7 (100) | 0 (0) | 7 |
| Sepak takraw | 9 (75.0) | 3 (25.0) | 12 |
| Softball | 15 (88.2) | 2 (11.8) | 17 |
| Squash | 3 (100) | 0 (0) | 3 |
| Field hockey | 17 (94.4) | 1 (5.6) | 18 |
| Total | 51 (89.5) | 6 (10.5) | 57 |
| Record (archery) | 5 (83.3) | 1 (16.7) | 6 |
| Water | | | |
| Diving | 3 (75.0) | 1 (25.0) | 4 |
| Swimming | 1 (100) | 0 (0) | 0 |
| Artistic swimming | 9 (81.8) | 2 (18.2) | 11 |
| Total | 13 (81.2) | 3 (18.8) | 16 |
| Weight division | | | |
| Wrestling | 8 (72.7) | 3 (27.3) | 11 |
| Weight lifting | 8 (100) | 0 (0) | 8 |
| Wushu | 3 (100) | 0 (0) | 3 |
| Judo | 6 (85.7) | 1 (14.3) | 7 |
| Rowing | 2 (50.0) | 2 (50.0) | 4 |
| Taekwondo | 5 (83.3) | 1 (16.7) | 6 |
| Total | 32 (82.1) | 7 (17.9) | 39 |
| Gymnastics | | | |
| Artistic gymnastics | 2 (66.7) | 1 (33.3) | 3 |
| Rhythmic gymnastics | 3 (100) | 0 (0) | 3 |
| Total | 5 (83.3) | 1 (16.7) | 6 |
| Total | 106 (85.5) | 18 (14.5) | 124 |

Values are presented as number (%) or number only.
p=0.88.

survey. The participants were from 17 sports. The average age, height, weight, and BMI according to each sport are listed in Table 1.

### 2. Prevalence of premenstrual syndrome

Of the 124 participants, 17 met the criteria of moderate-to-severe PMS. Since only one athlete was diagnosed with PMDD, we categorized it as moderate-to-severe PMS. The athletes who did not meet the criteria of moderate-to-severe PMS were defined as non-PMS athletes.

The prevalence of moderate-to-severe PMS was 14.5% in all participants. We evaluated the prevalence of moderate-to-severe PMS according to the sports. It was evenly distributed regardless of the 17 sports. And there were few participants to compare each of the 17 sports. Therefore we divided the 17 sports into weight division and non-weight division categories. And non-weight division sports were divided into ball, record, water, gymnastics sports according to characteristic of the sports. There were no significant differences by sports category (Table 2).

### 3. Symptoms and associated factors

To determine the general pattern of physical and emotional symptoms during the premenstrual period, we conducted a frequency analysis on each item of the PSST. Moderate-to-severe PMS athletes complained of fatigue/lack of energy mostly. And they complained of joint or muscle pain, bloating, and weight gain in the physical domain. They were also interference with school and work efficiency or productivity (Table 3).

**Table 3.** Premenstrual symptoms of all participants

| Symptom | Total participant (n=124) | | Moderate-to-severe PMS (n=18) | |
|---|---|---|---|---|
| | No-mild | Moderate to severe | No-mild | Moderate to severe |
| Anger/irritability | 83 (66.9) | 41 (33.1) | 4 (22.2) | 14 (77.8) |
| Anxiety/tension | 113 (91.1) | 11 (8.9) | 12 (66.7) | 6 (33.3) |
| Tearful/increased sensitivity to rejection | 95 (76.6) | 29 (23.4) | 9 (50.0) | 9 (50.0) |
| Depressed mood/hopelessness | 102 (82.3) | 22 (17.7) | 9 (50.0) | 9 (50.0) |
| Decreased interest | | | | |
| In work activities | 107 (86.3) | 17 (13.7) | 9 (50.0) | 9 (50.0) |
| In home activities | 114 (91.9) | 10 (8.1) | 11 (61.1) | 7 (38.9) |
| In social activities | 110 (88.7) | 14 (11.3) | 7 (38.9) | 11 (61.1) |
| Difficulty concentrating | 100 (80.6) | 24 (19.4) | 4 (22.2) | 14 (77.8) |
| Fatigue/lack of energy | 68 (54.8) | 56 (45.2) | 0 (0) | 18 (100) |
| Overeating/food craving | 72 (58.1) | 52 (41.9) | 7 (38.9) | 11 (61.1) |
| Insomnia | 106 (85.5) | 18 (14.5) | 12 (66.7) | 6 (33.3) |
| Hypersomnia (needing more sleep) | 91 (73.4) | 33 (26.6) | 7 (38.9) | 11 (61.1) |
| Feeling overwhelmed or out of control | 104 (83.9) | 20 (16.1) | 7 (38.9) | 11 (61.1) |
| Physical symptoms | | | | |
| Breast tenderness | 105 (84.7) | 19 (15.3) | 11 (61.1) | 7 (38.9) |
| Headaches | 117 (94.4) | 7 (5.6) | 12 (66.7) | 6 (33.3) |
| Joint/muscle pain | 117 (94.4) | 7 (5.6) | 8 (44.4) | 10 (55.6) |
| Bloating | 118 (95.2) | 6 (4.8) | 8 (44.4) | 10 (55.6) |
| Weight gain | 120 (96.8) | 4 (3.2) | 8 (44.4) | 10 (55.6) |
| Interfered with | | | | |
| School/work efficiency or productivity | 89 (71.8) | 35 (28.2) | 3 (16.7) | 15 (83.3) |
| Relationship with friends, classmate, coworkers | 105 (84.7) | 19 (15.3) | 12 (66.7) | 6 (33.3) |
| Relationships with family | 91 (73.4) | 33 (26.6) | 13 (72.2) | 5 (27.8) |
| Social life activities | 89 (71.8) | 35 (28.2) | 13 (72.2) | 5 (27.8) |
| Home responsibilities | 94 (75.8) | 30 (24.2) | 15 (83.3) | 3 (16.7) |

