ORIGINAL ARTICLE ASIAN JOURNAL OF MEDICAL SCIENCES

Prevalence of obstructive sleep apnea among Southern Indian pregnant women attending antenatal care

Mirnalini VS[1], Kirthana G[2], Roshini S[3], Keerthika R[4], Balamurugan[5], Chandrasekhar C[6]

[1]Postgraduate Resident, [2]Associate Professor, [5]Professor, [6]Professor and Head, [3,4]Respiratory Therapist, Department of Respiratory Medicine, A.C.S Medical College, Chennai, Tamil Nadu, India

Submission: 05-07-2023 Revision: 30-12-2023 Publication: 01-02-2024

ABSTRACT

Background: Physiological and hormonal changes during pregnancy can alter the sleep patterns of the pregnant women and were said to be precursor for the development of obstructive sleep apnea (OSA) and complication of pre-existing OSA. Developing country like India has no health cost distribution for the treatment, as this condition's treatment trends absorbs 65–82% of all health cost. There is oblivious state among clinicians and patients, self-reporting of the symptoms are poor which, in turn, results to upshot underdiagnoses of OSA among southern Indian population. **Aims and Objectives:** The aim of the study is to screen the prevalence of OSA among the southern Indian pregnant women attending antenatal care and to evaluate its predisposing factors. **Materials and Methods:** We enrolled 305 pregnant women according to our study selection criteria, attended antenatal care at ACS medical college and hospitals from Chennai. On face-to-face basis, berlin questionnaire screening was done. With a brief interview, sociodemographic details, medical records and laboratory parameters were obtained. To cluster the risk of OSA prevalence, percentage was estimated using frequency distribution. Chi-square analysis was done to obtain significant relationship between contributing factors and OSA symptoms. Statistical testing was done with SPSS software version 21. **Results:** Among 305 pregnant women, 31.8% (97) were shown to have high-risk OSA and 68.2% (208) low-risk OSA. Across the trimester, high-risk OSA were noted among 8.2% (25), 11.1% (34), and 15.4% (48) at first, second, and third trimester, respectively. Age, body mass index, occupation, neck circumference, multiple pregnancy, and presence of conditions such as gestational hypertension, chronic hypertension, adenoids, mallampatti grade, nasal congestion, and family history of OSA can be the predisposing factors which could influence the OSA symptoms. **Conclusion**: The future investigations should rely on the analysis of the fetal outcomes after proper diagnosis of OSA. Furthermore, independent predictive values of physical signs, history, risk factors, and mechanisms behind the progression of OSA should be studied well. Region and area specific difference of risk of OSA to identify disparities and to promote decentralization of sleep care could be done.

Key words: Antenatal care; Berlin screening; Gestational risk factors; Obstructive sleep apnea; Snoring

Access this article online

Website: http://nepjol.info/index.php/AJMS

DOI: 10.3126/ajms.v15i2.56383

E-ISSN: 2091-0576

P-ISSN: 2467-9100

INTRODUCTION

Obstructive sleep apnea (OSA) is a global health concern, estimated to affect more than 936 million individuals worldwide. During the early 1990s, there were limited data available regarding the prevalence of OSA within the Indian population. It was not until 2006 that pioneering research suggested that approximately 34 million people in India could be suffering from sleep apnea syndrome, emphasizing the potential for relieving the disabling symptoms associated with these disorders through proper diagnosis and intervention.[1]

Address of Correspondence:
Dr. Mirnalini VS, Postgraduate Resident, Department of Respiratory Medicine, A.C.S Medical College, Chennai, Tamil Nadu, India.
Mobile: +91-7339417181. **E-mail:** miusaravan@gmail.com

Subsequently, a study in North India revealed that the prevalence of OSA was significantly higher in men than in women. The most recent comprehensive study in 2019 observed the global phenotype of OSA and highlighted a rising prevalence of OSA in India, with an estimated number of individuals affected, ranking India as one of the countries with a substantial OSA burden. Notably, much of the existing data has predominantly focused on OSA among male individuals.[2,3] This ailment is defined by the repeated occurrence of either partial or total blockage of the upper airway while sleeping which leads to a range of negative health consequences, such as cardiovascular disease, metabolic abnormalities, and a reduced quality of life.[4]

