



## Typical sleep positions in pregnant women

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### ABSTRACT

**Objective:** Maternal supine posture in late pregnancy and labor is known to compromise maternal hemodynamics and subsequently affect the fetus. Recently, maternal supine sleep position during late pregnancy has been postulated to play a role in stillbirth. However, no objective data exist regarding how often pregnant women sleep supine. This study was therefore conducted to determine the proportion of pregnant women who spend time asleep in the supine position.

**Methods:** A secondary analysis of data from pregnant women who underwent home sleep studies.

**Results:** Of 51 pregnant women, mean gestational age  $28.3 \pm 6.9$  weeks, the vast majority of women (82.4%) spent some time sleeping in the supine position. The median proportion of overall time spent in the supine sleep position was 26.5% (90%CI 0.0–82.9%).

**Conclusion:** Our data suggest that if supine position plays a role in stillbirth, most women may benefit from education regarding sleep position.

**Practice implications:** Most pregnant women spend time asleep on their back. Given the known data on supine posture and maternal cardiovascular compromise together with emerging data on supine sleep position and stillbirth, it may be pertinent for healthcare providers to provide pregnant women with information about sleep position particularly during late pregnancy.

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## 1. Introduction

It has long been recognized that posture in late pregnancy can have a profound effect on maternal hemodynamics. In particular, during the supine position the gravid uterus compresses the inferior vena cava resulting in restriction of venous return [1], reduced ejection fraction, reduced cardiac output, and consequently impaired uterine perfusion [2]. Failure to prevent this compression can lead to maternal supine hypotensive syndrome (also known as inferior vena cava compression syndrome) [3–5] and ultimately to an adverse effect on gas exchange between mother and fetus with consequent fetal heart rate decelerations [6]. Since the 1950s it has been a standard of care to place laboring pregnant women in the left lateral tilt position to displace the uterus from the inferior vena cava and thus improve maternal hemodynamics and gas exchange [7,8]. Indeed, the American Heart Association recommends full left lateral tilt positioning for all women with hemodynamic distress who are in late pregnancy [9]. Furthermore, several authors suggest that

supine positioning of pregnant women during any kind of lengthy diagnostic or therapeutic intervention should be avoided [10,11].

Despite the wealth of knowledge regarding the negative impact of supine position on maternal cardiovascular control, little attention has been paid to maternal sleep position during pregnancy. Given that humans spend approximately one third of their life asleep, it stands to reason that a risk factor for inferior vena cava compression – and thus potential adverse maternal and fetal effects – could be supine sleep position. Of note, data from the Auckland Stillbirth Study [12], a case-control study that recruited women within 3 weeks of a stillbirth reported that women who did not settle to sleep on their left were more likely to experience a late stillbirth when compared with women who did and the odds ratio for stillbirth was highest for those who reported supine sleep (OR 2.54, 95%CI 1.04–6.18) [13]. Similarly, a cross-sectional study of sleep and pregnancy outcomes in Ghanaian women found that women who reported supine sleep were at particularly high risk of stillbirth (OR 8.0, 95%CI 1.5–43.2) and that this was mediated via the association between supine sleep and low birth weight [14]. While such findings suggest that sleep position may be a modifiable risk factor for poor pregnancy outcome, information is scarce regarding the proportion of pregnant women who may be impacted or the amount of time spent in supine sleep. Until these data exist, the impact of any intervention aimed at reduction of supine sleep remains unclear.

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Therefore, the goal of the present study was to determine typical sleep positions during pregnancy as documented from overnight sleep studies in the home environment.

## 2. Methods

This study was a secondary analysis of ambulatory sleep studies (polysomnograms; PSGs) of pregnant women who were recruited as part of other studies investigating maternal sleep and pregnancy outcomes. The studies were approved by the University of Michigan Institutional Review Board (IRBMed). All women underwent one night of PSG using a portable device (Medipalm, Braebon, Ontario, Canada or Embletta Gold, Embla, Bromfield, CO). A trained technologist visited all subjects at home, initiated the monitoring, and returned on the following morning to retrieve the equipment and download the data. The following channels were recorded: electrocardiogram (ECG), nasal and oral airflow (thermistors, nasal pressure transducer), chest and abdominal respiratory movement using respiratory inductance plethysmography, oxygen saturation (SpO<sub>2</sub>), and body position using a body position sensor (SPI, Pro-Tech, USA) attached to the anterior chest wall on the median line. The body position sensor differentiated 5 positions including the supine, right lateral, left lateral, prone and upright positions.

### 2.1. Statistical analysis

Analyses were performed using SPSS version 21 (IBM SPSS Statistics, Armonk, NY). Descriptive analyses were conducted to determine the proportion of time in each sleep position (supine, left lateral, right lateral, and prone) for the total population. The analyses were then repeated for women who were in their 3rd trimester (at least at 28 weeks' gestation).

## 3. Results

Overall, 51 women were included in the analysis. The mean maternal age was  $33.6 \pm 5.2$  years,  $n = 29$  (56.9%) were Caucasian,  $n = 21$  (41.2%) were African American,  $n = 1$  was Mixed race (2.0%), and  $n = 22$  (43.1%) were nulliparous. The mean gestational age at the time of the sleep study was  $28.3 \pm 6.9$  weeks (range 7–38 weeks).