Values are presented as number (%).
PMS: premenstrual syndrome.

We examined the factors that were associated with moderate-to-severe PMS. There were no significant differences in age, BMI, training time per week, or age of menarche between moderate-to-severe PMS and non-PMS athletes (Table 4). We also examined the differences in alcohol and coffee consumption, diet for weight loss, and menstrual regularity between moderate-to-severe PMS and non-PMS athletes. There were no significant differences between the two groups (Table 4).

The relationship between moderate-to-severe PMS and stress fracture was analyzed. In the non-PMS group, 28 athletes (26.4%) had been diagnosed with a stress fracture, while in the moderate-to-severe PMS group, 6 (33.3%) had been similarly diagnosed. There was no statistical difference between the two groups (Table 5). We investigated the relationship between physical symptoms during the luteal phase and stress fractures. Athletes who complained of a moderate-to-severe degree of at least one of five PSST physical symptoms were classified into the moderate-to-severe group and the rest were included in the no-mild group. There was no statistical difference between the two groups (Table 5).

### 4. Effect on performance and visits to the doctor

We asked participants whether their sports performance was

**Table 4.** Comparison of selected factors between moderate-to-severe PMS and non-PMS groups

| Variable | Non-PMS (n=106) | Moderate-to-severe PMS (n=18) | p-value |
|---|---|---|---|
| Age (yr) | 24.3±4.8 | 24.8±4.3 | 0.62 |
| Age of menarche (yr) | 13.6±1.8 | 13.7±2.0 | 0.79 |
| Training time (hr/wk) | 32.9±9.8 | 34.4±10.0 | 0.72 |
| Body mass index (kg/m$^2$) | 22.4±3.7 | 20.8±4.4 | 0.09 |
| Alcohol intake during previous month (time/wk) | | | 0.25 |
| 0 | 35 (33.0) | 3 (16.7) | |
| 1 | 62 (58.5) | 13 (72.2) | |
| 2−3 | 8 (7.5) | 2 (11.1) | |
| >4 | 1 (0.9) | 0 (0) | |
| Coffee intake/day (cup) | | | 0.80 |
| 0 | 58 (54.7) | 10 (55.6) | |
| 1−2 | 46 (43.4) | 8 (44.4) | |
| 3 | 1 (0.9) | 0 (0) | |
| >4 | 1 (0.9) | 0 (0) | |
| Diet for weight loss | | | 0.08 |
| Diet (+) | 36 (34.0) | 10 (55.6) | |
| Diet (−) | 70 (66.0) | 8 (44.4) | |
| Menstrual regularity | | | 0.29 |
| Regular | 69 (65.1) | 9 (50.0) | |
| Irregular | 37 (34.9) | 9 (50.0) | |

Values are presented as mean±standard deviation or number (%).
PMS: premenstrual syndrome.

**Table 5.** Stress fracture according to the premenstrual syndrome (PMS) and physical symptoms

| Variable | Stress fracture (+) | Stress fracture (−) | Total | p-value |
|---|---|---|---|---|
| Non-PMS | 28 (26.4) | 78 (73.6) | 106 | 0.54 |
| Moderate-to-severe PMS | 6 (33.3) | 12 (66.7) | 18 | |
| Physical symptoms of moderate-to-severe PMS | | | | 0.84 |
| No to mild | 14 (26.4) | 39 (73.6) | 53 | |
| Moderate to severe* | 20 (28.2) | 51 (71.8) | 71 | |
| Total | 34 (27.4) | 90 (72.6) | 124 | |

*Cases in which at least one of the five symptoms are moderate to severe.

