

Original article

## Effects of pregnancy on mothers' sleep

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### Abstract

**Objectives:** To survey the effects of pregnancy on mothers' sleep.

**Methods:** Mothers were interviewed during and after pregnancy with a series of five questionnaires to assess alterations in their sleep. The first questionnaire covered the 3 months before becoming pregnant, the next three the trimesters of pregnancy and the last the 3 months after delivery. The study was carried out in a central hospital and the maternity care units in the nearby rural community. Altogether, 325 pregnant women completed all five questionnaires.

**Results:** The total amounts of reported sleep and of nocturnal sleep increased significantly during the first trimester of pregnancy, began to decrease thereafter and were shortest during the 3 months after pregnancy. During late pregnancy expectant mothers over 30 years of age reported less sleep than those under 30. During the whole pregnancy, but increasingly toward the end of pregnancy, sleep became more restless and fragmentary and its subjective quality worsened, due at least partly to increased restless legs and nightly awakenings increasing with advancing pregnancy.

**Conclusions:** The subjective quality of sleep is disturbed as early as the first trimester of pregnancy, although total sleeping time increases. The amount of reported sleep begins to decrease in the second trimester. The frequency of reported sleep disturbances, such as restless legs syndrome and nocturnal awakenings, is maximum in the third trimester but is about normal within 3 months after delivery. © 2002 Elsevier Science B.V. All rights reserved.

**Keywords:** Sleep; Pregnancy; Restless legs syndrome; Periodic leg movements; Snoring; Sleep quality; Women

### 1. Introduction

Pregnancy alters sleep in many ways [1–14], but only a few studies with a large sample size have assessed the quantity and quality of the sleep of mothers before, during and after pregnancy.

According to earlier studies, an increase in total sleep time and daytime sleepiness is noted during the first trimester, whereas the third trimester and especially the first postpartum month [8] are characterized by a decrease in sleep time and an increase in the number of nocturnal awakenings [2,5,10]. In a recent study, at the 6 week prenatal care unit visit 37.5% of the young, healthy pregnant women questioned reported daytime sleepiness of variable severity, but later at the 6 month visit this was noted in 52% of the subjects [11]. The frequency of restless legs syndrome has

been reported to increase during pregnancy, occurring in one-third of mothers [12–14].

In a self-reporting survey, Loube et al. [15] found snoring to be significantly more frequent in 350 pregnant women than in 110 age-matched non-pregnant women. Loud snoring reported by bed partners occurred in 3.7% of the pre-pregnant study population and increased to 11.8% by the 6 month prenatal visit [11]. In a recent cross-sectional consecutive case series of 502 women with singleton pregnancies, Franklin et al. [9] reported that 23% of the women questioned snored every night during the last week of pregnancy (but only 4% before becoming pregnant) and found snoring during pregnancy to be associated with hypertension, pre-eclampsia and even growth retardation of the fetus. Brownell et al. [6] reported that the frequency of apneas and hypopneas of six pregnant women was significantly reduced during pregnancy, but the opposite has also been observed [7]. It has recently been shown [16] that nasal continuous positive airway pressure reduces sleep-induced blood pressure increments in pre-eclampsia.

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Hormonal changes during pregnancy have many effects on sleep [1,6,17] and may cause fatigue and energy loss [18]. Estrogen is known to cause nasal edema, while the high level of circulating progesterone facilitates breathing during sleep. Though it has been found that oxygenation is well maintained [6], in some studies oxygen saturation declines in pregnant women [1]. Guilleminault et al. [11] reported that in young, healthy pregnant women who snored during pregnancy, minor oxygenation drops during sleep were associated with the largest increase in blood pressure. A high concentration of sex steroids seems to be associated with decreased sleep latency and a decreased time spent awake [17]. An increased frequency of restless legs syndrome during pregnancy has been linked to a low level of serum ferritin [14]. Backache, fetal movements and a more frequent urge to urinate may also cause disturbances in sleep [2,10].

