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Actual Sleep Conditions from the Last Trimester of Pregnancy to Three Months Postpartum and the Associated Minor Problems

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Abstract: *Objective:* To investigate the actual sleep conditions at four time points from the last trimester of pregnancy to 3 months postpartum, and to examine the relationship between sleep and minor problems affecting sleep. *Methods:* A cross-sectional survey on the frequency of minor problems, Pittsburgh Sleep Quality Index (PSQI), and observations in a sleep diary was carried out on women at the end of pregnancy, 2 weeks postpartum, 1 month postpartum, and 3 months postpartum. The questionnaires were distributed to 165 participants. Correlation coefficients were obtained for each item and each scale, and the associations were analyzed. *Results:* The number of valid responses was 127. In the evaluation of sleep, sleep duration was the shortest and sleep quality was the lowest in the first month after delivery based on the PSQI score. In the correlation between "psychiatric symptoms" and sleep, women with anxiety and nervousness at the end of pregnancy were associated with poorer sleep quality. At all time-points, there was a significant association between "psychiatric symptoms" and poor sleep quality. *Conclusion:* An association exists between "psychiatric symptoms" and poor sleep quality in women from the last trimester of pregnancy to 3 months postpartum.

Keywords: Postpartum; Sleep quality; Pregnancy

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1. Introduction

From early pregnancy to the last trimester of pregnancy and postpartum, there is significant change in the dynamics of hormone secretion for the maintenance of pregnancy and breast milk production [1]. Sleepiness and lethargy in women occur due to progesterone secretion from the placenta. In the last trimester of pregnancy, the inability to sleep normally due to enlarged uterus, back pain, fetal movements, and nocturia increases nocturnal arousals, thus resulting in shallow sleep [1,2]. In addition, during gestational and postpartum periods, women tend to experience minor physical and psychological problems due to physiological changes [3-5]. On average, the number of "minor problems" experienced by a woman during the entire period of pregnancy has been reported to be 27 [3]. After the second trimester, physical changes and minor problems such as an enlarged abdomen, fetal movements, back pain, and frequent urination often interrupt sleep and may prevent sleep fulfillment [6-8]. In the postpartum period, there is a sense of responsibility, tension, and anxiety arising from the accumulation of fatigue during delivery, breastfeeding,

unfamiliarity to childcare, changes in marital relationship, and the sense of being a mother [9-10]. Hormonal fluctuations before and after childbirth are significant, with symptoms of minor problems changing from time to time [8] and being continuously observed [11]. Furthermore, in view of the accompanying changes in roles and lifestyle due to childbirth, women do not get enough rest and sleep, especially from the last trimester of pregnancy to the postpartum period [12]. In recent years, the number of women with little experience in child rearing has increased due to the declining birth rate and the increase in nuclear families. Although women tend to have close counselors and supporters during pregnancy [13], the reality is that specific explanations on sleep during pregnancy are not provided by midwife in outpatient clinics, leading to health problems for expectant and nursing mothers [4,5]. Therefore, we believe that nursing professionals should emphasize on health education and improve the quality of nursing care by understanding the relationship between sleep status and physical and psychological symptoms in women from the end of pregnancy to the postpartum period.

In light of that, we conducted a survey on sleep among women from the last trimester of pregnancy to the child-rearing period and examined the relationship between sleep quality and symptoms of minor problems as a factor affecting sleep quality.

2. Definition of terms

Sleep quality: An assessment of current sleep status using the Japanese version of Pittsburgh Sleep Quality Index, with subjective and objective indicators.

Minor problems: Uncomfortable symptoms that occur in the body due to hormonal fluctuations during pregnancy and in the postpartum period.

3. Methods

3.1. Research design

From April 2020 to June 2020, we carried out a self-administered, anonymous questionnaire survey for this cross-sectional study.

3.2. Study participants

We included first-time mothers and postpartum women between the 8th month (28 weeks) of pregnancy and 3 months postpartum who consented to this study. The four time points were the last trimester of pregnancy (28 weeks or later), 2 weeks postpartum, 1 month postpartum, and 3 months postpartum. Inclusion criteria: women after 8 months of pregnancy, when various symptoms occur due to physical changes, and around 3 months postpartum, when breastfeeding and child's sleep are established (the period between these two periods is considered to be the time when women undergo significant physical changes and experience irregular sleep, which may affect their physical and mental health). Exclusion criteria: (i) history of mental illness, (ii) history of insomnia, (iii) smoked or drank alcohol before the mid-pregnancy period, and (iv) obese with a body mass index (BMI) of 25 or higher. The survey was carried out in 165 women (about 40 at each time period), taking into account those who dropped out due to incomplete data and the minimum number of subjects needed for statistical analysis is 20 at each time period [14].

