

## Depressive Symptoms and Menstrual Cycle Irregularity among Community Women of Childbearing Age

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### Abstract

Menstrual cycle irregularity reflects the reproductive health of women of childbearing age, but studies are scant on women in communities. In this study, we identified factors associated with menstrual cycle irregularity among 884 community women of childbearing age (19–40 years) and confirmed the relationship between menstrual cycle irregularity and depressive symptoms. Data were collected through online or mobile platforms. We noted that 25% of participants had menstrual cycle irregularity. Multivariable ordinal logistic regression analysis revealed that age, irregular eating, and depressive symptoms were associated with menstrual cycle irregularity. After adjusting for confounding variables, participants with depressive symptoms were at a slightly higher risk of menstrual cycle irregularity (odds ratio = 1.078, confidence interval = 1.021–1.139). Additional support be provided for community-living women of childbearing age with depressive symptoms, to improve their reproductive health

**Keywords:** Depressive Symptoms; Menstrual Irregularity; Reproductive Health

### 1. INTRODUCTION

Menstruation is an important function that reflects the reproductive health of women of childbearing age. The quality and growth rate of the ovarian follicle and the length of the follicular phase together influence menstrual cycles. It is thus, an important indicator of the residual function of the ovaries [1]. Menstrual cycle irregularity is defined as “menstruation without any periodic cycle” and is widely prevalent (approximately 14.3 %–20 %) among women of childbearing age [2]. Previous population studies conducted in Korea, have reported that the prevalence of menstrual cycle irregularity is 14.3 % [3]; however, the proportion of women with irregular menstruation is increasing annually, indicating the urgency for action.

An irregular menstrual cycle can harm women’s health in various ways. Infertility, particularly, is a major social issue in Korea, where the number of people diagnosed therewith increased from 185,000 in 2010, to over 230,000 in 2019 [4]. This, therefore, calls for an investigation of the factors associated with menstrual

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cycle irregularity in women of childbearing age and the determination of appropriate interventions to reduce infertility rates. The main causes of menstrual cycle irregularity are reduced gonadotropin-releasing hormone secretion and functional hypothalamic amenorrhea, related to the hypothalamic-pituitary-adrenal (HPA) axis dysregulation, for which various modifiable risk factors are responsible [5]. The factors influencing menstrual cycle irregularity include age, age at menarche, body mass index (BMI), alcohol consumption, irregular eating habits, diet, sleep, and psychological disorders including stress and depression [3,6-10]. Particularly, depression is related to dysregulation of HPA control, which can slow down or interfere with the growth of the luteinising hormone and damage ovarian function [11].

Currently, in Korea, the prevalence of depression in comparison to various other mental health problems, continues to increase [12]. However, studies exploring the association between depression and menstrual cycle irregularity have mainly focused on patients with major depression, teenagers with mental health problems, and female college students [10-12]. Limited studies have targeted women of childbearing age in the community. Therefore, this study sought to determine the factors related to menstrual cycle irregularity among community women of childbearing age and confirm the association between it and depressive symptoms.

## **2. METHODS**

### **2.1 Study Design and Participants**

In this cross-sectional study, participants were community women, aged 19–40 years, living in Daejeon city, Chungcheongnam-do province. Women who were not pregnant, breastfeeding, or having primary or secondary amenorrhea were sampled. Data were collected from September to December 2020. Women in the community were invited to visit the survey website via online or mobile platforms. Participation in the survey was voluntary. Of the 966 respondents, 7 cases of missing values (0.7 %) and 75 women (7.8 %) who reported being diagnosed with polycystic ovary syndrome or cancer or that they were using birth control pills, were excluded. Thus, data from 884 participants were used in the final analysis.

The survey was advertised across online communities via social media commonly used by community women, and promotional posters with QR codes placed at local coffee shops and community centres. Women who were eligible and interested in the study could access the survey website; upon providing consent to participate in the online survey, they were provided with a full explanation of the study and a web-based informed consent form.

### **2.2 Measurements**

Menstrual cycle irregularity was measured using the following questions: “Have you menstruated recently?” (Yes/No), and “How are your recent menstruations?” Those who answered “Yes” to the first question were asked to choose between “I menstruate regularly” and “I do menstruate, but it has been irregular for the past 12 months” for the second question.

