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Original Article

Relationship between perceived sleep posture and subjective sleep quality: Changes related to progression of pregnancy

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Key words

pregnancy, sleep posture, subjective sleep quality

Abstract

The aim of present study was to clarify the relationship between changes in perceived sleep posture during progression of pregnancy and subjective sleep quality. A longitudinal study was conducted using questionnaires in the second and third trimesters. Pregnant women were recruited at one obstetric hospital in Tokyo, who were primipara, singleton pregnancy, and without severe complications. Completed questionnaires were returned by 201 (65.9%) women. Many items of the subjective sleep quality evaluation worsened in the third trimester compared with the second trimester. With regard to the perceived sleep posture, few women slept in supine position in the third trimester than the second. Sleep posture other than supine in the third trimester, and "Sleep posture is not free posture associated with enlargement of the breasts and abdomen" both in the second and third trimesters were associated with poor sleep quality. The results indicated that the perceived sleep posture varies with the progression of pregnancy and that it correlated with subjective sleep quality. Education about comfortable sleep during pregnancy should take into consideration that the perceived sleep posture relates to sleep quality.

Introduction

Human demonstrate gross body movements while asleep including shifts in body position. The number of gross movements and the length of time at each trunk direction vary widely in the same person and among individuals[1)].

For pregnant women, the increase in the size of the uterus with fetal growth often causes backache/dorsal pain and pelvic pain due to the heavier body trunk and changes in various

joints[2, 3]. These changes may influence body movements in bed and maintenance of the same posture during sleep. It has been reported that major body movements such as turning over in bed facilitate sleep stage transition from non-rapid eye movement (non-REM) sleep to REM sleep, and are thus closely related to the process of sleep, maintenance mechanism, and sleep cycle duration[1]. Thus, any difficulty in changing sleep posture in pregnant women may influence sleep architecture and thus cause deterioration in subjective sleep quality.

On the other hand, the current general advice on posture during rest and sleep for pregnant women recommends avoidance of supine posture and emphasis on the benefits of the lateral posture (particularly left lateral posture) and prone-like position[4]. The main reason is prevention of supine hypotensive syndrome (SHS). SHS is caused by pressure on the inferior vena cava by the large uterus in the supine position, and manifests clinically with hypotension, tachycardia, and syncope with bradycardia. The reported incidence of SHS ranges between 2.5% and 20.6% (mean of 8%)[5].

Sleep posture during pregnancy may also vary the severity of sleep disordered breathing (SDB)[6]. The decrease in functional residual capacity during the latter half of pregnancy can also cause peripheral airway obstruction[7], particularly in supine position[8]. Therefore, attention should be paid to sleep posture during pregnancy to prevent breathing abnormalities.

Analysis of sleep posture by Hertz *et al.* showed that pregnant women at 30 weeks of pregnancy or later spend significantly less time in supine posture compared with non-pregnant and postpartum women[9]. Using a body position sensor, Maasilta *et al.* reported that in both obese women and women with normal body mass index (BMI), the proportion of time spent sleeping in the supine posture decreased from 12 weeks of pregnancy to 30 weeks or later[10]. However, both studies did not analyze the relationship between changes in sleep posture and subjective sleep quality. Any educational antenatal program on sleep posture during pregnancy should take into account the relationship between changes in sleep posture and subjective sleep quality.

The objective of the present study was to clarify the relationship between changes in the perceived sleep posture with progression of pregnancy and subjective sleep quality. In this study, the trunk position at the time of falling asleep was defined as "sleep posture".

Methods

1. Study design and Participants

A longitudinal study was conducted in the second and third trimesters using a self-administered questionnaire from October 2005 to November 2006. The participants were pregnant women attending antenatal classes at an obstetric hospital in Tokyo. We recruited primiparous women, singleton, and free of serious pregnancy-related complications. The exclusion criteria were multiparous women, multiple pregnancies, illiteracy in Japanese, and plans for "SATOGAERI" (ancient Japanese custom of the wife going back to her natal home after completion of pregnancy).