The aim of the present study was to use mothers' self-reports to determine the quantity and quality of sleep as well as the frequencies of sleep disturbances before, during and after pregnancy.

## 2. Patients and methods

The study was carried out in an industrial city of 95 000 inhabitants and the nearby rural community (20 000 inhabitants) which belong to the area of the Central Hospital. When pregnancies were verified, the expectant mothers were referred to 16 local maternity care units. All the deliveries took place in the obstetric unit of the Central Hospital. Follow-up visits of the normal pregnancies according to the Finnish standards were conducted in the maternity care units of the community health centers and examinations and care of neurological patients took place in the neurological clinic of the Central Hospital.

From the beginning of September 1995 to the end of August 1996 all pregnant women on their first checkup visit to one of the 16 maternity care units received two questionnaires, the first concerning the 3 months before pregnancy and the second the first trimester. Of the 876 women who received these questionnaires, 682 completed them and were given three more covering the second and third trimester and the 3 months after delivery. The final study group consisted of the 325 patients (37.1% of the initial sample) who returned all five questionnaires. A total of 93.5% of this population were married or living steadily with a partner and were asked to fill out the questionnaire together with their partners.

The 357 patients who returned only the first two questionnaires were compared with the 325 who completed all five. The groups did not differ in terms of the main demographic and clinical features, including age, education, work and marital status, the number of previous pregnancies, smoking, and use of alcohol and coffee before the pregnancy. The characteristics of our study group are presented

in Table 1. Results did not differ when we compared these two groups with regard to the examined areas of sleep between the baseline and first follow-up.

### 2.1. Questionnaire

The content derives from the Basic Nordic Sleep Questionnaire (BNSQ) [19] and made use of the five-point scale presented by Partinen and Gislason. This scale, accepted and widely used in a variety of studies performed in Nordic countries, consists of the following: 1, 'never or less than once per month'; 2, 'less than once per week'; 3, 'on 1–2 nights per week'; 4, 'on 3–5 nights per week'; and 5, 'every night or almost every night'. However, in analyzing the results of snoring and restless legs, we used only a two-point scale: 1, 'sometimes'; 2, 'often/nearly always'.

Table 1  
Characteristics of the 325 pregnant women who returned all five questionnaires

Mean age (SD)	29.1 (5.2)
< 20 years (%)	11 (3.4)
> 35 years (%)	31 (9.5)
Marital status (%)	
Married (%)	199 (61.2)
Living steadily with a partner (%)	105 (32.3)
Single, divorced (%)	21 (6.5)
Education (%)	
Basic school training (%)	53 (16.3)
High school or college (%)	239 (73.5)
University degree (%)	28 (8.6)
Unknown (%)	5 (1.6)
Work (%)	
Outside home (%)	189 (58.2)
Shift work (%)	62 (19.1)
Own business (%)	7 (2.2)
Work at home (%)	41 (12.6)
Unemployed (%)	51 (15.7)
Not available (%)	44 (13.5)
Smoking before pregnancy (%)	
Never or very seldom (%)	245 (75.4)
1–5 cigarettes daily (%)	16 (4.9)
> 5 cigarettes daily (%)	33 (10.2)
Stopped smoking (%)	31 (9.5)
Number of pregnancies (%)	
First (%)	104 (32.0)
Second (%)	100 (30.8)
Third (%)	68 (20.9)
Fourth or more (%)	53 (16.3)
Units (= 4 cl) of alcohol consumption before pregnancy (%)	
Never (%)	110 (33.9)
< 4 units weekly (%)	178 (54.8)
4–10 units weekly (%)	27 (8.3)
> 10 units weekly (%)	5 (1.5)
Unknown (%)	5 (1.5)
Coffee or tea consumption before pregnancy (%)	
Never or very seldom	61 (18.7)
1–2 cups daily	142 (43.7)
3–5 cups daily	115 (35.4)
> 5 cups daily	7 (2.2)