While extensive research has examined OSA in diverse populations, its prevalence and implications among pregnant women have received relatively less attention, particularly in the context of Southern India. Pregnancy is a distinct physiological condition that places significant stress on the respiratory and cardiovascular systems. Pregnancy presents a crucial opportunity to study the frequency and medical implications of OSA.[5] During pregnancy, various physical and hormonal changes occur that affect women's sleep patterns. These changes can lead to the development or exacerbation of OSA. The elevated levels of progesterone and estrogen that occur during pregnancy will stimulate the strengthening of capillaries, excessive secretion, and swelling of the upper airway mucosa. This leads to a reduction in the size of the airway and an increase in airway resistance. These changes often commence in the early stages of the first trimester and gradually intensify over the course of the pregnancy. As pregnancy proceeds, these factors can cause a decrease in the size of the nasopharynx, oropharynx, and larynx, leading to an increase in airflow resistance and an increase in the Mallampatti score.[6] If OSA is not addressed, it can increase the likelihood of difficulties during pregnancy, including gestational hypertension (GHTN), preeclampsia, gestational diabetes, and preterm birth. These complications can have serious effects for the health of both the mother and the fetus. The potential risks of untreated OSA during pregnancy, such as GHTN, preeclampsia, gestational diabetes, and premature birth, emphasize the importance of addressing this health issue.[7]

Numerous studies have predominantly focused on the development of screening strategies for pregnant women due to the potential contribution of OSA to adverse outcomes for both the mother and the fetus.[8] Some of these studies have notably underscored the Berlin questionnaire as a reliable tool for predicting OSA during pregnancy.[9,10] Nevertheless, there remain unresolved controversies surrounding the risk factors that truly hold significant associations. These issues have yet to be adequately explored, particularly among pregnant women in India, specifically within the Southern Indian population.

Hence, this study aims to investigate the frequency of OSA in pregnant women from Southern India, as well as to discover any relevant risk factors and clinical outcomes linked to this condition. Gaining a thorough grasp of the extent of OSA in this particular group will enable healthcare professionals to improve antenatal care procedures, introduce timely treatment options, and ultimately improve the health outcomes for both mothers and their infants.

Aims and objectives

The aim of this study was to screen the prevalence of OSA among the southern Indian pregnant women attending antenatal care and to evaluate its predisposing factors.

The objectives of this study were as follows:

1. To screen the prevalence of OSA symptoms using Berlin's questionnaire among the pregnant women.
2. To describe the association between the OSA symptoms and the various contributing factors.

MATERIALS AND METHODS

After approval from the Institutional Ethics Committee with No. 189/2021/IEC/ACSMCH and obtaining written informed consent from all the eligible patients for the study, a cross-sectional, hospital-based study, carried out in the department of Gynecology and Obstetrics Outpatient Department for 2 years from March 05, 2021, at ACS Medical College and Hospitals, Chennai.

A 308 pregnant women who were attending antenatal services, including both primigravida and multigravida pregnant women, experiencing frequent, loud snoring, witnessed episodes of breathing pauses during sleep, excessive daytime sleepiness, fatigue or unrefreshing sleep, chronic HTN before pregnancy, recently diagnosed gestational hypertension or GHTN in a previous pregnancy, obesity defined by pre-pregnancy body mass index (BMI) $\geq$27.5 kg/m^2, and having diabetes mellitus (DM) before pregnancy or a history of gestational DM in a previous pregnancy or recently diagnosed gestational DM were included in the study.

Patients with history of abortion, ectopic pregnancy, or twin pregnancy, known OSA currently treated with CPAP, history of sleep disorders (insomnia, movement disorders, parasomnias, circadian rhythm disorders, and central disorders of hypersomnolence), significant medical conditions (chronic kidney disease, HIV, TB, viral hepatitis,

and sexually transmitted diseases), and life-threatening pregnancy-related conditions (placental issues, hemorrhage, pre-eclampsia, venous thromboembolism, epilepsy, and intracerebral hemorrhage) were excluded from the study.