Three hundred and five pregnant women were recruited, and 300 questionnaires were collected in the second trimester (98.4%). Thereafter, participants were excluded if they[1] discontinued participation in the antenatal classes due to hospitalization for threatened premature delivery or "SATOGAERI", 2) received sleep posture intervention during the third trimester due to breech presentation, and 3) travelled overseas within 1 month before the survey. A second questionnaire was provided during the third trimester. Thus, 201 (65.9%) women responded to both questionnaires and were the subjects of this study.

All participants received detailed explanation on the purpose of the study. The questionnaire was distributed at the end of the antenatal classes and collected in envelopes after completion. The study protocol was approved by the Ethical Committee of the Graduate School of Medicine, the University of Tokyo.

2. Questionnaire

Anonymous self-administered questionnaire was used in this study. The questionnaire items included demographic data and physic characteristics (age, height, body weight, birth experience, duration of pregnancy, employment status, overseas travel), sleeping conditions over the last 24 hours (10 items), position of the body during sleep, and turning over in bed. Questions on subjective physical symptoms that caused sleep disturbances (10 items) were added to the questionnaire in the third trimester.

Questions about subjective sleep quality were originally created items, which were based on the items of the "1996 survey of consciousness investigation about health promotion in Japanese people"[11]. The items were evaluated using a 5-grade response and included questions about total sleep time, sleep initiation, number of awakenings, sleep depth, morning clear-headedness, daytime sleepiness, and sleep satisfaction. Since sleep can significantly during pregnancy on a daily basis, it was considered that questions on "sleep over the last 24 hours" would provide responses that better reflect the actual conditions at the time of the study. With regard to the Cronbach's reliability coefficient (alpha) for the questions of sleep quality were 0.71 for the second trimester and 0.78 for the third trimester.

The frequency of postural change during sleep decreases with increase in the rates of sleep stages of the third and fourth. In the first sleep phase, the sleep stages of the third and fourth appear most[1]. Therefore, the perceived sleep posture at the time of falling asleep may be the posture during sleep mostly. Accordingly, questions on the sleep posture included "Which body position have you most often taken when falling asleep over the past 1 week?", with participants selecting positions from: a) supine, b) right lateral, c) left lateral, d) prone, and e) others. The present study also included questions on awareness of sleep at home, which lacks objectivity regarding sleep posture. We reported previously that although there are individual differences in postures during sleep, there is a relationship between the preferred sleep posture and the actual head position during sleep[12]. In addition, our recent study showed more than 80% concordance between sleep posture at home during pregnancy and the individual's perceived sleep posture after awakening[13], suggesting awareness of sleep posture.

Because of the general advice on posture during sleep for pregnant women recommends avoidance of supine posture, the sleep posture was classified into supine posture and non-supine posture (including all other sleep postures). Since sleep posture could vary with the progression of pregnancy, we divided the participants into four groups depending on the shift of the sleep posture from the second to the third trimesters: supine-to-supine posture, supine-to-non-supine, non-supine-to-supine and non-supine-to-non-supine.

Furthermore, the questionnaire included 8 items on subjective physical symptoms that caused sleep disturbances and disruption of sleep and inability to go back to sleep. These included morning sickness, abdominal pain/uterine contraction, fetal movement/stimulation associated with fetal movement, frequency of urination, posture /It's not free posture due to enlargement of the breasts and abdomen, backache, snoring and apnea. For all items, the responses to the above questions were based on a 5-grade scale of "not at all," "rarely," "sometimes," "often," and "always". Among these, responses of "sometimes," "often," and "always" were classified as "experienced".

3. Statistical analysis

The basic attributes of each subject were calculated using descriptive statistical quantities. All values are expressed as mean ± SD. The Wilcoxon signed-rank sum test was used to test for differences in sleep quality and sleep time at each stage of pregnancy. The Mann-Whitney U and Kruskal Wallis tests were used to test for differences in sleep quality of demographic characteristics, physical characteristics, sleep posture, and the presence of subjective symptoms. Logistic regression analysis was performed by converting the items of sleep satisfaction from the last 24 hours into dependent variables of

"Very satisfied," "Comparatively satisfied," "Normal" = 0 and "Comparatively unsatisfied," "Very unsatisfied" =1, and by employing physical subjective symptoms that disturb sleep as independent variables. For the independent variables, either those with $p<0.2$ based on the result of univariate analysis or those with a correlation coefficient greater than 0.4 among variables were forcibly introduced. Statistical analyses were performed using The Statistical Package for Social Sciences (SPSS) ver. 11. A p value less than 5% was established as a statistically significant level.

