Arch Gynecol Obstet
DOI 10.1007/s00404-012-2248-z

MATERNAL-FETAL MEDICINE

Factors related to insomnia and sleepiness in the late third trimester of pregnancy

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Received: 8 October 2011 / Accepted: 26 January 2012

Abstract
Objective To assess the presence of insomnia and sleepiness and related factors in the late third trimester of pregnancy.
Methods A total of 370 singleton gravids completed a general questionnaire containing personal data, the Insomnia Severity Index (ISI) and the Epworth Sleepiness Scale (ESS). In addition, maternal anthropometry was recorded upon survey.
Results Median [interquartile range] maternal age and gestational age upon survey was of 31 [7.0] years and 39 [1.8] weeks, respectively. A 73.5% of women displayed some degree of insomnia (Total ISI score 8–28) and 22.2% sleepiness (Total ESS score ≥10). Determined rho Spearman coefficients showed significant correlations between ISI scores and gestational age at survey and survey to birth interval (weeks) and between ESS scores and maternal weight and arm circumference at survey and neonatal birth weight. Multiple linear regression analysis found that smoking habit, higher blood pressure and shorter survey to birth interval (weeks) significantly predicted higher ISI scores, and hence a higher risk of insomnia. Employed status, increased arm circumference and neonatal weight predicted higher ESS scores (sleepiness).
Conclusion Insomnia and sleepiness were prevalent in the late third trimester of pregnancy in which lifestyle factors and maternal and neonatal body composition were significant predictors.

Keywords Sleep disorders · Sleepiness · Pregnancy · Insomnia Severity Index · Epworth Sleepiness Scale

Introduction

Sleep–wake cycle is regulated by genetic, physical, social, psychological, behavior, and environmental factors [1, 2]. Sleep and sleep disordered breathing are influenced by female biological milestones: puberty, pregnancy or the menopause [3–5]. Sleep characteristics may change very early during pregnancy due to endocrine and anatomical modifications. As pregnancy continues, sleep duration decreases and the prevalence of insomnia, sleep-related breathing disorders, restless leg syndrome and sleepiness significantly increases [6–8]. Pregnancy may also aggravate an existing sleep disorder [9]. Although excessive daytime sleepiness is considered an indirect indicator of a significant sleep disorder [10], daytime hypersomnolence may in fact increase during pregnancy as consequence of the aforementioned obstetrical modifications [11].

Excessive body mass index (BMI) or weight gain during pregnancy, have been associated to adverse obstetric outcomes [12]. Studies assessing sleep problems and related risk factors during pregnancy are few, confined to small samples and carried out early in the first trimester or before delivery [7, 13]. Hence, the purpose of the present study

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MS Code : ARCH-11-4464 | ☑ CP | ☑ DISK

was to assess the presence of insomnia and sleepiness and related factors at the end of pregnancy.

Materials and methods

Study design and participants

This cross-sectional study was carried out at the Obstetrics and Gynecology Department of the Torrecárdenas Hospital, Almería, Spain in order to assess the presence of insomnia and sleepiness and related factors among gravids in the late third trimester. This hospital is major referral center providing reproductive healthcare basically to the city of Almería and surrounding peripheral areas. During the year 2010, 3,571 deliveries were attended.

Participants were recruited from the outpatient clinic during antenatal visits as a convenience sample over a 14-month period, from January 2010 to April 2011. Women refusing participation or incapable of understanding the items included in the questionnaires, and those with pre-gestational hypertension, hereditary or acquired thrombophilias or undergoing emergency procedures, were excluded. Prenatal care was performed among participants according to the recommendations of the Spanish Society of Obstetrics and Gynecology [14].

Research protocol of the study was reviewed and approved by the Research Committee of the Torrecárdenas Hospital, and carried out in accordance to the principles of the Helsinki Declaration. All participants were informed about the research and its purposes and written consent obtained.

Sample size calculation was based on the fact that 40% of pregnant women present sleeping problems in the third trimester [7]. Hence, a minimal sample of 358 gravids was calculated considering a 40% prevalence of insomnia with a 15% desired precision and a 99% confidence interval. Gravids completed a questionnaire containing socio-demographic data, the Insomnia Severity Index (ISI) [5, 15] and the Epworth Sleepiness Scale (ESS) [10, 16, 17]. Maternal weight, height and blood pressure measurements were also recorded upon survey. Further maternal pre-gestational weight, obstetrical history (labor and delivery characteristics) and neonatal information (neonatal weight [g], gender and Apgar scores) were obtained from gravids' medical charts.

