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Sleep quality and stress in women with pregnancy-induced hypertension and gestational diabetes mellitus

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ABSTRACT

Background: Pregnant women with complications including pregnancy-induced hypertension (PIH) and gestational diabetes mellitus (GDM) often experience disrupted sleep patterns because of activation of the sympathetic nervous system. These pathologies are aggravated by sympathetic nervous system activation and may be related to stress. The present study aimed to clarify the characteristics of and changes in sleep quality and stress in pregnant women with PIH and GDM during the second and third trimesters.

Methods: We enrolled 56 women in their second or third trimesters who were diagnosed with PIH or GDM. Participants completed questionnaires, including the Pittsburgh Sleep Quality Index (PSQI) and the Perceived Stress Scale (PSS). Secretory immunoglobulin A (SIgA) concentrations were measured as a biological indicator of stress.

Results: PSS scores and subjective stress parameters were significantly higher than those reported from previous studies of healthy pregnant women (15.2 points and 15.1 points for the second and third trimesters, respectively).

Mean one-day values for SIgA were 168.3 and 205.7 μg/mL for the second and third trimesters, respectively. During the second and third trimesters, SIgA scores were higher than those reported for healthy pregnant women in previous studies. The PSQI component scores sleep disturbance (C5) and sleep duration (C3) in follow up case were significantly higher in the third trimester than in the second trimester.

Discussion: This investigation suggests that pregnant women with PIH and GDM experience higher stress levels than do non-pregnant women and healthy pregnant women. Further, our results indicate that sleep quality worsens during the third trimester compared with the second trimester.

1. Introduction

According to the Japan Society of Obstetrics and Gynaecology database, the incidence of pregnancy-induced hypertension (PIH) from 2005 to 2009 was 4.6%,[1] while that of gestational diabetes mellitus (GDM) was between 2.4% and 6%.[2,3] Sympathetic nervous system activation, insulin resistance, and hyperlipidaemia are involved in PIH and GDM. These conditions, which are often observed in lifestyle diseases such as hypertension, atherosclerosis (hyperlipidaemia), diabetes, and obesity may be related.[4,5] Activation of the sympathetic nervous system[6] in PIH disrupts circadian rhythms and increases wakefulness after sleep onset at night, impairing sleep patterns.[7] In addition, insomnia often occurs in adult diabetic patients.[8] Therefore, it appears that a lifestyle that includes a regular routine and good quality sleep during pregnancy is important in preventing perinatal abnormalities in women with lifestyle disease-like pathologies such as PIH and GDM.

An experiment in pregnant rats determined that the sympathetic nervous system is activated by stress.[9] Secretory immunoglobulin A (SIgA) is used as a biological marker of stress, because increased sympathetic nerve activity in response to acute stress enhances its secretion.[10] Therefore, SIgA may increase in pregnant

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women who have PIH and/or GDM, as these conditions involve increased sympathetic nerve activity.

Furthermore, maternal stress has been demonstrated to be an important risk factor for adverse pregnancy and birth outcomes, and is associated with gestational hypertension and changes in various physiological systems, including the autonomic nervous and endocrine systems. In particular, increased stress reactivity during pregnancy is associated with increased risks of preterm birth and low birth weight.[11,12]

Thus far, no studies have investigated the correlation between pregnancy and sleep–wake rhythms, sleep quality, and stress. Therefore, the present study was conducted to clarify the characteristics of and changes in sleep quality and stress in pregnant women with PIH and GDM during the second and third trimesters.

2. Methods

2.1. Subjects

We enrolled 56 pregnant women for this study from among subjects who were attending prenatal checkups at a University Hospital from February 2009 until April 2012. Women enrolled in the study were diagnosed with the pregnancy-related complications of PIH and/or GDM by an obstetrician at obstetric outpatient clinics during the second trimester (defined as 16 weeks, 0 days to 27 weeks 6 days) or the third trimester (defined as 28 weeks, 0 days to 40 weeks 6 days). In this study, 40 women were diagnosed with a complication in the second trimester of pregnancy, 27 of whom participated in a follow-up survey during their third trimester, and 16 women were diagnosed with a complication in the third trimester.

The aim of the research was explained to the study participants who were diagnosed with a pregnancy-related complication at an obstetric outpatient clinic, and written informed consent was obtained from each participant before enrolment in the study.