Results

1. Participants

The mean age was 32.3 years. The times at which the second and third questionnaires were applied were gestational age of 15-24 and 32-37 weeks, respectively. The mean BMI at the second and third trimesters were 20.6 and 22.9 kg/m^2 (Table 1). With regard to the shift in perceived posture from the second to third trimesters, 8, 36, 14, and 101 participants were classified as supine-to-supine posture, supine-to-non-supine, non-supine-to-supine and non-supine-to-non-supine, respectively. There were no differences in age and BMI between the second and third trimesters, and body weight gain, among the four groups. The percentage of women who worked before pregnancy was 80.1%, but this dropped to 50% in the second trimester and 14.1% in the third trimester.

2. Stage of pregnancy and subjective sleep quality

The response rate for several items pertaining sleep quality of the past 24 hours during pregnancy reflected a worse grade in the third trimester compared to the second trimester (Table 2).

The sleep time calculated from bedtime to wake-up time was shorter in the third trimester (419±88 min) than in the second trimester (442±83 min, p=0.001). In contrast, the time spent in daytime napping was longer in the third trimester (40±55 min) than in the second trimester (24±47 min, p=0.001).

3. Perceived sleep posture and subjective sleep quality

The number of pregnant women who took up a certain body position when falling asleep was 171 (85.1%) before pregnancy, 168 (83.6%) in the second trimester, and 176 (87.6%) in the third trimester. The rate of those taking up a supine posture was 29.8% before pregnancy, 25.0% in the second trimester, and 8.0% in the third trimester (Figure 1). In the second trimester, the change in posture patterns from the second to the third trimester was not associated with differences in sleep quality. However, many items in sleep quality were worse in the third trimester than the second trimester in the supine-to-non-supine and non-supine-to-non-supine groups. In contrast, the sense of morning clear-headedness was better in the third trimester than in the second trimester non-supine-to-supine group (Table 2).

With regard to the frequency of turning over in bed, the percentage of those who were aware of "increased" body movement increased by 8%, from 19.4% in the second trimester to 27.4% in the third trimester. Furthermore, the percent-

Table 1. Demographic and physical characteristics of participants (n=201)

	second trimester	third trimester
Age (years)	32.3±3.8 [24-43] a)	
Gestational age (weeks)	18.3±1.4 [15-24]	34.3±1.3 [32-37]
Height (m)	1.60±0.05 [1.46-1.75] a)	
Weight (kg)	52.8±5.7 [42-80]	58.7±6.2 [45-92]
BMI (kg/m^2) b)	20.6±2.0 [15.5-28.7]	22.9±2.2 [16.5-33.0]

Data are mean±SD [range]
a) Age and height are answers at 2nd trimester research
b) BMI : Body Mass Index

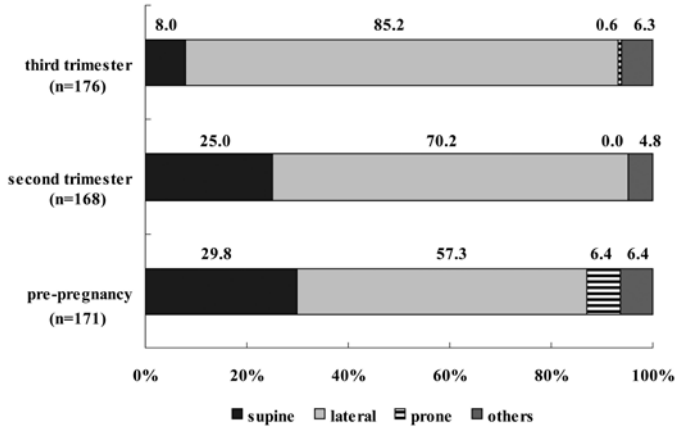

Figure 1. The sleep posture with pregnant progress

The number of pregnant women who took up a certain body position when falling asleep.