Depressive symptoms were assessed using the Patient Health Questionnaire (PHQ-9), which comprises nine questions on displeasure, fatigue, appetite change, guilt or worthlessness, decreased concentration, slow movement or restlessness, and suicidal ideation. Each item is rated on a 4-point Likert scale, ranging from 0 (not at all), to 3 (nearly every day). Scores 0–4, 5–9, 10–14, 15–19, and 20 or more, indicate minimal, mild, moderate, moderately severe, and severe depressive symptoms, respectively. Total scores—ranging from 0 to 27—were used for the final analysis; the higher the total score, the greater the degree of depressive symptoms. Cronbach’s alpha for the scale in the original study was 0.86, and in this study, it was 0.84 [14].

The Korean version of the Perceived Stress Scale-10 (PSS-10), was employed to measure stress [15]. The scale comprises 10 items, each of which is rated on a 5-point Likert scale ranging from 0 (not at all), to 4 (very often). Total scores range from 0 to 40. The fourth, fifth, seventh, and eighth items were reverse-scored, such that the higher the score, the greater the level of stress. Cronbach's alpha for this scale in the original study was 0.82, while in this study, it was 0.76.

Sleep disturbance was measured using the Jenkins Sleep Questionnaire, which comprises four questions regarding sleep problems experienced in the past four weeks: (a) trouble falling asleep, (b) waking up several times each night, (c) trouble staying asleep, (d) waking up feeling tired despite getting the usual amount of sleep [16]. Each item is measured on a 6-point Likert scale ranging from 0 (not at all), to 5 (22–31 days). The total score ranges from 0 to 20, with higher scores indicating a more severe sleep problem. Cronbach's alpha of the original study was 0.79, and in this study too, it was 0.79 [16].

### 2.3 Ethical Considerations

This study was conducted according to the Declaration of Helsinki guidelines, and after obtaining approval from the Institutional Review Board (IRB No.: \*\*\*-\*\*\*\*-\*\*\*-1). Prior to the survey, informed consent was obtained from all participants. They were guaranteed anonymity and confidentiality.

### 2.4 Data Analysis

Data from 884 participants were analysed using SPSS version 26.0 for Windows (IBM Corp.; Armonk, NY, USA). Descriptive statistics, chi-squared test, and t-test were performed to investigate differences in the baseline characteristics according to menstrual cycle irregularity. The correlations among the variables were analysed using Spearman's correlation coefficients.

To verify the factors associated with menstrual cycle irregularity, a multivariable ordinal logistic regression analysis was performed. In Model 1, sociodemographic and lifestyle factors were included. Sleep and perceived stress were included in Model 2. The final model consisted of depressive symptoms and all the variables included in Model 2. Odds ratio and 95 % confidence intervals (CIs) were calculated from the multivariable ordinal logistic regression. The threshold for statistical significance in this study was  $p < 0.05$ .

## 3. RESULTS

Of the 884 participants, 25 % ( $n = 221$ ) had an irregular menstrual cycle. Table 1 shows that the distribution of key variables with and without menstrual cycle irregularity and the differences between the two groups by key variables. The mean ( $\pm$ SD) age of the participants was  $24.04 \pm 4.38$  years; the mean ( $\pm$ SD) age of the regular menstrual cycle group ( $24.5 \pm 4.61$ ) was significantly greater than that of the irregular menstrual cycle group ( $22.63 \pm 3.26$ ). The majority (93.0 %) of the participants were unmarried, and 85.2 % earned less than 20 million won annually. The mean ( $\pm$ SD) age at menarche was  $13.69 \pm 1.81$  years, and the average BMI was  $21.09 \pm 2.90$ . Furthermore, 65.4 % of the participants had normal BMI, whereas 14.6 %, 10.5 %, and 9.5 % of the participants were considered underweight, overweight, and obese, respectively.

Regarding "effort to control weight," 58.3 % of women stated that they made efforts to lose weight, 16.5 % made efforts to maintain weight, and 22.2 % did not make any such efforts. Regarding alcohol consumption per month, 43.7 % of the participants reported drinking once, 36.2 % drank 2–4 times, and 10.7 % drank 5 or more times. As to eating and exercise frequencies, 53.1 % of the participants did not eat regularly, and 73.5 % did not exercise on a consistent basis. There were significant differences in the irregularity of the menstrual

cycle between the two groups according to age ( $t = 5.632$ ,  $p < 0.001$ ), marital status ( $\chi^2 = 6.684$ ,  $p = 0.005$ ), income ( $\chi^2 = 13.419$ ,  $p = 0.001$ ), alcohol consumption ( $\chi^2 = 7.997$ ,  $p = 0.046$ ), and regular eating ( $\chi^2 = 10.430$ ,  $p = 0.001$ ).