Table 6. Feelings of decreased performance and experience of consulting a doctor due to premenstrual symptoms

| Variable | No. (%) | Experience of consulting doctor |
|---|---|---|
| Feelings of decreased performance | | |
| No | 29 (23.4) | 1 (3.4)* |
| Sometimes | 73 (58.9) | 6 (8.2)* |
| Frequently | 15 (12.1) | 6 (40.0)* |
| Always | 7 (5.6) | 3 (42.9)* |
| Total | 124 (100) | 16 (12.9)* |
| Moderate-to-severe PMS | | |
| Yes | 18 (14.5) | 5 (27.8)† |
| No | 106 (85.4) | 11 (10.4)† |
| Total | 124 (100) | 16 (12.9)† |

PMS: premenstrual syndrome.
*Number (% of feeling of decreased performance); †number (% of PMS).

affected by PMS-related symptoms. A total of 95 athletes (76.6%) claimed that PMS-related symptoms affected their sports performance. In particular, seven athletes (5.6%) reported that it "always affected" their performance (Table 6). Although not included in the criteria for PMS, many athletes subjectively recognized that their performance was affected by PMS-related symptoms.

We asked all participants whether they were in the habit of visiting a doctor for the symptoms related to PMS. Among the 95 athletes affected by PMS-related symptoms, 15 (15.8%) had visited doctors (Table 6). Of the 18 athletes diagnosed with moderate-to-severe PMS, 5 (27.8%) had visited a doctor (Table 6). Despite diagnosis of PMS, there were few athletes who had visited doctors.

## Discussion

This study is the first cross-sectional study to assess the prevalence and risk factors of PMS in Korean elite female athletes. We found that 18 (14.5%) of the 124 female athletes were diagnosed with moderate-to-severe PMS. We did not identify any risk factors for moderate-to-severe PMS.

According to a meta-analysis of PMS prevalence studies from 1996 to 2011, the prevalence of PMS was 47.8% (95% confidence interval, 32.6%–62.9%). However, there were various prevalence rates ranging from 10% to 98.2%[9]. In a study of Korean female adolescents in 2014, 20% of adolescents reported having moderate-to-severe PMS[10].

There have been some other studies of PMS in female athletes. In a study of medium to long-distance female athletes in Poland, 9.33% of athletes had PMDD and 49.33% suffered from PMS[6], while a study of 232 female athletes in Japan found that 2.9% of athletes experienced PMDD and 8.6% reported moderate-to-severe PMS[7]. In a study of 52 Brazilian female football players, 59.6% of athletes had PMS[11], and in a study of 45 Polish female gymnasts, 48.89% of athletes were shown to have PMS[12]. The reported prevalence of PMS varies according to the study subjects. With the exception of a Japanese university study on athletes[7], the prevalence of PMS in our study was lower than that in other studies.

The pathophysiology of PMS is not well understood, but it is thought to be related to hormonal changes and serotonergic dysfunction during the luteal phase. Poor dietary habits, stress, and lack of exercise are thought to contribute to the development of PMS[13,14]. Participants in this study are national elite athletes who thoroughly control diet and exercise for their best condition. The results of the study show that the participants had less alcohol, coffee and exercised regularly. This point is thought to explain the relatively low prevalence of this study.

Several previous studies have reported that exercise can help in relieving symptoms of PMS. In a study of 748 female college students, women who exercised reported fewer symptoms of PMS than women who did not[15]. An 8-week study comparing aerobic and resistance exercise reported that both types of exercise improved symptoms of PMS although the aerobic exercise group showed more benefit, especially in relieving depressive symptoms during the premenstrual period[16]. Exercise blocks the renin-angiotensin system overactivity[17]. It decreases the reabsorption of sodium and water, thereby reducing edema and improving physical symptoms.

The point that participants are athletes who exercise regularly may explain our relatively low prevalence of PMS. However, there are some reports[6,11,12] that the prevalence of PMS is high among elite female athletes. It is therefore difficult to generalize that low PMS prevalence is due to the exercise of elite female athletes in this study. Athletes with severe symptoms of PMS might have already dropped out before becoming a national team

member. Further studies are needed to address this question.

In this study, we surveyed participants to find out risk factors associated with moderate-to-severe PMS. Training time per week was not associated with PMS, a finding supported by a study of Polish gymnasts that has also shown that training time and frequency did not affect the prevalence of PMS[12]. Several studies have reported that regular exercise can help improve PMS symptoms[18-20]. The subjects of this study are national athletes who follow a regular training program and this may have helped reduce the symptoms of PMS reported. National athletes, however, do high-intensity training, but we did not investigate the intensity of exercise in this study. Further study on the relationship between the intensity of the exercise and PMS is desirable.