Table 2. Comparison of a subjective sleep quality and sleep posture, the 2nd and 3rd trimester of pregnancy (%)

	Total			second:supine ↓ third:supine [a]			second:supine ↓ third:non-supine [a]			second:non-supine ↓ third:supine [a]			second:non-supine ↓ third:non-supine [a]		
	second	third	p [b]	second	third	p [b]	second	third	p [b]	second	third	p [b]	second	third	p [b]
Sleep initiation			(n=201)			(n= 8)			(n=36)			(n=14)			(n=101)
Very well	28.4	19.9		0.0	12.5		27.8	25.0		14.3	7.1		33.7	19.8	
Comparatively well	34.3	28.4		87.5	37.5		41.7	22.2		42.9	42.9		25.7	26.7	
Normal	21.9	27.9	**	12.5	50.0	n.s.	13.9	28.8	†	42.9	28.6	n.s.	21.8	25.7	*
Comparatively badly	13.9	18.4		0.0	0.0		16.7	11.1		0	21.4		16.8	23.8	
Very badly	1.5	5.5		0.0	0.0		0.0	13.9		0	0		2.0	4.0	
Number of awakenings			(n=199)			(n= 7)			(n=36)			(n=14)			(n=100)
Not at all	29.9	21.6		37.5	28.6		27.8	27.8		35.7	28.6		31.7	16.0	
Once	36.3	30.2		37.5	28.6		44.4	30.6		35.7	28.6		39.6	32.0	
Twice	20.4	27.6	**	0.0	28.6	n.s.	16.7	22.2	n.s.	28.6	21.4	n.s.	15.8	29.0	**
Three times	10.4	13.1		25.0	14.3		8.3	11.1		0	14.3		8.9	15.0	
More than four times	3.0	7.5		0.0	0.0		2.8	8.3		0	7.1		4.0	8.0	
Sleep depth			(n=200)			(n= 8)			(n=36)			(n=14)			(n=100)
Deep	25.0	17.9		25.0	12.5		22.2	16.7		14.3	14.3		27.0	17.8	
Fairly deep	39.0	32.3		62.5	75.0		41.7	33.3		42.9	42.9		39.0	30.7	
Normal	20.5	25.4	**	0.0	0.0	n.s.	19.4	22.2	n.s.	35.7	21.4	n.s.	18.0	29.7	*
Fairly light	13.5	18.4		12.5	12.5		13.9	22.2		7.1	21.4		14.0	15.8	
Light	2.0	6.0		0.0	0.0		2.8	5.6		0	0		2.0	5.9	
Morning clear-headedness			(n=200)			(n= 8)			(n=36)			(n=13)			(n=101)
Very alart	6.5	4.5		0.0	12.5		5.6	0.0		0	7.7		8.9	3.0	
Comparatively alart	32.8	34.5		37.5	37.5		36.1	25.0		21.4	53.8		28.7	34.7	
Normal	29.4	28.5	n.s.	37.5	25.0	n.s.	19.4	33.3	n.s.	50	30.8	*	28.7	30.7	n.s.
Comparatively drowsy	21.9	25.5		12.5	12.5		25.0	33.3		21.4	7.7		25.7	28.7	
Very drowsy	9.5	7.0		12.5	12.5		13.9	8.3		7.1	0		7.9	3.0	
The daytime sleepiness			(n=200)			(n= 8)			(n=36)			(n=14)			(n=100)
Not at all	9.0	4.0		12.5	0.0		8.3	8.3		14.3	0		7.0	3.0	
Rarely	20.0	15.4		0.0	0.0		19.4	2.8		14.3	21.4		24.0	16.8	
Sometimes	53.0	55.7	**	75.0	75.0	n.s.	55.6	77.8	n.s.	35.7	57.1	n.s.	53.0	50.5	**
Often	14.5	16.9		12.5	25.0		16.7	8.3		28.6	14.3		13.0	20.8	
Usual	3.5	8.0		0.0	0.0		0.0	2.8		7.1	7.1		3.0	8.9	
Sleep satisfaction			(n=200)			(n= 8)			(n=36)			(n=13)			(n=101)
Very satisfied	8.5	4.0		0.0	0.0		8.3	0.0		0	7.7		9.9	2.0	
Conparatively satisfied	32.8	31.0		37.5	50.0		36.1	25.0		28.6	30.8		32.7	32.7	
Normal	32.8	34.0	*	25.0	12.5	n.s.	33.3	33.3	**	64.3	46.2	n.s.	28.7	34.7	n.s.
Conparatively unsatisfied	24.4	25.0		37.5	37.5		22.2	30.6		7.1	15.4		26.7	27.7	
Very unsatisfied	1.5	6.0		0.0	0.0		0.0	11.1		0	0		2.0	3.0	