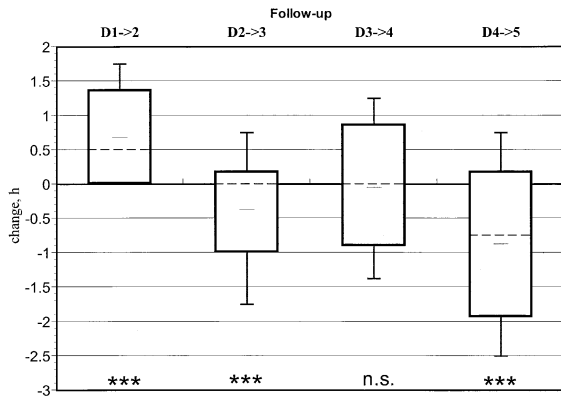


Fig. 1. Change of total sleeping time per whole day from one study period to another. Box-and-whisker plots show upper and lower quartiles and median from changes. D1 → 2, change in hours from before pregnancy to first trimester; D2 → 3, change from first to second trimester; D3 → 4, change from second to third trimester; D4 → 5, change from third trimester to after the delivery. n.s., non-significant; \*\*\* $P < 0.001$ , Bowker's test of symmetry.

We evaluated complications (diagnosis of diabetes, eclampsia, pre-eclampsia, endometritis, bleedings, mastitis and puerperal sepsis) in the final study group by analyzing the diagnoses made during hospital visits. For comparison purposes we also evaluated all corresponding diagnoses during the calendar year 1996 from the same area. Rare conditions such as eclampsia were not found in either evaluation. Pre-eclampsia was found in 11 mothers from the study group (3.4%) and in 28 of all mothers from 1996 (3.2%). Diabetes was found in 17 mothers from the study group (5.2%) and in 66 of all mothers from 1996 (7.5%). Some minor complications were probably taken care of by general practitioners, since in the study group there were no cases of diagnosed bleeding or mastitis (one in 1996) and only two diagnoses of endometritis (six in 1996).

## 2.2. Statistical methods

Student's *t*-test for differences was used for tests of percentages. The conventional  $\chi^2$ -test was applied for independent samples. Bowker's test of symmetry was applied for dependent samples, e.g. in comparing changes between the five study periods. Statistical analyses of the results were based on the SAS programs [20].

## 3. Results

The change in the reported total sleeping time per 24 h from one study period to another is illustrated in Fig. 1. The mean number of hours of the reported total sleep per 24 h (standard deviation is indicated in parentheses) before pregnancy was 8.0 (0.9), increasing during the first trimester to 8.7 (0.9) ( $P < 0.001$ ) and decreasing during the second trimester to 8.4 (1.0) ( $P < 0.001$ ). In late pregnancy it remained unchanged at 8.3 (1.2) h, but decreased after the

delivery to 7.4 (1.2) h ( $P < 0.001$ ). Total sleep time during pregnancy was affected by the mother's age, the older mothers (>30 years of age) more frequently reporting that during late pregnancy they slept for less than 7 hours ( $P < 0.0001$ ).

Changes in the duration of reported sleeping times at night between the study periods are illustrated in Fig. 2. The reported mean sleeping time at night was 7.8 (0.9) h before the pregnancy, 8.2 (0.9) h in the first trimester ( $P < 0.001$ ), 8.0 (1.0) h in the second trimester ( $P < 0.001$ ), 7.8 (1.2) h in the third trimester ( $P < 0.001$ ) and 7.0 (1.1) h after delivery ( $P < 0.001$ ).

To determine the effect on sleep duration of having other child(ren) at home, we compared the reports of all 682 mothers (77.9% of the potential sample) who reported sleep habits during pre-pregnancy and the first trimester with those of our sample, but the results did not differ significantly.