3.3. Recruitment

The survey was carried out in two obstetrics and gynecology clinics in prefecture A and 1 midwifery center in prefecture B. Visitors to motherhood classes, 2-week postpartum health checkups, 1-month postpartum health checkups, and 3-month postpartum breastfeeding consultations at each collaborating institution were given a written and verbal explanation of the study and asked to cooperate in the survey. The purpose, objectives, methods, and ethical considerations of the study were explained to the participants who gave

their consent, using the explanatory text of the study. The participants were asked to fill in the consent column to confirm their agreement to cooperate in the study on the written form of the unregistered self-administered questionnaire, an "L" was in the consent column when consent was given.

3.4. Contents of questionnaire

(i) Demographics: age, history of pregnancy, history of childbirth, expected date of childbirth, number of weeks of pregnancy, sleeping conditions, postnatal living conditions, and number of breastfeeding sessions.

(ii) Symptoms of minor problems (45 symptoms) [3-5,15-16]: (a) general and neuropsychiatric symptoms (easily fatigue, drowsiness, malaise, irritability, anxiety, emotional instability, decreased thinking, forgetfulness, headache, depression, tension, low motivation, weight gain, and weight loss); (b) joint and motor system symptoms (stiff shoulders, back pain, and pelvic pain); (c) urinary and genitourinary symptoms (frequent urination, incontinence, residual urine, and pubic discomfort); (d) digestive symptoms (constipation, diarrhea, increased appetite, anorexia, abdominal distention, nausea, heartburn, abdominal pain, hemorrhoids); I circulatory, respiratory, and vasomotor symptoms (cold extremities, edema, palpitations, shortness of breath, chest pain, dizziness, hot flashes, and sweating); (f) skin and sensory symptoms (skin dryness, itching, dullness, increased body hair, hair loss, and tinnitus). With reference to previous literature, these symptoms are common and frequent symptoms of minor problems during pregnancy and postpartum. A five-point Ritz-Cart scale was used according to the frequency of occurrence of each symptom: "1," not at all; "2," occasionally, about once a week; "3," several times, every 3 to 5 days; "4," often, every 1 to 2 days; and "5," always. A table for each item was created.

(iii) Pittsburgh Sleep Quality Index – Japanese version (PSQI-J) [17-19] (the PSQI scale was developed by Buysse *et al*. in 1989, and the reliability and validity of the Japanese version had been examined by Doi *et al*. [9]; PSQI has been used in many domestic and international studies as a measure of sleep quality): a total of 7 items including sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, use of sleeping medications, and daytime sleepiness in the past month, with scores ranging from 0 to 3 points and a total score of 21 points. A higher total score indicates a subjective decrease in sleep quality, and a score of 5.5 or higher indicates the presence of a sleep disorder.

(iv) Sleep diary: An investigation of the subject's sleep status during the period in terms of time occupied by sleep. The subjects were asked to describe their habitual daily living conditions during that period, such as sleeping hours as a daily routine for each period, frequency of awakenings during nighttime sleep, nap times during the day, meal times, number of feedings, and time spent doing household chores.

3.5. Survey methodology

Three midwifery researchers with master's degrees or above checked and revised the sentences in the survey form and the time required to complete the questionnaire. After explaining the content of the study, questionnaires were distributed to subjects in the last trimester of pregnancy, 2 weeks postpartum, 1 month postpartum, and 3 months postpartum, who consented to this study, in the waiting room of the collaborating institution for about 20 minutes per subject. The questionnaires were collected on the same day. For some who were 3 months postpartum, the questionnaires were collected by mail.

3.6. Statistical analysis

Statistical package software IBM SPSS 26.0 was used for data analysis, with a statistical significance level of less than 5%. Descriptive statistics were performed for each item in the questionnaire. The data were calculated, and the normality of each item was checked using Shapiro-Wilk test. For the correlation between each item and scale, Pearson's product-rate correlation coefficient was used for normality, and Spearman's

rank correlation coefficient was used for non-normality [20].

3.7. Ethical considerations

The study was conducted with the approval of the Ethical Review Committee of Shiga University of Medical Science (Approval no. R2019-287; date of approval, March 23, 2020).

