ORIGINAL ARTICLE

OSA (Obstructive Sleep Apnea) Risk Factor-Based Predictive Model for New-onset Preeclampsia during Pregnancy in Indonesian Women

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ABSTRACT

Introduction: Preeclampsia is a potentially dangerous pregnancy complication characterized by high blood pressure and its prevalence is around 5-8% of all diseases that occur during pregnancy. However, OSA (Obstruction Sleep Apnea) causes inflammation and oxidative stress, endothelial damage, and metabolic disorders. This study aims to produce a risk factor model for OSA as a predictor of preeclampsia in pregnancy. **Methods:** TThis is anobservational analytic study with a Case-Control design using a retrospective approach, carried out at Wahidin Sudiro Husoda Mojokerto Hospital and Sakinah Mojokerto Hospital from October 2020 - February 2021. The samples were obtained by cluster random sampling of 272 people with the inclusion criteria for preeclampsia pregnant and normal pregnant > 32 weeks. The samples in the case and control groups were 136 and 136 people, respectively. The data analysis was carried out using binary logistic regression, which was a differentiating category scale. **Results:** : The results of the classification data in the models of the individual and familial risk factors of OSA have a suitable value of 95.2% and 80.5% (> 75%), respectively. Meanwhile, the results of data classification in the OSA incidence model have a good suitability value of 62.5% (>50%). The predictive probability data was used to predict the incidence of preeclampsia. The results of the data classification in the Preeclampsia incidence model have a good suitability value of 74.3% (>50%). **Conclusion:** The OSA model is an appropriate, cheap, and easy screening in predicting the incidence of preeclampsia.

Keywords: OSA , Predictor, Risk Factor, Peeclampsia, Pregnancy

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INTRODUCTION

Preeclampsia is the most serious complication in which mothers experience high blood pressure during pregnancy, not due to hypertension but due to a placental nidation. Furthermore, its effect is the appearance of HELLP (Hemolysis, Elevated Liver Enzymes, and Low Platelet Count) syndrome or hemolysis, elevated liver enzymes, and low platelet counts. The HELLP syndrome associated with preeclampsia results in many maternal deaths (1–3).

The prevalence of preeclampsia is around 5-8% of all diseases that occur during pregnancy (1). In addition, it is a major cause of perinatal and maternal mortality globally, with approximately 50,000 to 60,000 deaths each year. However, sleep apnea syndrome (Obstructive sleep apnea) is a possible causal factor for various cardiovascular diseases (4,5). Epidemiological studies showed a prevalence of 2-13% of OSA (obstructive sleep apnea) in pregnancy. Snoring is often associated with cardinal symptoms, where 15-25% of pregnant women with OSA are at risk for hypertension and insulin-resistant diabetes. Obstructive sleep apnea causes inflammation and oxidative stress response, endothelial damage, and metabolic disturbances (6–8).

Obstructive sleep apnea is a sleep disorder characterized

by periodic apnea due to an upper airway obstruction during sleep that causes intermittent airflow obstruction, hypoventilation, and nocturnal hypoxia. Furthermore, OSA is characterized by the presence of an airway obstruction that leads to brief respiratory arrest, completely or partially (9). Anatomical narrowing and increased resistance in the respiratory system can occur as high levels of estrogen and progesterone lead to swelling of the capillaries, hypersecretion, and mucosal edema of the upper respiratory tract. Pregnancy causes anatomical, physiological, and endocrine changes, including narrowing of the upper respiratory tract. Therefore, this study aims to produce a model for OSA (Obstructive Sleep Apnea) risk factors and incidence as predictors of pre-eclampsia during pregnancy. There are many studies to prevent the occurrence of preeclampsia, such as obstructive sleep apnea in pregnant women. A prospective study has shown that pregnant women have a 20% high risk of developing OSA in early pregnancy and increasing with gestational age (2,5).

MATERIALS AND METHODS

This is an observational analytic study with a Case-Control design using a retrospective approach. The first phase was carried out at Wahidin Sudiro Husoda Mojokerto Hospital, Sakinah Mojokerto Hospital, Sooko Health Center, and Gayaman Health Center from August 2019-April 2020. The samples in the case and control groups were 136 and 136 people, respectively, with a total of 272. Pregnant women with preeclampsia were 20 - 38 weeks, while pregnant women in control were > 38 weeks. There was a complete pregnancy record. The sampling technique used was Cluster Random Sampling. In addition, OSA was measured using a berlin questionnaire and preeclampsia was measured for blood pressure, edema, and proteinuria. The inferential data analysis used was binary logistic regression, which was a differentiating category scale (7,10,11).