In our study population, reports of snoring 'often/nearly always' represented 5.0% before becoming pregnant, 6.8% in the first trimester, 6.8% in the second trimester and 10.4% in the third trimester (difference compared to the pre-pregnant period,  $P = 0.077$ ). After delivery the percentage decreases to 4.4%, similar to pre-pregnancy levels (change from the third trimester,  $P = 0.004$ ) (Fig. 3). There was no significant difference in reported snoring between those who used alcohol and those who did not, either before pregnancy (69/207 (33.3%) vs. 25/107 (23.4%)), during the first trimester (24/63 (38.1%) vs. 70/257 (27.2%),  $P = 0.074$ ), or during the later pregnancy period and after delivery. Before pregnancy and during the first trimester 2.5% of the women reported occasional sleep apneas, 2.2% reported them in the second trimester, 2.8% reported them in the third trimester and 0.9% reported them after the delivery (change from the third trimester to after delivery,  $P = 0.096$ ). The neurologist in our research team examined two women who had major

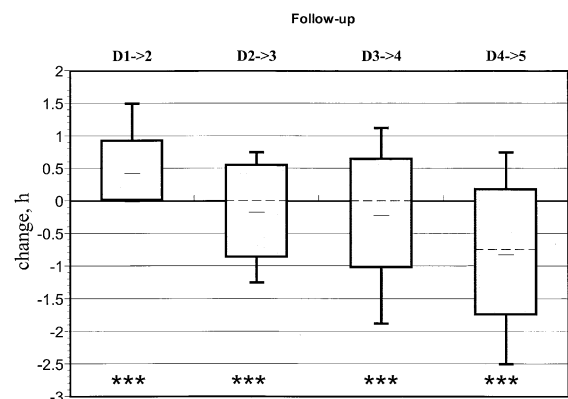


Fig. 2. Distributions of changes in duration of sleep at night between the study periods. Box-and-whisker plots show upper and lower quartiles and median from changes. D1 → 2, change in hours from before pregnancy to first trimester; D2 → 3, change from first to second trimester; D3 → 4, change from second to third trimester; D4 → 5, change from third trimester to after the delivery. \*\*\* $P < 0.001$ , Bowker's test of symmetry.

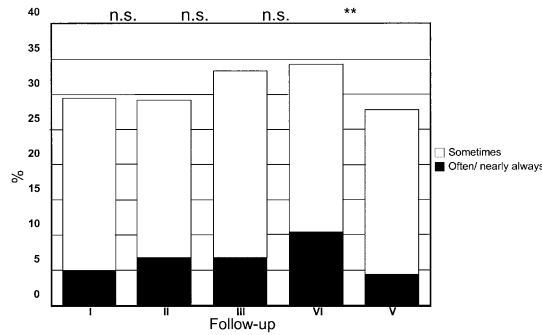


Fig. 3. Snoring during sleep. I, the 3 month pre-pregnant period; II–IV, first to third trimesters of pregnancy; V, the 3 month post-delivery period. From one study period to another no statistical differences were seen between those not snoring and those snoring. n.s., non-significant between adjacent columns;  $**P < 0.01$  between adjacent columns, Bowker's test of symmetry.

problems with sleep and snoring, but detected no sleep apnea syndrome.

The quality of sleep was found to decline during pregnancy (Fig. 4). Restless sleep before pregnancy was reported by 10.1% of the mothers, during the first trimester by 15.4% ( $P < 0.001$ ), during the second trimester by 20.3% ( $P = 0.003$ ) and during the third trimester by 30.3% ( $P < 0.001$ ). After the delivery, the figure was 20.5% (change from the third trimester,  $P < 0.001$ ) (Fig. 4).

The number of reported awakenings during the night increased during pregnancy and afterwards (Fig. 5). The percentage of those reporting no nocturnal awakenings was 27.2% before pregnancy, 7.8% during the first trimester ( $P < 0.001$ ), 5.5% during the second trimester ( $P = 0.061$ ), 1.9% during the third trimester ( $P < 0.001$ ) and 4.7% after the delivery ( $P = 0.017$ ).