Sociodemographic and medical details of the patients were collected. Cross-examination of patients' records was performed to gather information on measures of parity, gravida, trimester, and the number of pregnancies. Laboratory reports of the participants were reviewed to confirm the presence of predisposing factors related to a history of chronic HTN, DM, steroid use, familial predisposition, PCOD, adenoids, and nasal congestion. After a succinct patient review, a physical examination for the analysis of neck circumference using inch tapes, height with a stadiometer, weight using a weighing machine, blood pressure with a sphygmomanometer, and Mallampatti grading after visualization of pharyngeal structures was carried out on every pregnant woman. Body mass index was calculated with the standard formula. Blood samples were obtained to calibrate values of fasting blood sugar, postprandial blood sugar, Hb, and lipid profile.

Berlin questionnaire screening (Questionanaire 1)

All the participants were asked to respond to the pre-validated 11-item Berlin questionnaire which explores the risk of OSA with three domains: snoring severity (05 items), excessive daytime sleepiness (03 items), and history pertaining to obesity/HTN (02 items). Scoring of the Berlin questionnaire is as follows:

Positive responses to 05 items in domain I about snoring and witnessing breathing cessation were defined as frequent symptoms (>3 times per week) (2 or more points).

Positive responses to 03 items in domain II are defined by >3 times per week frequency of tiredness and drowsiness (2 or more points).

Positive responses to 02 items of domain III are defined as the presence of HTN and obesity (BMI ≥30 kg/m^2) (1 or 2 points).

Overall risk stratification of OSA

High-risk OSA, two or more domains are positive, and low-risk OSA, one or no domain is positive.

Statistical analysis

To establish the prevalence of OSA among pregnant women, frequency distribution was used to estimate the count and percentage. The relationship between dependent variables such as sociodemographics, anthropometric measurements, pregnancy traits, and systemic risk with the risk of OSA was computed using a Chi-square analysis. P<0.005 was considered significant. Statistical interpretation was performed using SPSS software version 21.

RESULTS

As seen in Table 1 age showed a significant association with OSA risk (P<0.001). Women aged 20–25 years had a significantly higher risk of OSA compared to those aged 26–30 years and above 30 years. Education level also played a role in OSA risk, with illiterate individuals having a higher risk. Occupations involving night shifts were associated with increased OSA risk, and a higher BMI (above 30 kg/m^2) was strongly correlated with OSA. Neck circumference and Mallampatti grade were also significant factors, with larger neck circumferences and higher Mallampatti grades indicating a higher risk of OSA.

As per findings mentioned in Table 2 it was found that the trimester of pregnancy had a significant impact on OSA risk (P=0.016). Women in the third trimester had a significantly higher risk of OSA compared to those in the first and second trimesters. In addition, the number of pregnancies (primigravida vs. multigravida) was strongly associated with OSA risk.

Table 3 delves into the association of systemic risk factors with the risk of OSA. Notably, a family history of OSA significantly increased the risk of OSA (P=0.001). Among the pregnancy-related clinical conditions, GHTN significantly elevated the risk of OSA (P<0.001). Endocrinal risk factors such as polycystic ovarian syndrome (PCOD), DM, and hypothyroidism were all associated with higher OSA risk. Cardiovascular risk factors, including HTN, and pulmonary risk factors such as adenoids and nasal congestion, also demonstrated a significant association with OSA risk.

These findings highlight the importance of sociodemographic, anthropometric, and systemic factors in assessing OSA risk among pregnant women. Understanding these risk factors can aid in the early identification and intervention for OSA during pregnancy, potentially improving maternal and fetal outcomes.