Value is the response rate of each items are based on a 5-grade scale.

a) sleep posture in pregnancy: the second trimester of pregnancy→the third trimester of pregnancy, non-spine posture: including all other sleep postures.

b) Wilcoxon signed-rank sum test

** : $p<0.001$, * : $p<0.05$, † : $p<0.1$, n.s. : not significant

age of those who were aware of "no change" also increased by 4.4%, from 28.9% in the second trimester to 33.3% in the third trimester. The percentage of those who were aware of "decreased" body movement increased by 2.9%, from 10.0% in the second trimester to 12.9% in the third trimester.

4. Experience of physical subjective symptoms during sleep

The majority of pregnant women experienced at least one form of subjective physical symptoms that caused sleep disturbances. These included increased frequency of urination (n=158, 78.6%), fetal movement/stimulation associated with fetal movement (n=133, 66.2%), posture/It's not free posture associated with enlargement of the breasts and abdomen (n=132, 66.0%), backache (n=105, 52.3%), abdominal pain/uterine contractions (n=87, 43.3%), morning sickness (n=75, 37.3%), snoring (n=49, 25.8%) and apnea (n=2, 1.0%). Posture/It's not free posture correlated with fetal movement/stimulation associated with fetal movement and backache, and fetal movement/stimulation associated with fetal movement correlated with abdominal pain/uterine contractions ($r>0.4$, $p<0.001$).

Logistic regression analysis of the relationship between experiencing symptoms and subjective sleep satisfaction showed that unfavorable sleep satisfaction correlated significantly with experiencing posture/It's not free posture both in the second and third trimesters (second trimester: OR=2.47, 95%CI=1.07, 5.66, third trimester: OR=2.08, 95%CI=1.00, 4.31) (Table 3).

There was no difference between disturbed sleep due to posture/It's not free posture and sleep posture in the second trimester, while in the third trimester, the experience was significantly more frequent in the non-supine group (71.4%) than in the supine group (21.4%) (p=0.000).

Discussion

Our longitudinal study revealed actual conditions of sleep, including the perceived sleep posture, associated with pregnancy progression. Many items of the subjective sleep quality of pregnant women were low in the third trimester (Table 2). The results indicated fewer women slept in the supine position in the third trimester (Figure 1).

The subjective sleep quality was in agreement with the reported results of other studies[14, 15, 16]. The sleep disorders that are associated with pregnancy are defined by The International Classification of Sleep Disorders (ICSD) as pregnancy-associated sleep disorders[17] and these include various etiologies[18]. To our knowledge, however, no study has so far investigated the relationship between sleep posture during pregnancy and subjective sleep quality.