4. Results

4.1. Target population

The 165 women who consented to this study were distributed as follows: 41 in the last trimester of pregnancy, 44 at 2 weeks postpartum, 43 at 1 month postpartum, and 37 at 3 months postpartum. The total number of valid responses was 127, and the valid response rates for each period were as follows: 34 (82.9%) for the last trimester, 28 (63.6%) for the first 2 weeks of postpartum, 35 (81.4%) for the first month of postpartum, and 30 (81.1%) for the third month of postpartum.

4.2. Demographics

The mean age of the participants at the end of pregnancy, 2 weeks postpartum, 1 month postpartum, and 3 months postpartum was 32.6 ± 5.0, 31.8 ± 3.9, 32.1 ± 4.0, and 31.0 ± 3.8, respectively. There were 14 (41.2%) women aged 35 or older at the last trimester of pregnancy, 8 (28.6%) at 2 weeks postpartum, 10 (28.6%) at 1 month postpartum, and 6 (20.0%) at 3 months postpartum. The proportion of first-time mothers to those who had given birth previously was about half in the last trimester and 2 weeks postpartum, while there were more first-time mothers who were in their 1 month and 3 months postpartum periods.

Among the postpartum women in the study, the highest mean total number of feedings per day was 8.9 ± 1.6 in the 2-week postpartum period. The mean number of night feedings was also highest among 2-week postpartum women at 2.8 ± 0.7 times. The details are shown in **Table 1**.

Table 1. Demographics and breastfeeding frequency by time period

		End of pregnancy n = 34		**2 weeks postpartum** n = 28		**1 month postpartum** n = 35		**3 months postpartum** n = 30	
Age	Mean ± SD	32.6 ± 5.0		31.8 ± 3.9		32.1 ± 4.0		31.0 ± 3.8	
		n	%	n	%	n	%	n	%
	Under 35 years old	20	58.8	20	74.4	25	74.4	24	80.0
	Over 35 years old	14	41.2	8	28.6	10	28.6	6	20.0
History of childbirth	Primipara	19	55.9	14	50.0	23	65.7	22	73.3
	Multipara	15	44.1	14	50.0	12	34.3	8	26.7
Number of feedings	Total feedings per day			8.9 ± 1.6		8.8 ± 1.9		8.4 ± 2.0	
Number of night feedings	Mean age ± SD			2.8 ± 0.7		2.7 ± 1.0		2.3 ± 1.4	

4.3. Mean sleep duration

The mean sleep duration of women at the last trimester, 2 weeks postpartum, 1 month postpartum, and 3 months postpartum was 7.2 ± 1.6 hours, 6.9 ± 2.0 hours, 5.9 ± 1.3 hours, and 6.4 ± 1.5 hours, respectively; women at 1 month postpartum had the shortest sleep duration (**Table 2**). There were eight women (23.5%) at the end of pregnancy who slept less than 6 hours, 9 (32.1%) at 2 weeks postpartum, 25 (71.4%) at 1

month postpartum, and 18 (60.0%) at 3 months postpartum. There were 10 women (28.5%) at 1 month postpartum who slept 7 to 9 hours a night and 11 (36.7%) at 3 months postpartum. 60%–70% of the women averaged less than 6 hours of sleep at 1 month and 3 months postpartum (**Table 2**).

Table 2. Distribution of average sleeping hours by time period

Sleep time	**End of pregnancy**		**2 weeks postpartum**		**1 month postpartum**		**3 months postpartum**	
	n = 34		n = 28		n = 35		n = 30	
Mean ± SD	7.2 ± 1.6		6.9 ± 2.0		5.9 ± 1.3		6.4 ± 1.5	
	n	%	n	%	n	%	n	%
Less than 6 hours	8	23.5	9	32.1	25	71.4	18	60.0
7 hours	9	26.5	10	35.7	6	17.1	6	20.0
8–9 hours	16	47.1	8	28.6	4	11.4	5	16.7
More than 10 hours	1	2.9	1	3.6	0	0	1	3.3

4.4. Pittsburgh Sleep Quality Index – Japanese Version (PSQI-J) scores

The mean score of women at the end of pregnancy, 2 weeks postpartum, 1 month postpartum, and 3 months postpartum was 5.5 ± 3.1, 6.2 ± 2.8, 6.6 ± 3.2, and 5.8 ± 2.9, respectively (**Table 3**).