DISCUSSION

OSA is a substantial public health problem due to its various adverse effects on both the pregnant women and their offspring.[11-13] OSA can trigger complications such as gestational diabetes, GHTN, pregnancy-related obesity, and other systemic comorbiditie.[14,15] In this study, the prevalence of OSA among pregnant women in a Southern

Table 1: Association of sociodemographical features and anthropometric measurements with OSA

Variables	Category	High-risk OSA (n%)	Low-risk OSA (n%)	P-value
Age	20–25 years	7 (10.8)	83 (26.9)	0.000*
	26–30 years	45 (69.2)	99 (32.1)	
	Above 30 years	45 (69.2)	26 (8.4)	
Education	Graduate	25 (38.5)	64 (20.8)	0.014
	Schooling	27 (41.5)	65 (21.1)	
	Illiterate	45 (69)	79 (26)	
Occupation	Day shift workers	23 (35)	42 (14)	0.000*
	Night shift workers	09 (14)	31 (10)	
	Housewife	65 (51)	135 (44)	
BMI	18.6–24.9 kg/m^2	02 (3)	35 (11)	0.000*
	25.0–29.9 kg/m^2	14 (22)	157 (51)	
	Above 30 kg/m^2	81 (75)	16 (5)	
Neck circumference	Above 14 inches	35 (54)	40 (13)	0.004*
	Below 14 inches	72 (46)	174 (87)	
Mallampatti grade	Grade 01	03 (5)	74 (24)	0.000*
	Grade 02	18 (28)	100 (33)	
	Grade 03	25 (39)	32 (10)	
	Grade 04	50 (77)	02 (0.6)	

OSA: Obstructive sleep apnea

Table 2: Association of pregnancy traits with risk of OSA

Variables	Category	High-risk OSA (%)	Low-risk OSA (%)	P-value
Trimester	First	25 (41)	79 (26)	0.016
	Second	34 (55)	58 (19)	
	Third	48 (79)	71 (23)	
Number of pregnancies	Primigravida	18 (30)	119 (39)	0.000*
	Multigravida	79 (94)	89 (29)	

OSA: Obstructive sleep apnea

Table 3: Association of systemic risk factors with risk of OSA

System involved	Variables	Category	High-risk OSA (%)	Low-risk OSA (%)	P-value
Past history	Family history of OSA	Present	38 (55)	24 (45)	0.001*
		Absent	79 (68)	184 (32)	
	Steroidal medication	Used	33 (40)	50 (24)	0.074
		Not used	64 (605)	158 (76)	
Pregnancy related clinical conditions	GDM	Present	06 (60)	04 (40)	0.060
		Absent	91 (69)	204 (31)	
	GHTN	Present	27 (69)	12 (31)	0.000*
		Absent	70 (26)	196 (74)	
Endocrinal risk factors	PCOD	Present	20 (47)	23 (54)	0.033
		Absent	77 (29)	185 (71)	
	DM	Present	26 (59)	18 (41)	0.000*
		Absent	71 (27)	190 (73)	
	Hypothyroidism	Present	12 (57)	06 (33)	0.004*
		Absent	85 (30)	202 (70)	
Cardiovascular risk factors	HTN	Present	32 (82)	07 (18)	0.000*
		Absent	65 (24)	201 (76)	
	Anemia	Present	17 (49)	18 (51)	0.024
		Absent	80 (30)	190 (70)	
	Hyperlipidemia	Present	16 (41)	23 (59)	0.200
		Absent	81 (31)	185 (70)	
Pulmonary risk factors	Adenoids	Present	32 (80)	08 (20)	0.000*
		Absent	65 (24)	200 (76)	
	Nasal congestion	Present	30 (63.8)	17 (36.2)	0.000*
		Absent	67 (26)	191 (74)	

GHTN: Gestational hypertension, PCOD: Polycystic ovarian syndrome, DM: Diabetes mellitus, HTN: Including hypertension, OSA: Obstructive sleep apnea

Indian population was screened and its predisposing factors were evaluated.

The demographic analysis of the pregnant women attending the antenatal care revealed various aspects related

Berlin Questionnaire®
Sleep Apnea

Height (m) _____ Weight (kg) _____ Age _____ Male / Female

Please choose the correct response to each question.