Maternal variables included in the survey were age (years), place of residency (urban or rural), level of education, job status, church attendance, parity, pre-pregnancy BMI, neck circumference (cm), mid-upper arm circumference (cm), gestational age, weight gain during pregnancy, and current social habits (cigarette, alcohol, coffee, and/or isotonic drink consumption). Pre-pregnancy BMI was calculated as body weight (kg) divided by height (m) squared. BMI of participants were categorized according to internationally accepted cut-off points as low (<18.5 kg/m^2), normal (18.5–24.9 kg/m^2), or high (≥25 kg/m^2) Women with high BMI were further categorized as being overweight (25–29.99 kg/m^2) or obese (≥30 kg/m^2) [18]. Pregnancy weight gain was calculated as weight (kg) at survey minus pre-pregnancy weight. Blood pressure was obtained upon survey according to standard techniques.

The Insomnia Severity Index

The ISI includes seven items targeting sleep disturbance severity, sleep-related satisfaction and the degree of daytime functional impairment, impairment perception and distress and concern related to the sleeping problem. Each item is rated on a 5-point Likert scale (0–4) and summed up to provide a total score ranging from 0 to 28. Higher scores reveal more severe insomnia. Scores may be categorized as 0–7 (no clinically significant insomnia) or 8–28 (some degree of insomnia). The latter can be further divided into 8–14 (sub-threshold insomnia or mild); 15–21 (moderate insomnia) and 22–28 (severe insomnia) [5, 15]. The Spanish version of the ISI was used in this research which has shown adequate internal consistency in non-pregnant women [5].

The Epworth Sleepiness Scale

The ESS is a patient rated 8-item instrument which quantifies on a 3-point scale the perceived severity of daytime sleepiness and insomnia-related interference with daytime functioning. A global score is obtained by summing the graded eight items. A score of 10 or more is considered as sleepy whereas 18 or more as very sleepy [10, 16]. The validated Spanish version of the ESS was used which has shown appropriate internal consistency, reliability, and evidenced measuring validity [17].

Statistical analysis

Statistical analysis was performed using SPSS statistical package (Version 18.0 for Windows, SPSS Inc, Chicago IL, USA). Data are expressed as medians, interquartile ranges [IQR], beta coefficients and 95% confidence intervals (CI). The Kolmogorov–Smirnov test was used to determine the normality of data distribution. According to this, continuous non parametric data were compared using the Mann–Whitney test (two independent samples) or the Kruskal–

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Wallis test (various independent samples). Rho Spearman coefficients were calculated to determine correlations between ISI and ESS scores and various numeric variables (bivariate analysis). Multiple linear regression analysis was performed to obtain best fit model predicting total ISI and ESS scores. A model was constructed for each scale (ISI and the ESS) which included independent variables found to be significant during bivariate analysis. A p value of <0.05 was considered as statistically significant.

Results

During the study period a total of 370 singleton gravids were surveyed. ISI and ESS total scores according to socio-demographic and pregnancy characteristics of the studied women are depicted on Table 1. Median [IQR] ISI total score was 11.0 [8.0]. The tool identified 73.5% of women with some degree of insomnia (Total ISI score 8–28) which was further categorized as mild (score 8–14, 45.4%, $n = 168$), moderate (score 15–21, 25.9%, $n = 96$) and severe (scores 22–28, 2.2%, $n = 2$). Median [IQR] ESS total score was 6.0 [5.0], with a 22.2% displaying scores suggestive of sleepiness (ESS scores $\geq$10). In two cases (0.5%) total ESS scores were 18 or more considered as very sleepy.

Median [IQR] maternal age and gestational age upon survey was of 31 [7.0] years and 39 [1.8] weeks, respectively. A 28.1% of gravids came from a rural area, 31.1% were unemployed housewives and 58.1% primigravid. Median pre-pregnancy BMI was 23.0 [5.0] kg/m^2, with 18.9% being overweight and 11.9% obese. Upon survey, 18.9% smoked and 0.8% consumed alcohol during pregnancy, presenting a median neck circumference, arm circumference and weight of 35.0 cm, 28.0 cm and 75.0 kg, respectively. Median weight gain during pregnancy was 13 [7.0] kg.

Insomnia Severity Index scores were significantly higher (higher risk of insomnia) among women who smoked, were older, had a shorter survey to birth interval (weeks) and had higher pre-pregnancy BMI values. Employed women, with higher weight at survey, and higher neonatal birth weight displayed higher ESS scores, suggesting increased sleepiness. Pregnancy ended in a cesarean section in 22.7% of surveyed women, who displayed significantly higher ESS scores.