The mean duration of recorded sleep time was  $5.8 \pm 1.6$  h. Overall, the vast majority of women (82.4%) spent some time sleeping in the supine position. The median proportion of overall time spent in the supine sleep position was 26.5% (90%CI 0.0–82.9%) with similar median sleep times spent in the left lateral (27.3%, 90%CI 0.0–71.3%) and right lateral (27.8%, 90%CI 0.0–82.4%) sleep positions respectively. The median proportion of time spent in the prone position was 0.0% (90%CI 0.0–0.6%). Prone sleep position occurred in only 7 women (13.7%).

Almost two-thirds of women ( $n = 33$ ; 64.7%) were at least at 28 weeks' gestation. Analysis of this subgroup of women demonstrated that the median proportion of time spent in each sleep position was as follows: supine position 26.5% (90%CI 0.0–73.7%); left lateral position 35.7%; (90%CI 0.0–67.0%); right lateral position 35.5% (90%CI 0.0–80.5%); and prone position 0.0% (90%CI 0.0–3.9%).

## 4. Discussion

These data demonstrate that the majority of pregnant women spend at least some time asleep in the supine position. Although supine sleep time was variable, the median duration was approximately one quarter of the night in this position. Thus, if maternal sleep position does play a role in stillbirth, an opportunity exists for educational and therapeutic interventions that may reduce the proportion of supine sleep.

In addition to stillbirth, maternal supine sleep may play a role in fetal wellbeing. Physiologically, it is plausible that supine sleep may impact

placental perfusion and subsequently fetal hemodynamics. Indeed, alteration of maternal position from standing to supine has been shown to increase the pulsatility index of the umbilical artery [15]. Position change from semi-lateral to supine has also been shown to increase the umbilical artery systolic/diastolic ratio [16]. More recently Ryo et al. [17] demonstrated that the umbilical artery blood flow velocity waveform index was higher in mothers placed in the supine position compared to those in the left lateral position during 27–29 weeks' gestation. These aforementioned changes observed in the supine position may be explained by vena caval compression with consequently reduced uterine blood flow. Of note, several studies, including a systematic review [18] have described an association between measures of umbilical artery blood flow and poor obstetric outcome such as fetal hypoxia [19], pre-eclampsia [20–24], fetal growth restriction [20,21, 24–26], and perinatal death [23,24].

The strength of our data is that we have provided objective evidence from sleep studies recorded in the home environment with pregnant women who were not asked to try to adopt or maintain any sleep position. Therefore we have documented typical sleep position during pregnancy. Thus we have been able to provide information regarding how common supine sleep is in pregnant women and the variability in duration across the night. No previous studies have performed home sleep monitoring in relation to maternal sleep position. In a previous study of maternal sleep position in 52 women after 30 weeks' gestation [27] it was found that 77% adopted a left position on going to sleep and only one woman adopted a supine position. However, this study was conducted with women admitted to hospital for various problems requiring prenatal admission and position was identified by the visual inspection by hospital staff at bedtime. No objective data were collected nor were position changes noted during sleep. These findings conflict with Ogita et al. [28] who reported visual inspection of sleep position in 302 pregnant women (mean gestational age  $27.2 \pm 5.7$  weeks, range 17–41 weeks). Sleep position was noted by hospital staff at several times throughout the night: 10 pm, midnight, 3 am, and 6 am. Supine sleep was noted in 50.7% of women at 10 pm, 29.6% at midnight, 23.2% at 3 am and 33.6% at 6 am. Overall, during the 4 periods of observation, they concluded that pregnant women spent 34.2% in the supine position. Despite no objective measures in the latter inpatient study, the average proportion of supine sleep time from visual inspection of position at several time points across the night is similar to our findings using continuous objective data collected in the home environment.

However, the current study is not without limitation. While body position sensors can detect gross body positions, they are not sensitive enough to measure subtle differences in position that may impact the degree of vena caval compression. Use of nocturnal video may be helpful; indeed, a video sleep study in pregnant women is currently underway (Warland, personal communication). Nonetheless, overnight sleep studies in conjunction with video would be particularly helpful.

In summary, we have provided initial objective evidence that a large proportion of pregnant women spend some time during the night asleep in the supine position. Supine position during wake time has long been known as a risk for compression of the inferior vena cava and consequent hemodynamic instability, yet little attention has been paid to sleep time. Given that humans spend approximately one third of their life asleep, and the recent publications regarding associations between supine sleep and stillbirth, we suggest that future research on pregnancy outcomes should focus on this modifiable risk factor. Nonetheless, before a public awareness campaign can be launched it will be important to further study the impact of maternal sleep position on fetal outcomes. However, as there is already much information about sleep position in pregnancy in the public domain it may be helpful to counsel pregnant women to avoid settling to sleeping on their back and if they wake during the night to settle back to sleep in a lateral

position. Other potentially useful strategies to avoid supine sleep may include use of mattress wedges or pillows [29] or other interventions such as the 'tennis ball' technique [30].

### Conflict of interest

The authors have no conflicts to declare.

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