While sleep did not differ between the two groups, stress ( $t = -2.038$ ,  $p = 0.042$ ) was significantly higher in the irregular menstrual cycle group than in the regular menstrual cycle group (Table 1).

**Table 1. Descriptive characteristics according to menstrual cycle irregularity**

	Menstrual cycle irregularity			$\chi^2$ or $t$
	All (N = 884)	No (N = 663)	Yes (N = 221)	
	n (%) or $M \pm SD$	n (%)	n (%)	
Age (years)	24.04 $\pm$ 4.38	24.51 $\pm$ 4.61	22.63 $\pm$ 3.26	5.632***
Marital status				
Unmarried	822(93.0)	608(91.7)	214(96.8)	6.684**
Married or other status	6 (7.0)	55(8.3)	7(3.2)	
Annual income (₩10,000)				
< 2,000	753(85.2)	548(82.6)	205(92.8)	13.419**
2,000–2,999	80(9.0)	70(10.6)	10(4.5)	
$\geq$ 3,000	5 (5.8)	45(6.8)	6(2.7)	
Menarcheal age (years)	13.69 $\pm$ 1.81	13.7 $\pm$ 11.86	13.6 $\pm$ 51.64	0.396
BMI	21.09 $\pm$ 2.90	21.0 $\pm$ 32.82	21.2 $\pm$ 83.15	
Underweight (< 18.5)	129(14.6)	97(14.6)	32(14.5)	-1.078
Normal (18.5–22.9)	578(65.4)	440(66.4)	138(62.4)	
Overweight (23–24.9)	93(10.5)	69(10.4)	24(10.9)	
Obese ( $\geq$ 25)	84(9.5)	57(8.6)	27(12.2)	
Effort to control weight (wt)				
No	196(22.2)	152(22.9)	44(19.9)	7.774
Yes, effort to gain wt	27(3.1)	16(2.4)	11(5.0)	
Yes, effort to maintain wt	146(16.5)	118(17.8)	28(12.7)	
Yes, effort to lose wt	515(58.3)	377(56.9)	138(62.4)	
Alcohol consumption				
No	83(9.4)	59(8.9)	24(10.9)	7.997*
Once a month	38 (43.7)	296(44.6)	90(40.7)	
2–4 times a month	320(36.2)	24(37.3)	73(33.0)	
5 or more times a month	95(10.7)	61(9.2)	34(15.4)	
Regular eating				
Yes	415(46.9)	332(50.1)	83(37.6)	10.430**
No	469(53.1)	331(49.9)	138(62.4)	
Regular exercise				
Yes	234(26.5)	177(26.7)	57(25.8)	0.860
No	650(73.5)	486(73.3)	164(74.2)	
Sleep	4.32 $\pm$ 4.27	4.24 $\pm$ 4.35	4.55 $\pm$ 4.03	-0.931
Stress	17.50 $\pm$ 5.36	17.29 $\pm$ 5.28	18.14 $\pm$ 5.56	-2.038*

Note: BMI: body mass index

\*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

Table 2 shows the differences in menstrual cycle irregularity by the severity of participants’ depressive symptoms. The total score of depressive symptoms was higher in women with irregular menstrual cycles than in those with regular menstrual cycles ( $t = -3.177, p = 0.002$ ). Depressive symptoms were more than mild in 39.1 % and 47.5 % of the regular and irregular menstrual cycle groups, respectively, indicating a significant difference ( $\chi^2 = 18.066, p = 0.001$ ).