Table 3. PSQI-J scores by time period

PSQI-J score		**End of pregnancy**		**2 weeks postpartum**		**1 month postpartum**		**3 months postpartum**	
		n = 34		n = 28		n = 35		n = 30	
Mean ± SD		5.5 ± 3.1		6.2 ± 2.8		6.6 ± 3.2		5.8 ± 2.9	
		n	%	n	%	n	%	n	%
Less than 6 points	No sleep disorder	18	52.9	12	42.9	12	34.3	15	50.0
6–8 points	Mild sleep disorder	12	35.3	12	42.9	14	40.0	9	30.0
9 points or more	Severe sleep disorder	4	11.8	4	14.3	9	25.7	6	20.0

Abbreviation: PSQI-J, Pittsburgh Sleep Quality Index – Japanese version; SD, standard deviation.

4.5. Relationship between sleep duration and sleep quality (PSQI) in women at each period from the last trimester to 3 months postpartum

There was a negative correlation between sleep duration and sleep quality in women at the end of pregnancy (r = -0.58, $P < 0.001$), 2 weeks postpartum (r = -0.67, $P < 0.001$), 1 month postpartum (r = -0.61, $P < 0.001$), and 3 months postpartum (r = -0.38, $P = 0.039$). It can be said that the shorter the sleep duration, the poorer the sleep quality (**Table 4**).

Table 4. Correlation coefficients between sleep duration and PSQI-J scores by time period

	r	***P***
last trimester of pregnancy	-0.58**[b]	< 0.001
2 weeks postpartum	-0.67**[b]	< 0.001
1 month postpartum	-0.61**[a]	< 0.001
3 months postpartum	-0.38*[b]	0.039

Note: [a]Pearson's product-moment correlation coefficient; [b]Spearman's rank correlation coefficient; *$P < 0.05$; **$P < 0.01$.

4.6. Minor problems

4.6.1. Perceived minor problems by time period

The median and quartile range of symptom frequency were determined, and symptoms were classified by site, except for symptoms with a score of 1 or less in each time period. Symptoms with the highest values in each time period are shown in order (**Table 5**). The common symptoms of minor problems with 3 or more points among women at the four time points were easily fatigue and drowsiness; at the end of pregnancy, there were 9 common symptoms, including easily fatigue, drowsiness, malaise, back pain, frequent urination, constipation, edema, dry skin, and itchy skin; at 2 weeks postpartum, there were 4 common symptoms, including easily fatigue, drowsiness, stiff shoulders, and constipation; at 1 month postpartum, there were 6 common symptoms, including easily fatigue, drowsiness, malaise, stiff shoulders, back pain, and dry skin; at 3 months postpartum, there were 5 common symptoms, including easily fatigue, drowsiness, stiff shoulders, back pain, and dry skin.

Table 5. Median and quartile range for minor problems by time period

Symptoms	**End of pregnancy**		**2 weeks postpartum**		**1 month postpartum**		**3 months postpartum**	
	n = 34		n = 28		n = 35		n = 30	
	Median	Quartile range	Median	Quartile range	Median	Quartile range	Median	Quartile range
General and neuropsychiatric								
Easily fatigue	4.0	3.00–4.00	3.0	2.00–4.00	3.0	2.00–4.00	4.0	3.00–4.00
Drowsiness	3.5	3.00–4.00	3.0	2.00–4.00	4.0	3.00–5.00	3.0	3.00–4.25
Malaise	3.0	2.75–4.00	2.0	1.00–3.00	3.0	2.00–4.00	2.0	1.00–3.00
Irritability	2.0	1.75–3.00	2.0	1.25–3.00	2.0	1.00–3.00	2.5	1.00–2.00
Anxiety	2.0	2.00–3.00	2.0	2.00–3.00	2.0	1.00–3.00	2.0	1.00–3.00
Emotional instability	2.0	2.00–3.00	2.0	1.00–3.00	2.0	1.00–3.00	2.0	1.00–3.00
Decreased thinking	2.0	1.00–3.00	1.0	1.00–2.75	2.0	1.00–2.00	2.0	1.00–3.00
Forgetfulness	2.0	1.00–3.00	1.0	1.00–2.00	2.0	1.00–3.00	2.0	1.00–3.00
Headache	2.0	1.00–2.00	2.0	1.00–2.75	2.0	1.00–2.00	1.5	1.00–2.00
Depression	2.0	1.00–2.25	1.5	1.00–2.00	1.0	1.00–3.00	2.0	1.00–2.00
Low motivation	2.0	1.00–3.00	1.0	1.00–2.00	1.0	1.00–2.00	1.0	1.00–2.00
Tension	2.0	1.00–3.00	1.0	1.00–2.00	2.0	1.00–3.00	1.0	1.00–2.00
Joint and motor								
Stiff shoulders	2.0	2.00–4.00	4.0	2.00–5.00	5.0	3.00–5.00	3.5	2.00–5.00
Back pain	4.0	2.00–4.00	2.5	2.00–4.00	3.0	2.00–4.00	3.0	2.00–4.00
Urinary system								
Frequent urination	4.0	2.00–4.25	1.0	1.00–2.00	1.0	1.00–2.00	1.0	1.00–2.00
Digestive system								
Constipation	3.0	2.00–4.00	3.0	1.00–4.00	2.0	1.00–3.00	2.0	1.00–3.00
Increased appetite	2.0	1.00–4.00	2.0	1.00–3.00	2.0	1.00–3.00	2.0	1.00–4.00
Cardiovascular system								
Cold extremities	2.5	1.75–4.00	2.0	1.00–4.00	2.0	1.00–4.00	2.0	1.00–4.00
Edema	3.0	2.00–4.00	2.0	1.00–3.00	1.0	1.00–3.00	1.0	1.00–2.25
Skin and sensory								
Skin dryness	3.0	2.00–4.00	2.0	1.25–4.00	3.0	2.00–5.00	3.0	1.00–4.00
Itchy skin	3.0	2.00–4.00	1.5	1.00–3.75	2.0	1.00–3.00	2.5	1.75–3.25