This is anobservational analytic study with a Case-Control design using a retrospective approach, carried out at Wahidin Sudiro Husoda Mojokerto Hospital and Sakinah Mojokerto Hospital from October 2020 - February 2021. The samples were obtained by cluster random sampling of 272 people with the inclusion criteria for preeclampsia pregnant and normal pregnant > 32 weeks. The samples in the case and control groups were 136 and 136 people, respectively. The data analysis was carried out using binary logistic regression, which was a differentiating category scale.

ETHICAL CLEARANCE

This study was approved by Reseach Ethics Committee, Faculty of Nursing Universitas Airlangga No : 2091-KEPK.

RESULT

The table I. and II. shows that the significant variables are OSA Risk Factor (X) and Incidence (Z) because they have a significant value below 0.05. The variables with a significant effect are maternal age, neck circumference, parity, history of hypertension, and OSA. This means that when the 5 variables above are used as predictors, it can be concluded that the preeclampsia response has a significant effect.

Logistic regression analysis uses the Backward Stepwise (Wald) method. The OSA factor has a directly proportional and significant influence on preeclampsia, and therefore the higher the OSA level of pregnant women, the higher the tendency for preeclampsia. A constant negative value further strengthens the fact that the incidence of OSA has an effect on preeclampsia in pregnant women (12–14). The logistic equation model is used to predict the incidence of Preeclampsia (Y), based on the independent variables included in the model. The results of the regression model predictive probability equation for the incidence of preeclampsia (Y) are as follows:

Preeclampsia = 1*Maternal Age + 1*Neck Circumference + 1*Parity + 1*History of Hypertension + 5*OSA

The gestational age affects OSA, especially the third-trimester increases body weight, obesity, and fat accumulation. Pregnant women, especially in their third-trimester experience an increase in the frequency of snoring, sleep disturbances, and poor sleep quality due to air pollution.

Table.I. Family risk factors for OSA in respondents at hospitals and health centers in the Mojokerto region in 2020-2021

Variable	Code / Category	Frequency	Percent (%)	M ± SD
Maternal age (X1.1)	1no risk (reproduction: 20-35 years)	205	75.4	29.74 ± 6.20
	2. Age at risk: < 20 years or > 35 years	67	24.6	
Gestational age (X1.2)	1.Trimester 1: 0-12 mg	7	2.6	34.45 ± 7.15
	2.Trimester 2: 13-24 mg	25	9.2	
	3.Trimester 3: 25-32 mg	240	88.2	
BMI (X1.3)	1.Normal: 18,5 – 23 kg/ cm	41	15.1	28.38 ± 4.98
	2. Low Weight : < 18,5 kg/ cm	12	4.4	
	3.Obesity: > 25 kg/ cm	219	80.5	

CONTINUE

Table.I. Family risk factors for OSA in respondents at hospitals and health centers in the Mojokerto region in 2020-2021(CONT.)

Variable	Code / Category	Frequency	Percent (%)	M ± SD
Neck circumference (X1.4)	1. Small	234	86.0	34.72 ± 3.55
	2. Big	38	14.0	
Disease (X1.5)	1. there are no diseases (pharyngitis, rhinitis, allergies)	268	98.5	-
	2. there are diseases (pharyngitis, rhinitis, allergies)	4	1.5	
Wife's Occupation (X1.6)	1.not Working	220	80.9	-
	2.Physical	18	6.6	
	3.Manager	27	9.9	
	4.Physical and manager	7	2.6	
Parity (X1.7)	1.Do not have kids yet	53	19.5	1.61 ± 1.17
	2. 1 child	78	28.7	
	3. 2-4 kids	77	28.3	
	4. > 4 kids	64	23.5	
History of Hypertension (X2.1)	1. No	163	59.9	-
	2. yes	109	40.1	
History of DM (X2.2)	1.No	257	94.5	-
	2.yes	15	5.5	
History of asthma (X2.3)	1.No	269	98.9	-
	2.yes	3	1.1	
(Snoring history X2.4)	1.No	265	97.4	
	2.Yes	7	2.6	
Family income (X2.5)	1.Low	102	37.5	2.455.882,35 ± 904.010,31
	2. High	170	62.5	
Smoking Husband (X3.1)	No	196	72.	
	Yes	76	27.9	
Temperature environment (X3.2)	Cold (< 32C)	67	24.6	32.41 ± 1.47
	Heat (> 32C)	205	75.4	
OSA (Y1)	No	175	64.3	
	Yes	97	35.7	
Preeclampsia (Y2)	No preeclampsia	148	54.4	-
	Mild Preeclampsia	63	23.2	
	Severe preeclampsia	61	22.4	

DISCUSSION

OSA (Obstructive Sleep Apnea). The variable OSA (Obstructive Sleep Apnea) has an effect on preeclampsia. . Endothelial dysfunction in nonpregnant adults links OSA (Obstructive Sleep Apnea) with cardiovascular disease. Some of these same mechanisms have been detected in the development of preeclampsia and pregnancy complications. The results of an American study published in the American Herat Association found association between preeclampsia and heart disease. Pregnant women who have had preeclampsia are at risk of developing heart disease in the future. From the research results, pregnant women with OSA (Obstructive Sleep Apnea) and have a history of hypertension are at risk of preeclampsia. OSA (Obstructive Sleep Apnea) in pregnant women is at risk of preeclampsia.