Rho Spearman coefficients between ISI and ESS scores and several numeric variables are displayed on Table 2. Significant correlations were found between ISI scores and gestational age at survey and survey to birth interval and between ESS scores and maternal weight and arm circumference at survey and neonatal birth weight.

Final best reduced models predicting ISI and ESS scores after multiple linear regression analysis are presented in Table 3. Smoking habit, higher blood pressures and shorter survey to birth interval significantly predicted higher ISI scores, and hence a higher risk of insomnia. Employed status, increased arm circumference and neonatal weight predicted higher ESS scores (sleepiness).

Discussion

Pregnancy alters sleep characteristics from the very beginning to the end of gestation. Although polysomnographic methods allow the assessment of sleep architecture [19] they are not applicable to large populations and in many countries (i.e. Spain) pregnant women refuse their use. Sleep diaries constitute the gold standards for research [20], although they are difficult to be carried out in pregnant women. Updated studies relating to sleep disorders carried out during the first and early third trimesters of pregnancy do not give information about the validity or reliability of the used tool [7]. Studies assessing sleep characteristics just prior to birth among term pregnant women are scarce or lacking. Facco et al. [7] studied pregnant women at the beginning of the third trimester whereas Higgins et al. [13] studied risk of sleep disordered breathing just before delivery or in the puerperium. To the best of our knowledge our series may be in fact the first to specifically use two validated tools (the ISI and the ESS) in the late third trimester (median 39 weeks) and find that more than 70% of women have some degree of insomnia and 22.2% had sleepiness. Both tools have previously been used among mid-aged women [5, 17]. However, worth mentioning is the fact that both tools have not been specifically validated among pregnant women.

The ISI is a simple, reliable and validated tool that provides a quantitative index of perceived insomnia severity. As mentioned, the tool identified 73.5% of women with some degree of insomnia (ISI scores $\geq$ 8) further classified as mild (50.5%), moderate (15.7%) and severe (3.8%). Thus, mild degree insomnia is the most frequent complaint at the end of pregnancy. One study performed by Facco et al. [7] found that early in the third trimester of pregnancy (gestational age 30.0 $\pm$ 2.2 weeks) short sleep duration is affected in 39.9% of cases and that poor sleep quality (as measured with the Pittsburgh Sleep Quality Index) increased from 39.0% in the first trimester of pregnancy to 53.5% in the early third trimester. Bivariate analysis in our series found that higher ISI scores significantly correlated to maternal age, smoking habit, shorter survey to birth interval, and pre-pregnancy weight. According to calculated rho Spearman coefficients, ISI

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Table 1 ISI and EES total scores according to the characteristics of gravids

	ISI score	ESS score
Socio-demographic characteristics		
Age (years): 31.0 [7.0]		
<20 ($n = 17$)	9.0 [7.0]	6.0 [5.0]
20–30 ($n = 163$)	12.0 [7.0]	6.0 [6.0]
>30 ($n = 190$)	10.5 [9.0]	7.0 [5.0]
p*	0.04[a]	0.62[a]
Rural residency		
No ($n = 266$)	11.0 [8.0]	7.0 [5.0]
Yes ($n = 104$)	11.0 [7.0]	6.0 [5.0]
p	0.80[b]	0.31[b]
Level of education		
None ($n = 4$)	6.0 [6.0]	3.5 [3.0]
Elementary ($n = 95$)	12.0 [6.0]	6.0 [5.0]
High school ($n = 129$)	12.0 [7.0]	7.0 [5.0]
University ($n = 142$)	10.0 [9.0]	7.0 [5.0]
p	0.10[a]	0.11[a]
Employment status		
No ($n = 115$)	11.0 [6.0]	6.0 [6.0]
Yes ($n = 255$)	11.0 [8.0]	7.0 [4.0]
p	0.68[b]	0.003[b]
Church assistance		
No ($n = 322$)	11.0 [8.0]	6.5 [5.0]
Yes ($n = 48$)	10.0 [9.0]	6.0 [5.0]
p	0.72[b]	0.69[b]
Tobacco use		
No ($n = 300$)	10.0 [8.0]	6.0 [5.0]
Yes ($n = 70$)	13.0 [6.0]	6.0 [6.0]
p	0.02[b]	0.47[b]
Alcohol use		
No ($n = 367$)	11.0 [8.0]	6.0 [5.0]
Yes ($n = 3$)	17.0 [9.0]	8.0 [7.0]
p	0.09[b]	0.93[b]
Coffee consumption		
No ($n = 226$)	11.0 [8.0]	7.0 [5.0]
Yes ($n = 144$)	11.0 [8.0]	6.0 [5.0]
p	0.71[b]	0.36[b]
Isotonic drink consumption		
No ($n = 204$)	11.5 [8.0]	6.0 [5.0]
Yes ($n = 166$)	11.0 [8.0]	7.0 [5.0]
p	0.37[b]	0.72[b]
Obstetrical history and pregnancy clinical characteristics		
Parity 0.0 [1.0]		
0 ($n = 215$)	11.0 [8.0]	7.0 [5.0]
1 ($n = 119$)	11.0 [7.0]	6.0 [5.0]
≥2 ($n = 36$)	11.5 [9.0]	7.0 [4.0]
p	0.80[a]	0.70[a]
Gestational age at survey (weeks) 39.0 [1.8]		
<39 ($n = 122$)	11.0 [8.0]	6.0 [5.0]
≥39 ($n = 248$)	11.0 [7.0]	6.5 [5.0]