4.6.2. Relationship between minor problems and both sleep duration and sleep quality (PSQI)

In the last trimester of pregnancy, there was a significant association between poor sleep quality and anxiety (r = 0.43, *P* = 0.012) and tension (r = 0.39, *P* = 0.023). At 2 weeks postpartum, there was a significant association between decreased sleep quality and anxiety (r = 0.48, *P* = 0.010). At 1 month postpartum, decreased sleep was negatively associated with anxiety (r = -0.37, *P* = 0.031) and tension (r = -0.41, *P* = 0.014); there was also significant association between poor sleep quality and anxiety (r = 0.40, *P* = 0.016), tension (r = 0.50, *P* = 0.002), drowsiness (r = 0.46, *P* = 0.006), and depression (r = 0.41, *P* = 0.014). At 3 months postpartum, decreased sleep quality was significantly associated with anxiety (r = 0.57, *P* = 0.001), depression (r = 0.56, *P* = 0.001), and emotional instability (r = 0.55, *P* = 0.002). Details are shown in **Table 6**.

Table 6. Correlation coefficients between minor problems and sleep duration and PSQI by time period

			Hours of sleep		**PSQI-J score**	
	n		r	*P*	r	*P*
Last trimester of pregnancy	34	Anxiety			0.43*	0.012
		Tension			0.39*	0.023
2 weeks postpartum	28	Anxiety			0.48*	0.010
1 month postpartum	35	Anxiety	-0.37*	0.31	0.40*	0.016
		Tension	-0.41*	0.14	0.50**	0.002
		Drowsiness			0.46**	0.006
		Depression			0.41**	0.014
3 months postpartum	30	Anxiety			0.57**	0.001
		Depression			0.56**	0.001
		Emotional instability			0.55**	0.002

Note: r, Spearman's rank correlation coefficient; *$P < 0.05$; **$P < 0.01$.

5. Discussion

5.1. Actual sleep condition of women from the last trimester of pregnancy to 3 months postpartum

In the present study, the average sleep duration in the last trimester of pregnancy is similar to that observed in previous studies [21,22] and to the average sleep duration during non-pregnancy as reported by the National Survey of Hours of Living [23]. Sleep is induced by sex hormones secreted by the placenta. Since the last trimester of pregnancy is a period of marked abdominal enlargement and major physical changes, about 8 hours of sleep is necessary during the gestational period [24,25]. However, it is clear that women do not get enough sleep in this period.