During pregnancy there was a significant increase in the number of women who reported the symptoms of restless legs (Fig. 6). The syndrome was most frequent in late pregnancy, but returned to the initial pre-pregnant level after delivery. The reported frequencies of the restless legs

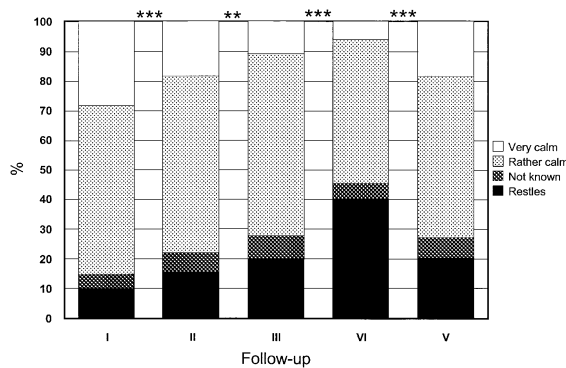


Fig. 4. Quality of sleep at nights in study periods. I, the 3 month pre-pregnant period; II–IV, first to third trimesters of pregnancy; V, the 3 month post-delivery period.  $**P < 0.01$  between adjacent columns;  $***P < 0.001$  between adjacent columns, Bowker's test of symmetry.

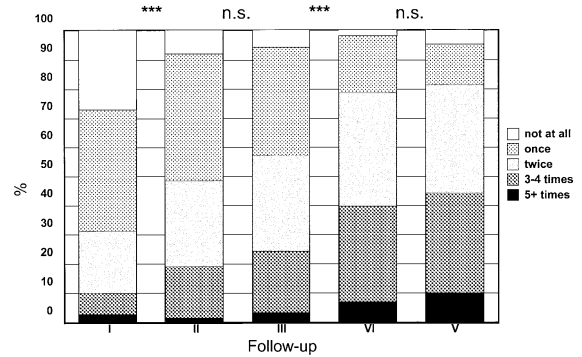


Fig. 5. Average number of awakenings during nights in study periods. I, the 3 month pre-pregnant period; II–IV, first to third trimesters of pregnancy; V, the 3 month post-delivery period. n.s., non-significant between adjacent columns;  $***P < 0.001$  between adjacent columns, Bowker's test of symmetry.

syndrome did not vary among the five different age groups of  $<20$ ,  $20-25$ ,  $25-30$ ,  $30-35$ , and  $>35$  years.

The birth weight of the child was not significantly linked to any of the observed parameters of the mother's sleep during the pregnancy (the amount of total sleep, nightly sleep, snoring and awakenings during the night). Furthermore, the quality of sleep from pre-pregnancy through the third trimester did not differ between the mothers with babies with birth weights of over 4000 g (22.5%) and those with babies with birth weights of less than 4000 g (77.5%).

Before the pregnancy 2.1% of the mothers occasionally used sleeping pills, during the first trimester 0.9%, during the second trimester 0%, during the third trimester 2.2% and after the delivery 1.6%.

#### 4. Discussion

The present case series of mothers' sleep disturbances during pregnancy is to our knowledge the most extensive published so far. Loube et al. [15] followed 350 pregnant

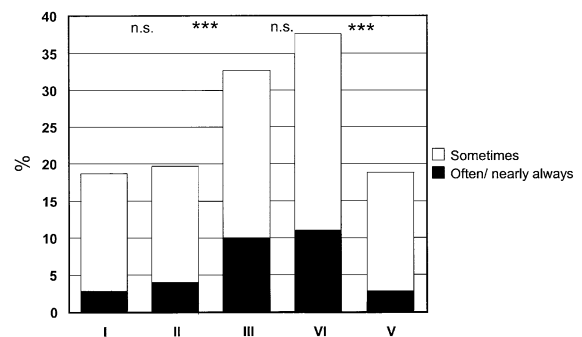


Fig. 6. Prevalences of restless legs syndrome in the study periods. I, the 3 month pre-pregnant period; II–IV, first to third trimesters of pregnancy; V, the 3 month post-delivery period. n.s., non-significant between adjacent columns;  $***P < 0.001$  between adjacent columns, Bowker's test of symmetry.

women with self-reported questionnaires, but concentrated mainly on snoring. In our study the number of pregnant women returning all five self-reporting surveys ( $N = 325$ ) was higher than in earlier subjective surveys [5,10,21–24]. Although our evaluation was limited to 37.1% of our initial sample of 876 women, the main demographics and examined areas of sleep of the respondents answering all five questionnaires and those returning only the first two ( $N = 375$ ) did not differ. The frequency of pregnancy complications in our group, as well as the whole population of the same area, was low. It was therefore assumed that the present results could reliably be taken to represent those of the wider population under investigation and were not distorted by the self-selected nature of the sample used.