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Table 1 continued

	ISI score	ESS score
p	0.09[b]	0.87[b]
Gestational age at birth (weeks) 40.0 [2.0]		
<40 ($n = 102$)	12.0 [8.0]	7.0 [4.0]
≥40 ($n = 268$)	11.0 [8.0]	6.0 [5.0]
p	0.38[b]	0.56[b]
Survey to birth interval (weeks) 0.5 [1.5]		
<0.5 ($n = 179$)	12.0 [7.0]	7.0 [6.0]
≥0.5 ($n = 191$)	10.0 [8.0]	6.0 [5.0]
p	0.01[b]	0.42[b]
Pre-pregnancy BMI (kg/m^2) 23.0 [5.0]		
<18.5 ($n = 18$)	9.0 [7.0]	7.0 [7.0]
18.5–24.99 ($n = 238$)	10.5 [8.0]	6.0 [5.0]
25.0–29.99 ($n = 70$)	12.0 [6.0]	6.0 [4.0]
≥30.0 ($n = 44$)	11.0 [7.0]	8.0 [5.0]
p	0.03[a]	0.25[a]
Weight (kg) at the time of survey 75.0 [15.0]		
<75 ($n = 176$)	10.0 [9.0]	6.0 [6.0]
≥75 ($n = 194$)	12.0 [7.0]	7.5 [5.0]
p	0.16[b]	0.001[b]
Weight gain during pregnancy (kg) 13.0 [7.0]		
<13 ($n = 181$)	10.0 [8.0]	6.0 [5.0]
≥13 ($n = 189$)	12.0 [8.0]	7.0 [6.0]
p	0.43[b]	0.08[b]
Neck circumference (cm) 35.0 [4.0]		
<35 ($n = 166$)	11.0 [8.0]	6.0 [6.0]
≥35 ($n = 204$)	11.0 [8.0]	7.0 [4.0]
p	0.67[b]	0.17[b]
Arm circumference (cm) 28.0 [5.0]		
<28 ($n = 98$)	10.0 [7.0]	6.0 [5.0]
≥28 ($n = 272$)	12.0 [7.0]	7.0 [5.0]
p	0.10[b]	0.17[b]
Systolic blood pressure at survey (mmHg) 113.5 [16.0]		
<113.5 ($n = 185$)	10.0 [9.0]	7.0 [5.0]
≥113.5 ($n = 185$)	12.0 [7.0]	6.0 [5.0]
p	0.09[b]	0.79[b]
Low birth weight (g) 3,310 [580]		
<3,310 ($n = 184$)	11.0 [8.0]	6.0 [5.0]
≥3,310 ($n = 186$)	11.0 [7.0]	7.0 [6.0]
p	0.92[b]	0.01[b]
Male fetal sex		
No ($n = 181$)	12.0 [8.0]	6.0 [5.0]
Yes ($n = 189$)	11.0 [8.0]	7.0 [5.0]
p	0.18[b]	0.11[b]

Data are presented as medians [interquartile range]

BMI body mass index

**p* values were determined with the Kruskall–Wallis test[a] or the Mann–Whitney test[b]

scores positively correlated to gestational age at survey and inversely to the survey to birth interval.