**Table 2. Menstrual cycle irregularity according to the severity of depressive symptoms**

Variable	Total 884 (100 %)	Menstrual cycle irregularity		$\chi^2$ or t
		No 663(75 %)	Yes 221(25 %)	
Severity of depressive symptoms	4.89±4.45	4.62±4.28	5.71±4.86	-3.177**
Minimal(0–4)	520(58.8 %)	404(60.9 %)	116(52.5 %)	18.066**
Mild(5–9)	217(24.6 %)	152(22.9 %)	65(29.4 %)	
Moderate(10–14)	110(12.4 %)	87(13.1 %)	23(10.4 %)	
Moderately severe(15–19)	32(3.6 %)	19(2.9 %)	13(5.9 %)	
Severe(≥ 20)	5(0.6 %)	1(0.2 %)	4(1.8 %)	

\*\*  $p < .01$

Table 3 shows the results of the multivariable ordinal logistic regression analysis. The final model analysis showed that among the sociodemographic characteristics in Model 1, age was a significant factor; increasing age was significantly associated with a reduced risk of menstrual cycle irregularity (odds ratio [OR] = 0.887, confidence interval [CI] = 0.832–0.944). Among the lifestyle-related variables, both weight-controlling efforts (OR = 2.860, CI = 1.176–6.954) and irregular eating (OR = 1.551, CI = 1.117–2.154) had significant associations with increased risk of menstrual cycle irregularity. In Model 2, sleep and stress were not significantly related to menstrual cycle irregularity. Lastly, Model 3 verified the association of depressive symptoms with menstrual cycle regularity, after controlling for the confounding variables, and the more severe the depressive symptoms, the higher the risk of menstrual cycle irregularity (OR = 1.078, CI = 1.021–1.139).

**Table 3. Odds ratio (OR) and 95 % confidence interval (CI) for menstrual cycle irregularity in the multivariable ordinal logistic regression**

	Model 1		Model 2		Model 3	
	OR	95 % CI	OR	95 % CI	OR	95 % CI
Age	0.887***	0.832–0.944	0.880***	0.826–0.939	0.877***	0.822–0.936
Marital status						
Unmarried (ref)						
Married or other status	1.275	0.468–3.473	1.386	0.505–3.802	1.490	0.538–4.125
Annual income						
(₩10,000) < 20,000 (ref)						

20,000–29,999	0.733	0.340–1.582	0.724	0.335–1.565	0.699	0.322–1.516
≥ 30,000	0.764	0.296–1.973	0.789	0.305–2.044	0.749	0.287–1.954
Menarcheal age (years)	1.033	0.935–1.141	1.036	0.937–1.146	1.059	0.956–1.174
BMI	1.037	0.979–1.098	1.034	0.975–1.095	1.032	0.973–1.094
Effort to control weight						
No (ref)						
Effort to gain wt	1.304	0.848–2.004	1.293	0.840–1.991	1.315	0.852–2.031
Effort to maintain wt	0.983	0.563–1.716	0.987	0.565–1.726	1.037	0.592–1.818
Effort to lose wt	2.860*	1.176–6.954	2.520*	1.021–6.221	2.319	0.930–5.781
Drinking frequency						
No (ref)						
Less than twice a month	0.680	0.388–1.191	0.673	0.384–1.180	0.675	0.383–1.189
2–4 times a month	0.687	0.387–1.220	0.679	0.382–1.208	0.691	0.387–1.234
≥ 5 times a month	1.384	0.709–2.702	1.378	0.704–2.697	1.432	0.727–2.817
Regular eating						
Yes (ref)						
No	1.551 **	1.117–2.154	1.488*	1.067–2.075	1.431*	1.023–2.001
Regular exercise						
Yes (ref)						
No	1.029	0.706–1.500	1.009	0.691–1.473	1.019	0.696–1.493
Sleep			1.005	0.964–1.048	0.972	0.926–1.021
Stress			1.029	0.997–1.061	0.999	0.962–1.038
Depressive symptoms					1.078**	1.021–1.139
Nagelkerke R <sup>2</sup>	0.100		0.106		0.117	
Chi/df	61.514/14		65.490/16		72.869/17	

Note: BMI: body mass index

\*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

#### 4. DISCUSSION

We confirmed that the prevalence of menstrual cycle irregularity is high (25 %) among community women of childbearing age. This rate is much higher compared to the 14.3 % reported in a study that used weighted-population data on women aged 19–40 years, and the 17.8 % reported in the Tehran Lipid and Glucose Study on 2128 women, aged 18–49 years [2, 3]. These findings, therefore, call for continuous monitoring of the prevalence of menstrual cycle irregularity among community women of childbearing age.