Category 1

1. Do you snore?
□ a. Yes
□ b. No
□ c. Don't know

If you answered 'yes':

2. You snoring is:
□ a. Slightly louder than breathing
□ b. As loud as talking
□ c. Louder than talking

3. How often do you snore?
□ a. Almost every day
□ b. 3-4 times per week
□ c. 1-2 times per week
□ d. 1-2 times per month
□ e. Rarely or never

4. Has your snoring ever bothered other people?
□ a. Yes
□ b. No
□ c. Don't know

5. Has anyone noticed that you stop breathing during your sleep?
□ a. Almost every day
□ b. 3-4 times per week
□ c. 1-2 times per week
□ d. 1-2 times per month
□ □ e. Rarely or never

Category 2

6. How often do you feel tired or fatigued after your sleep?
□ a. Almost every day
□ b. 3-4 times per week
□ c. 1-2 times per week
□ d. 1-2 times per month
□ e. Rarely or never

7. During your waking time, do you feel tired, fatigued or not up to par?
□ a. Almost every day
□ b. 3-4 times per week
□ c. 1-2 times per week
□ d. 1-2 times per month
□ e. Rarely or never

8. Have you ever nodded off or fallen asleep while driving a vehicle?
□ a. Yes
□ b. No

If you answered 'yes':

9. How often does this occur?
□ a. Almost every day
□ b. 3-4 times per week
□ c. 1-2 times per week
□ d. 1-2 times per month
□ e. Rarely or never

Category 3

10. Do you have high blood pressure?
□ Yes
□ No
□ Don't know

Scoring Berlin Questionnaire

The questionnaire consists of 3 categories related to the risk of having sleep apnea. Patients can be classified into High Risk or Low Risk based on their responses to the individual items and their overall scores in the symptom categories.

Categories and Scoring:
Category 1: items 1, 2, 3, 4, and 5;
Item 1: if '**Yes**', assign **1 point**
Item 2: if '**c**' or '**d**' is the response, assign **1 point**
Item 3: if '**a**' or '**b**' is the response, assign **1 point**
Item 4: if '**a**' is the response, assign **1 point**
Item 5: if '**a**' or '**b**' is the response, assign **2 points**
Add points. *Category 1 is positive if the total score is 2 or more points.*

Category 2: items 6, 7, 8 (item 9 should be noted separately).
Item 6: if '**a**' or '**b**' is the response, assign **1 point**
Item 7: if '**a**' or '**b**' is the response, assign **1 point**
Item 8: if '**a**' is the response, assign **1 point**
Add points. *Category 2 is positive if the total score is 2 or more points.*

Category 3 is positive if the answer to item 10 is '**Yes**' or if the BMI of the patient is greater than 30kg/m2.
(BMI is defined as weight (kg) divided by height (m) squared, i.e.., kg/m2).

High Risk: if there are 2 or more categories where the score is positive.

Low Risk: if there is only 1 or no categories where the score is positive.

Additional Question: item 9 should be noted separately.

Questionanaire 1: Questionanaire used for scoring

to their risk of OSA. The results indicated that pregnant women above 30 years of age had a high risk of OSA compared to the younger age groups. This observation is in line with the previous studies showing that age is a significant risk factor for OSA.[16,17] In this study, education level was also found to be a significant factor, with illiterate women having a higher risk of OSA. This is consistent with research suggesting that a lower level of education may be associated with a higher prevalence of OSA.[3] The occupation of pregnant women also played a role in OSA risk, with housewives having a higher risk compared to day and night shift workers. This observation may be linked to differences in lifestyle and daily routines.

Anthropometric measurements were crucial in evaluating OSA risk among the study participants. A higher Mallampatti grade, indicating a more constricted upper airway, was associated with an increased risk of OSA. This is consistent with the previous research that has linked airway constriction to OSA development.[18,19] In addition, BMI was a significant factor in OSA risk, with obese pregnant women having a much higher risk compared to those with a normal BMI. This finding aligns with numerous studies that have shown a strong association between obesity and OSA.[11] Neck circumference, an indicator of upper airway fat deposits, was also a significant predictor of OSA risk, with a larger neck circumference associated with a higher risk.