In our present study, the average sleep duration of women in the first month after delivery was the shortest among the other periods; this finding is similar to previous studies [26]. We believe that unfamiliarity to childcare, breastfeeding, irregular sleep-wake rhythm of the newborn, and a sense of responsibility as a mother [27] may have contributed to the decrease in sleep duration during the first month after delivery. A decrease in sleep duration during the first month postpartum affects the mother's physical and mental health, causing maternal fatigue, poor concentration, and lethargy. For a woman to maintain her health without excessive daytime sleepiness and without disrupting her life, 7–9 hours of sleep are needed [21,28]. In the present study, 60% of women in the last trimester of pregnancy and the first 2 weeks of postpartum slept 7–9 hours; 71.4% of women in the first month after delivery and 60.0% in the third month after delivery slept 6 hours or less. These results showed that many women in the first to third month after delivery sleep extremely little, with little or no decrease in the number of nighttime feedings or feedings per day,

suggesting that sleep duration may be inadequate over several months. Persistent sleep deprivation has been linked to postpartum depression [29]. Lifestyle guidance on sleep should be provided from the time of pregnancy to promote the mother's physical and mental stability as well as mother-child relationship; in addition, their sleep status should be inquired during examinations; after childbirth, it is necessary to provide lifestyle and sleep guidance that takes into account of life with the child.

5.2. PSQI scores of women from the last trimester of pregnancy to 3 months postpartum

In terms of women's sleep quality from the last trimester of pregnancy to 3 months postpartum based on PSQI, we found that the mean PSQI score from the last trimester of pregnancy to the third month postpartum was 5.5 or higher. Among the four time points, the highest score was observed in women at 1 month postpartum, indicating that their sleep quality was poor. In addition, we also found that women in the first month of postpartum had the shortest sleep duration, thus further indicating poor sleep quality.

The classification of "sleep disturbances" by PSQI indicated that about half of the mothers in the study had sleep disturbances. Mindell *et al*. [7] found that 83.5% of women had sleep disturbances at 8 months of gestation [7]. In addition, Rinko *et al*. [29] stated that the frequency of sleep disturbances is high in women by about 12 weeks of delivery. Sleep disturbance is a condition in which there are some problems with sleep that last for more than one month. There are about 100 sleep-related illnesses and a variety of sleep disorders that interfere with daily life due to insomnia or daytime sleepiness [30]. Tomfohr *et al*. [31] reported that in a group with high PSQI scores during pregnancy, the patients were treated for depression during pregnancy and subsequently experienced postpartum depression. The major changes in physical and mental health during pregnancy and in the postpartum period tend to disrupt sleep habits, which can easily lead to physical and mental alterations [12]. It is necessary to understand the daily life of women in pregnancy and after delivery as well as provide health guidance based on the individual's background beginning from the pregnancy period.

5.3. Sleep and minor problems in women from the last trimester of pregnancy to three months postpartum

In our study, no association was found between sleep and "physical symptoms" at all time points, but in terms of "psychiatric symptoms," women with anxiety and tension in the last trimester of pregnancy were found to be associated with poorer sleep quality. Among women at 1 month postpartum, anxiety and tension were associated with decreased sleep duration, and drowsiness, tension, anxiety, and depression were associated with poor sleep quality. In women at the 3 postpartum time points, "psychiatric symptoms" were associated with poor sleep quality.

Hormone secretion, which is usually highest in the last trimester to maintain pregnancy, declines rapidly after delivery. In the postpartum period, prolactin and oxytocin are secreted in pulses during breastfeeding. This rapid change in hormonal dynamics can destabilize mental health. It has been suggested that the "physical symptoms" and "psychiatric symptoms" of minor problems in pregnancy, childbirth, and postpartum may be caused by hormones [32] and the "psychiatric symptoms" of minor problems are exacerbated by decreased sleep time and poor sleep quality during pregnancy and in the postpartum period. The occurrence of daytime sleepiness and "psychiatric symptoms" resembled symptoms of sleep disturbances. Women's perception of symptoms is an indicator of sleep deprivation. In light of that, it is necessary to solve this problem through health education, so that sleep quality-improving self-care behaviors can be habituated from the period of pregnancy.

6. Limitations of this study and prospects

In this study, the results of minor problems may not have sufficient validity in view of the use of a self-

made scale. Another limitation of this study is that sleep duration was self-reported and thus cannot be deemed as objective data. In the future, a longitudinal study should be conducted to ensure reliability, and comparisons should be made at each time period using continuous data to confirm the relevance of data on an individual basis.

7. Conclusions

(i) The average sleep duration at the end of pregnancy is similar to that of non-pregnant women.
(ii) Women who are anxious and tense during the last trimester of pregnancy are associated with poorer sleep quality.
(iii) 60%–70% of women in the first and third month after delivery sleep less than 6 hours on average.
(iv) Postpartum "psychiatric symptoms" of minor problems, such as anxiety, tension, and depression, are associated with poor sleep quality.
(v) Sleep is not associated with "physical symptoms" of minor problems at all time points.

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Disclosure statement

The authors declare no conflict of interest.

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