The prevalence of depressive symptoms among participants in the current study was 41.2 %, which is considerably higher than those among Korean female adults aged 19–29 years (8.2 %) and 30–39 years (6.4 %), as well as American female adults, aged 20–30 years (10.1 %) [12, 13, 17]. The high prevalence of depressive symptoms among our participants may be attributable to the fact that a PHQ-9 score of 5 or higher was deemed to indicate mild depressive symptoms, unlike the cut-off of 10 or higher in a study by Shin et al. [12]. However, the proportion of our participants with a PHQ-9 score of 10 or higher (16.6 %), was also higher than that reported in previous studies, suggesting that the elevated levels of depression among community women of childbearing age warrant attention.

To determine the association of depressive symptoms with menstrual cycle irregularity, we performed a multivariable ordinal logistic regression, controlling for the confounding variables, and found that depressive symptoms are associated with menstrual cycle irregularity. In line with previous studies that identified an

association between depressive symptoms and irregular menstrual cycles among women aged 19–40 years and teenagers aged 12–18 years [3,10], our findings confirm that depressive symptoms are slightly associated with menstrual cycle irregularity. The findings of the Pregnancy Study Online reported that women with severe depressive symptoms at baseline, regardless of the use of psychotropic medication, were 1.8 times more likely to have irregular menstrual cycles compared to women with moderate to low depressive symptoms in the follow-up study [18]. Thus, to improve the reproductive health of community women at childbearing age, it is necessary to not only reduce the prevalence of depression but also for society to make efforts to prevent mild symptoms from developing into severe depression. A combined effort from the government and local community through various mediation efforts, such as virtual counselling programmes and support groups for those at a high risk of depression, would be a good start.

Besides depressive symptoms, increasing age showed decreased ORs for menstrual cycle irregularity in a previous study. This result is consistent with a report that the prevalence of irregular menstrual cycles decreases with age [3]. Meanwhile, another study on nulliparous women aged 18–40 years found an association between increasing age and irregular menstrual patterns [7]. Therefore, future studies must investigate this association according to parturition history. Among the control variables, irregular eating habits were also related to 1.43 times higher risk of menstrual cycle irregularity (OR = 1.431, CI = 1.023–2.003). This is consistent with Fujiwara et al.'s study, which showed that the incidence of menstrual irregularity and disorders among female college students who skip breakfast is significantly higher compared to students who do not skip breakfast [19]. Moreover, the results on the association of poor eating and dietary habits with women's reproductive health are in keeping with a previous study's finding [20]. Young women of childbearing age are at a higher risk of frequent meal skipping due to weight loss intentions or school/work demands [21]. Considering our participants' mean age (24 years), it is necessary to strengthen the education and awareness of this young group at the societal level to improve such modifiable risk factors.

In this study, stress was not associated with menstrual cycle irregularity. While some studies have linked stress to the dysregulation of the HPA axis and identified it as a significant predictor of menstrual cycle irregularity, another study observed that only a high level of stress (PSS-10 score > 20) is associated with menstrual cycle irregularity [3, 22]. Thus, future studies should examine the effects of stress on menstrual cycle irregularity to confirm this association.

A key strength of this study is that it sheds light on the predictors of menstrual cycle irregularity among community women of childbearing age—a population that has not received much research interest in the past. However, the following limitations must also be considered. First, as this study was cross-sectional, we could not establish causal links between the factors and menstrual cycle irregularity. Therefore, longitudinal studies are needed in the future to make causal inferences. Second, this study only identified the association between depressive symptoms and menstrual cycle irregularity, without controlling for the effect of endocrine function on menstrual cycle irregularity. Future studies should address this issue by including and controlling for variables related to participants' endocrine function.

## 5. CONCLUSION

This study confirmed the prevalence of menstrual cycle irregularity among community women of childbearing age in Korea, and identified the association between menstrual cycle irregularity and depressive symptoms. We found out that the prevalence of menstrual cycle irregularity among our participants was 25%, and depressive symptoms, age, and irregular eating habits were significantly associated with menstrual cycle

irregularity. After adjusting for confounding variables, participants with depressive symptoms were at a slightly higher risk of menstrual cycle irregularity (odds ratio = 1.078, confidence interval = 1.021–1.139). However, stress was not associated with menstrual cycle irregularity. Thus, to improve their reproductive health, the prevalence of depressive symptoms among community women of childbearing age must be carefully monitored, and future studies should examine the effects of stress on menstrual cycle irregularity to confirm this association.

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