2.2. Survey methods

All study participants were asked to complete a questionnaire regarding their characteristics and lifestyles, as well as the Pittsburgh Sleep Quality Index (PSQI) and the Perceived Stress Scale (PSS), and saliva samples were obtained for SIgA measurements. Medical information regarding a subject's diagnosis, treatment course, delivery style, number of gestational weeks, birth weight, delivery abnormalities, and postpartum course was obtained from medical records. The survey was initiated in the second trimester because pregnancy complications usually develop during the third trimester, and severe cases often experience the onset of complications during the second trimester that may lead to premature births.

2.3. Pittsburgh Sleep Quality Index

The PSQI is a self-rated questionnaire, which evaluates sleep quality, and was developed by the Department of Psychiatry at the University of Pittsburgh, Pennsylvania, USA.[13] The Japanese version created by Doi et al.,[14] is a self-completed questionnaire comprising 18 items. Each item is scored on a scale from 0 to 3, using a 4-level Likert scale, for each of the following 7 elements: sleep quality (C1, subjective sleep quality in the past month), sleep latency (C2, time from going to bed until falling asleep; scoring of sleep latency), sleep duration (C3, scoring of sleeping duration), habitual sleep efficiency (C4, proportion of hours spent asleep in bed), sleep disturbance (C5, scoring of the frequency of items that relate to sleep difficulties: nocturnal or early morning waking, waking to use the toilet, difficulty breathing, loud coughing or snoring, feeling cold, feeling hot, having bad dreams, and pain or other reasons, including foetal movement or breastfeeding), use of sleeping medication (C6, scoring the frequency of use), and daytime dysfunction (C7, scoring frequency of onset and enthusiasm get things done). The total scores were converted into an average PSQI global score (PSQIG), from 0 to 21 points. For each item, a higher score indicated greater sleep impairment and the total score cut-off value was 5.5 points.[13,14]

2.4. Perceived Stress Scale

The PSS is a questionnaire designed to evaluate subjective stress. The PSS-10 is composed of 10 items that are assessed using a 5-level Likert scale (0 points: never; 4 points: always). Hence, PSS scores range from 0 to 40 points, with higher scores indicating higher stress levels. Its reliability and internal validity have been verified,[15] and it is reliable in studies involving pregnant women. The questionnaire's reliability was verified in the present study by using an alpha coefficient of 0.80 for pregnant women in the second trimester and an alpha coefficient of 0.84 for pregnant women in the third trimester.[16]

2.5. Secretory immunoglobulin A

SIgA was measured as a biological indicator of stress. Saliva samples (1 mL) were taken by subjects at home 4-times a day for 3 days before breakfast, lunch, dinner, and before going to bed, because SIgA concentrations fluctuate throughout the day.[17] Saliva samples were stored in 1.5-mL Safe Lock Tubes at −20 °C in the subjects' freezers. Thawed saliva samples were centrifuged at 1500 rpm for 15 min at 4 °C. Quantitative measurements of SIgA concentrations were then conducted using an enzyme immunoassay kit (Salimetrics LLC, State College, PA, USA), and optical densities at 450 nm were determined using a spectrophotometer (Model 680, Bio-Rad Laboratories Japan, Inc., Tokyo, Japan). The intra- and inter-assay coefficient of variation were 2.13% and 2.90%, respectively.

2.6. Statistical analysis

The unpaired *t*-test evaluated differences between mean values in the second and third trimesters. The paired *t*-test evaluated differences between mean values of parameters in the second and third trimesters obtained from participants in their second trimesters who undertook follow-up surveys in their third trimesters. The χ^2 test was used to compare the expected frequencies with the observed frequencies for one or more categories, and a one-way analysis of variance (ANOVA) was used to compare diurnal variations in SIgA concentrations. The SPSS version 22.0 (SPSS, Inc., Chicago, IL, USA) was used for all statistical analyses.

We analysed the participants and grouped them based on their diagnoses in subgroups as follows: women with diabetes and GDM were placed in the diabetes mellitus (DM) group and those with high blood pressure and PIH were placed in the hypertension (HT) group.

2.7. Ethical considerations

The study was approved by the ethics committees of the Osaka University Graduate School of Medicine, Osaka, Japan and the Saitama Medical University, Saitama, Japan.

3. Results

The participants' backgrounds are summarised in Table 1.