Age and obesity have been associated to poor sleep in both non-pregnant and pregnant women [5, 7, 21]. Multiple linear regression analysis of the present study found a positive correlation between ISI total scores and smoking habit and systolic blood pressure levels. Scores inversely correlated to survey to birth interval. In this model,

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Table 2 Rho Spearman coefficient correlations between ISI and ESS scores and several numeric variables ($n = 370$)

	ISI	ESS
ISI	–	0.011 (0.83)
Maternal age	0.022 (0.66)	0.048 (0.35)
Educational level	0.021 (0.68)	0.069 (0.18)
Parity	0.031 (0.55)	−0.035 (0.50)
Pre-pregnancy BMI	0.062 (0.23)	0.067 (0.20)
Pre-pregnancy weight	0.056 (0.27)	0.081 (0.12)
Gestational age at survey	0.118 (0.02)	0.026 (0.62)
Survey to birth interval	−0.181 (0.0001)	−0.041 (0.42)
Weight at the time of survey	0.084 (0.10)	0.128 (0.01)
Weight gain during pregnancy	0.071 (0.17)	0.073 (0.16)
Neck circumference	0.038 (0.46)	0.118 (0.02)
Arm circumference	0.082 (0.11)	0.115 (0.03)
Systolic blood pressure	0.10 (0.05)	0.028 (0.59)
Diastolic blood pressure	0.054 (0.29)	−0.036 (0.49)
Gestational age at birth	−0.034 (0.51)	0.045 (0.39)
Neonatal birth weight	0.055 (0.29)	0.123 (0.02)

Values in parenthesis are p values

BMI body mass index

maternal age and BMI values were not significant correlates of ISI scores. Decreased sleeping hours is one of the most common causes of excessive daytime sleepiness, which can cause difficulty in performing daily tasks and causes irritability, moodiness and memory problems. Sleepiness, however, differs from fatigue or tiredness and has been reported in 12–34% of non-pregnant women [17, 22]. Moreover, reduced sleep duration has not only been associated to increased daytime sleepiness and decreased performance yet also to increased inflammatory cytokine production, insulin resistance and cardiovascular risk [23]. Associations between insomnia and maternal age, BMI values and employed status have been reported early in the third trimester of pregnancy [7].

The ESS has been reported to be a short and effective instrument used to assess excessive daytime sleepiness and screen for obstructive sleep-apnea [24]. Notwithstanding, some criticism has been raised in relation to its reliability [25]. Previous studies have reported daytime sleepiness in 23–45% of pregnant women using the ESS [7, 11, 22, 26]. The wide range in the prevalence of daytime pregnancy related sleepiness found with the ESS suggests that it may have some limitations. Finding no correlation between ISI and ESS scores in the present study seems to support this fact. Nevertheless, the prevalence of sleepiness in the present study was lower than that reported during the first (32.8%) and early third trimesters of pregnancy (30 weeks, 38.1%) [7].

The prevalence of sleepiness during pregnancy may vary in relation to gestational age, study design, and maternal ethnical and socio-demographical background [7, 11]. In the present study, multiple linear regression analysis found that ESS scores significantly correlated to maternal employment status and arm circumference and neonatal birth weight. As others have observed [27, 28], an increased maternal arm circumference (indirect measure of gestational weight gain) and neonatal birth weight may relate to an increased uterine fundus which exerts a ventilatory limitation that favors sleep disorders and sleepiness.

Finally as for the limitations of this study one can mention its cross-sectional nature and the use of a convenience sample obtained at the end of pregnancy. Sampling late in the third trimester is in fact a limitation, as it does not allow quantifying changes in the prevalence of sleep problems throughout pregnancy or determining the influence of these changes over obstetrical outcome. Despite these limitations, the present study adds to the few found in the literature assessing insomnia and sleepiness in the late third trimester of pregnancy, in which both problems were prevalent and related to lifestyle factors and maternal–neonatal body composition. Further research is warranted in this regard to support the present findings.

Table 3 Final best reduced model predicting total ISI and ESS scores: multiple linear regression analysis ($n = 370$)

	Beta coefficient	Standard error	CI 95%	t	p value
Model for ISI scores					
Smoking	1.686	0.713	0.283–3.088	2.363	0.01
Systolic blood pressure (mmHg)	0.036	0.02	−0.003–0.074	1.819	0.07
Survey to birth interval (weeks)	−0.106	0.283	−1.616 to −0.504	−3.748	0.0001
Model for ESS scores					
Employed	1.198	0.407	0.397–1.998	2.943	0.003
Arm circumference (cm)	0.113	0.046	0.022–0.204	2.452	0.015
Neonatal birth weight	0.001	0.01	0.001–0.002	2.316	0.021

ISI score: $r^2 = 0.06$; adjusted $r^2 = 0.05$, $p = 0.001$; ESS score: $r^2 = 0.06$; adjusted $r^2 = 0.05$, $p = 0.001$

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Conflict of interest The authors declare no conflict of interest.

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