The observed alterations in the amount of sleep during early pregnancy in the present study are in accordance with earlier studies. The total hours of sleep and sleep at night increased during the first trimester [2,5,8], lessened during the second trimester and further decreased during the third trimester. Previous surveys of the sleep of pregnant women indicated a shorter sleep time and disturbed sleep in late pregnancy [2,5,21], but our results suggest that reduced sleep begins in the second trimester. The mean sleeping time of the mothers in our study continued to decrease after the delivery, which is not an unexpected finding considering the care demanded by the baby. Lee et al. [8] have also shown that mothers sleep least during the first postpartum month.

Snoring, especially recurrent and loud, seems to increase during pregnancy [9,11,15]. In our study recurrent snoring doubled in the third trimester when compared to the pre-pregnant period ( $P = 0.077$ ), but decreased to the original level after the delivery ( $P = 0.004$ ). Sleep apneas were not a great problem before or during pregnancy. Our results thus differed from those of Brownell et al. [6] who found a decrease in the frequency of apneas during pregnancy.

Our study verifies the common complaint that the quality of sleep worsens during pregnancy. The increased frequency of nocturnal awakenings begins in the first trimester and progresses during later pregnancy. A previous study found the two-fold increase in the number of awakenings from pre-conception to the third trimester of pregnancy to be predominantly due to the need to urinate [10]. Hertz et al. [1] indicate a lower sleep efficiency in late pregnancy than in a non-pregnant control group, the most frequent complaints being restless sleep, low back pain, leg cramps and frightening dreams.

Another principal factor reducing sleep quality during pregnancy is restless legs syndrome, known to be common during pregnancy. A review article by McParland and Pearce [12] attributes restless legs syndrome to one in every three pregnant women. In our study a positive response to this question was in the same range; 37.7% of the women complained of restless legs in late pregnancy. Phillips et al. [25] reported that the prevalence of restless legs (occurring five or more times per month) in the general adult population is 3% in those aged 18–29 years and 10%

in those aged 30–79 years. Of our 325 women, 18.8% ('at least sometimes') and 2.9% ('often/nearly always') responded positively when asked about restless legs before pregnancy. The mother's age did not seem to influence the prevalence of the syndrome during pregnancy. This syndrome must be considered one of the most frequent sleep complaints among pregnant women, but it seems to normalize within 3 months after delivery.

The majority of women notice sleep alterations during pregnancy, usually in the form of more awakenings and fewer hours of sleep, becoming more pronounced in the third trimester. Several factors explain these disturbances. Patients are more likely to be awakened by noises in the environment, through which they would normally sleep, due to decreased depth of sleep. The mechanical effects of the enlarged uterus cause a more frequent urge to urinate, resulting in more awakenings [10]. Backache and fetal movements may also cause disturbances in sleep [2]. It remains to be determined whether the alterations in sleep structure during pregnancy reflect specific hormonal changes.

We conclude that a mother's sleep is considerably disturbed during pregnancy, increasingly toward the end of pregnancy and to a lesser extent for the 3 months after the delivery. The amount of sleep increases during the first trimester of pregnancy, coinciding with the subjective worsening of sleep quality, and begins to return to its former level during the second trimester. The frequency of the restless legs syndrome and nocturnal awakenings increases during the whole pregnancy. Alterations in sleep do not seem to correspond to the weight of the child at birth or the mother's age, although during late pregnancy older mothers have shorter total sleeping times. This knowledge of mothers' sleep alterations is useful for reassuring expectant mothers in their regular pre-delivery checkups.

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