The results of the present study showed wors-

Table 3. The logistic-regression analysis that dependent variable is sleep satisfaction in pregnancy

	second trimester			third trimester		
	Odds ratio	95%CI	*p*	Odds ratio	95%CI	*p*
Age (years)	1.07	0.97-1.16	n.s.	1.05	0.96-1.14	n.s.
Working status [a)]	0.88	0.45-1.74	n.s.	0.61	0.24-1.59	n.s.
Symptomatic experience of sleep disturbance						
Morning sickness [b)]	1.45	0.71-2.96	n.s.	—	—	—
Fetal movement [b)]	1.83	0.80-4.19	n.s.	—	—	—
Abdominal pain/uterine contraction [b)]	—	—	—	1.42	0.75-2.70	n.s.
Frequent urination [b)]	1.53	0.60-3.88	n.s.	1.38	0.62-3.09	n.s.
Posture/It's not free posture [b)]	2.47	1.07-5.66	<0.05	2.08	1.00-4.31	<0.05

The dependent variable is sleep satisfaction in pregnancy
a) Working status: "not working" "leave of absence" = 0 and "working" = 1
b) Symptomatic experience causing sleep disturbance: "not at all" "rarely" =0, "sometimes" "often" "always" = 1
n.s. : not significant, CI: Confidence Interval

ening of subjective sleep quality in those who attended non-supine posture during sleep (i.e., non-supine-to-non-supine and supine-to-non-supine groups) (Table 2). In addition, sleeping in a particular posture imposed by the status of pregnancy (large breasts/abdomen) correlated with poor sleep satisfaction both in the second and third trimesters even after adjustment for age and working status (Table 3). Hansenn *et al.* reported that it is difficult for pregnant women with pelvic pain to turn over in bed and take up a posture similar to normal sleep[19]. The results of the present study suggest that rather than a sense of difficulty in turning over in bed, awareness of restricted movement in sleep to non-supine posture correlated with poor subjective sleep quality.

SDB, especially of obstructive sleep apnea, correlates with sleep posture[20, 21] ; and pregnant women are no exception to this observation. In addition, the risk of late stillbirth was reported recently to correlate with maternal sleep-related practices including sleep position[22]. The absolute risk of late stillbirth in pregnant woman who did not go to sleep on the left side was increased compared to those who went to sleep on that side. Considered together, these results highlight the need for education on the importance of sleep posture in pregnant women. Any program designed to select proper sleep posture during pregnancy should take into consideration the relationship between sleep posture and subjective sleep quality. In other words, subjective sleep quality could worsen if pregnant women are advised to avoid sleeping supine.

The present study has certain limitations. First, the study was conducted in only one facility, a general hospital in the Tokyo Metropolitan area, and thus the characteristics of the participants might be biased. Second, sleep posture and sleep quality were dependent on the individual awareness; therefore, we could not clarify the relationship between the actual time spent in each sleep posture and sleep quality. Further studies on pregnant women to record body movements, polysomnography including brain activity (electroencephalography, electromyography and electrooculography) with synchronized video recording of body posture are needed for a more precise evaluation of the effects of pregnancy, body posture and sleep quality to provide optimal assistance for comfortable sleep for pregnant women.

Conclusion

The present study demonstrated that the perceived sleep posture during pregnancy varies with the progression of pregnancy and that the perceived sleep posture correlated with subjective sleep quality. In particular, in the third trimester, non-supine sleep posture and factors related to body changes in pregnancy (breast and abdomen enlargement) correlated with poor subjective sleep quality.

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妊娠経過に伴う睡眠姿勢の自覚の変化と主観的睡眠感との関連

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キーワード
妊娠，睡眠姿勢，主観的睡眠感

要　旨

妊娠の進行に伴う睡眠姿勢の自覚の変化と主観的睡眠感との関連を明らかにすることを目的とし、妊娠中期と末期の自記式質問紙による縦断調査を行った。都内１施設で健診を受ける、重篤な合併症のない、初産婦、単胎妊娠の女性を対象とし、201人が分析対象であった（65.9％）。主観的睡眠感の多くの項目は、妊娠中期よりも末期に悪い評価となった。妊娠中の睡眠姿勢の自覚は，末期になるほど仰臥位が減少していた。妊娠末期に仰臥位以外の睡眠姿勢であること，“乳房や腹部増大のため自由な姿勢がとれない”という自覚が、妊娠中期および末期ともに睡眠感の悪さと関連していた。妊娠の進行に伴い睡眠姿勢の自覚は変化し、主観的睡眠感と関連していることが示された。妊娠期の快適な睡眠のための指導では、睡眠姿勢の自覚が睡眠の質と関連している可能性にも考慮が必要である。