Pregnancy-related factors were assessed to understand their contribution to OSA risk. The trimester of pregnancy did not significantly affect OSA risk. This finding contradicts some previous research that suggested an increased risk of OSA in the third trimester.[20] However, this discrepancy may be due to the relatively small sample size and the cross-sectional nature of this study. Gravida status was associated with OSA risk, with multigravida pregnant women having a higher risk compared to primigravida women. This may be due to differences in physiological adaptations in subsequent pregnancies.

Systemic risk factors were also explored, with a family history of OSA being a significant predictor of OSA risk. This supports the idea that genetic factors play a role in OSA development.[21,22] Steroidal medication use was associated with a higher OSA risk, consistent with the previous studies showing that certain medications can contribute to OSA.[15] A history of adenoids or nasal congestion was not significantly associated with OSA risk in this study.

The results of this study indicate that there are various demographic, anthropometric, and systemic factors that contribute to OSA risk in pregnant women. These findings are consistent with the previous research and emphasize the need for comprehensive screening and evaluation of OSA in this population. The creation of educational materials for pregnant women is essential to raise awareness about the risks and consequences of OSA. Early detection and intervention for OSA during pregnancy can help mitigate adverse outcomes for both mothers and their offspring.

Limitations of the study

The study is confined to a single clinical setting, limiting generalizability. Causal relationships couldn't be explored due to study design. Reliance on questionnaires without a gold standard diagnosis may affect precision. The lack of clinical interventions hinders exploration of therapeutic outcomes. These limitations should be considered in interpreting the study's findings.

CONCLUSION

This study found that there is a significant prevalence of OSA among pregnant women in a southern Indian population. Several demographics, anthropometric, and systemic risk factors were identified as contributors to OSA risk. These findings underscore the importance of screening and raising awareness about OSA in pregnant women to mitigate the potential adverse effects on maternal and fetal health. Further research with larger sample sizes and longitudinal studies are needed to confirm these findings and better understand the dynamics of OSA in pregnancy.

Study strengths

The study exhibited several notable strengths, including its cost-efficient symptom-based screening, the identification of modifiable factors for improved patient outcomes, and proactive efforts to raise awareness through the creation of infographics and pamphlets.

Future research opportunities

Promising avenues for future research include emphasizing community-based analysis, delving into the outcomes of OSA during pregnancy, exploring predictive values and the mechanisms behind OSA progression, and investigating regional disparities to promote decentralized sleep care.

ACKNOWLEDGMENTS

The authors would like to acknowledge the Institutional Ethics Committee of ACS Medical College and Hospitals for their approval and support in conducting this study. Special thanks to all the pregnant women who participated in this study. Thanks to department of obstetrics and gynecology department of A.C.S who have extended their help in completing the study.

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Authors Contribution:
MVS- Prepared first draft of manuscript, implementation of study protocol, data collection, data analysis, manuscript preparation and submission; **KG-** Definition of intellectual content, literature survey, concept, statistical analysis and interpretation; **R-** Data collection; **K-** Data collection; **B-** Editing and manuscript revision; **CC-** Manuscript revision.

Work attributed to:
A.C.S Medical College, Chennai, Tamil Nadu, India.

Orcid ID:
Dr. Mirnalini VS - https://orcid.org/0009-0003-2824-1121
Dr. Kirthana G - https://orcid.org/0009-0008-2097-1177
Roshini S - https://orcid.org/0009-0006-4650-2198
Keerthika R - https://orcid.org/0009-0009-9026-7326
Dr. Balamurugan - https://orcid.org/0000-0001-7067-7728
Chandrasekhar C - https://orcid.org/0000-0002-6610-0974

Source of Support: Nil, **Conflicts of Interest:** None declared.