In this study, caffeine and alcohol intake were not significantly different when analyzed according to the presence of PMS. According to the other study, however, caffeine and alcohol intake was significantly correlated with the incidence of premenstrual symptoms (PMS, PMDD) among elite gymnasts[12]. Other previous studies have shown that alcohol consumption after menstruation was significantly associated with the development of PMS[21]. In one study, women who consumed alcohol had a 2.5-fold higher incidence of PMS than those who did not[14]. These results are all contrary to the results of our study.

The subjects of our study are disciplined in managing their physical condition. We found that 122 of our athletes (98.4%) consumed less than two or three cups of coffee a day and 113 of them (91.1%) consumed alcohol less than once a week. This low consumption may explain why caffeine and alcohol intake did not appear to affect the chance of PMS in our study. More research is needed in this regard.

Our study did not find any association between diet for weight loss and PMS. Previous studies have investigated aspects of nutrition; for example, vitamin and micronutrient status in subjects with PMS have been investigated but no nutrient deficiency affecting PMS was found[22]. Another study reports that calcium and vitamin D may help improve symptoms of PMS[23]. Since we simply surveyed the diet status of athletes, the actual nutritional status was not investigated. This is a limitation of our study, and further study on the relationship between nutritional status and PMS in athletes is needed.

The BMI of female athletes was not significantly associated with the PMS in our study. Earlier work has shown that obese women with a BMI of 30 $kg/m^2$ or higher are nearly three times more likely to develop PMS than women who are not obese[24]. The subjects of our study had an average BMI of nearly 20 $kg/m^2$ and few athletes were obese.

Our study also found no relationship between menstrual cycle regularity and PMS. In a study of 221 Japanese college students, premenstrual symptoms were not significantly associated with irregular menstrual cycles[25]. However, there are no consistent reports on the association between PMS and menstrual cycle, current age, or age at menarche; therefore, further studies are needed.

There was no significant association between PMS and stress fracture in this study. In a previous study of Japanese high school club athletes, the “physical symptoms” of PMS had a significant association with the occurrence of stress fractures[26], which was not the case in our study. As research in this area is minimal, more studies on this aspect are needed.

Regardless of the diagnosis of moderate-to-severe PMS, most participants felt that symptoms related to PMS interfered with their performance. Many of the participants had emotional symptoms such as fatigue/lack of energy (45.2%), overeating/food craving (41.9%), anger/irritability (33.1%), and physical symptoms such as breast tenderness (15.3%), headaches (5.6%), and joint/muscle pain (5.6%) during the premenstrual period. These symptoms are thought to have influenced the subjective perception of athletes’ performance decrease. This result was derived through a simple questionnaire. There is a limitation that it is not an experimental measurement of changes in performance. Therefore, we think that experimental research on the effect of PMS on sports performance is necessary in the future.

Participants complained of symptoms and subjective performance decrease due to PMS, but few athletes met a doctor for these symptoms. Even those athletes diagnosed with PMS rarely met a doctor for these symptoms. In an earlier study of factors influencing the decision of female college students to visit the gynecology clinic, fear and concern for social stigma regarding gynecologic diagnoses was a significant influence[27]. The requirement for nudity, intimate gynecologic examination, and social prejudice experienced by women who visit the gynecologist are among the factors that may have made our young athletes in

their late teens and early twenties reluctant to seek medical care. The negative feelings and delay in seeking treatment for symptoms may then have had an additional impact on their sports performance. It is important for athletes who suffer from PMS to visit a gynecologist and other relevant specialists for proper treatment.

There are some limitations to our study. First, this is a cross-sectional study that reflects only the situation at the time it was carried out. We were not able to consider life events such as upcoming important competitions and injuries. Keeping a journal about PMS is recommended as an effective investigative tool for PMS[28]. Prospective studies of PMS based upon the daily records of elite female athletes would be valuable.

In addition, it is difficult to generalize this study because the subjects were limited to elite female athletes trained at the National Training Center in 2019. However, there are very few domestic studies that have targeted Olympic-level female athletes in South Korea, which may therefore also be considered a strength of this study.

In conclusion, the 18 elite female athletes (14.5%) experienced moderate-to-severe PMS and none of the factors we investigated were related to PMS. Regardless of the diagnosis, many of the participants felt that symptoms related to PMS interfered with their sports performance. Nevertheless, they did not seek professional treatment. We recommend that elite female athletes constantly manage this aspect of their health and seek treatment for PMS when needed. In addition, further research on related characteristics, effects on performance, and treatment of PMS in elite female athletes are needed.

## Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Conceptualization: TY. Data curation: MB. Formal analysis: MB. Methodology: TY. Project administration: TY. Visualization: MB. Writing–original draft: MB. Writing–review & editing: TY.

## Supplementary Material

Supplementary Material can be found at https://doi.org/10.5763/kjsm.2021.39.1.10.

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