Mojokerto is a city with many large companies including Ciwi (the largest paper mill in Asia), Ajinomoto, and Mertex. All of these factories emit waste by air, land, and noise, which causes the results of research on environmental temperature indicators to be invalid. The most important driver of climate change is the burning of fossil fuels, which also contributes significantly to air pollution. The health effects of air pollution are serious, and air pollution from exhaust fumes from vehicles, factories, and households causes breathing problems for most people (12,15).

Neck circumference is a depot of subcutaneous fat and is measured using a metline tape in an upright, calm, and straight-facing position. The measurement of the neck circumference of female subjects is carried out in the middle of the neck between the mid-cervical spine to the mid anterior neck (16–18). A total of 66 neck circumferences are new findings that, depending on the anatomy of the Malaysian-born Indonesians (small bodies), can be used as predictions for PE with an intersection of 32 cm.

Pregnant women with a history of snoring and chronic hypertension, age, BMI, neck circumference, and systolic blood pressure are most likely to increase the risk of OSA (19–21). Pregnant women that snore has the potential for chronic hypertension, hypertensive pregnancy, pre-eclampsia, and gestational diabetes. The logistic regression model controls potential covariates such as maternal age, race, BMI before pregnancy, weight gain, gravida, smoking, education level, history of gestational hypertension, family history of PE (9,22,23). The OSA risk arises not only from a history of high blood pressure but also from a history of age, pregnancy, parity, and other diseases. Some respondents have a history of parental hypertension and have high blood pressure before and it also occurs in the second trimester of pregnancy (< 20 weeks) (24).

Hypertension occurs due to disorders of the sympathetic

Table II. Distribution of the effect of individual risk factors on respondents in hospitals and health centers in the Mojokerto region in 2020-2021

No	Indicator	B	SE	P	OR	95%CI	
						lower	High
1	Maternal age (X1.1)						
	No risk (1)	0,048	0,057	0.398	1.049	0,938	1,173
	Risk (2)						
	Gestational age (X1.2)						.
2	Trimester 1 (1)	0.316	0.078	0.000	1,371	1,178	1,597
	Trimester 2 (2)						
	Trimester 3 (3)						
3	BMI (X1.3)						
	Low h (1)	1.513	0,267	0,000	4,541	2.690	7,666
	Normal (2)						
	Obesity (3)						
4	Neck circumference (X1.4)						
	small (1)	-0.102	0.127	0.421	0,903	0.704	1.158
	Large (2)						
5	Disease X1.5)						.
	Yes (1)	18.743	124 58,2	0.999	1379 721	0.000	
	no (2)						
6	Working (X1.6)			0,002			
	No working (1).	0,762	0,969	0,431	2,143	0,321	14, 319
	Physical (2)	9,390	2,463	0,000	13974	95, 829	1496 186
	Physical and manager (3)	15,745	212 18	0,999	688 516	0,000	
	Manager (4)						
7	Parity (x1.7)						
	No children (1)	-0,053	0,426	0,902	0,946	0,412	2,185
	1 child (2)						
	2-4 children (3)						
	>4 children (4)						

CONTINUE

Table II. Distribution of the effect of individual risk factors on respondents in hospitals and health centers in the Mojokerto region in 2020-2021(CONT.)

No	Indicator	B	SE	P	OR	95%CI	
						lower	High
8	History of hypertension (X2.1						
	Yes	5.490	0.746	0.000	242. 204	56. 174	1044. 299
	no						
9	History of DM (X2.2).						.
	Yes	5.007	1.394	0.000	146. 470	9.726	2294. 96
	No						
10	History of asthma (X2.3)						.
	Yes	41.722	1682 97.9	0.985	1.317	0.000	
	No						
11	Snoring history (X2.4)						.
	Yes	21.122	323 2.6	0.995	1.491	0.000	
	No						
12	Family income (X2.5).						.
	Yes	0.000	0.001	0.983	1.000	0.997	1.003
	No						
13	Smoking/husband (X3.1)						
	Yes	1.060	0.302	0.000	2.887	1.609	5.290
	No						
15	Environment temperature (X3.2)						
	hot	0.039	0.098	0.689	1.040	0.858	1.260
	Cold						

nervous system, OSA conditions cause an increase in sympathetic nerve activity which causes hypertension. OSA (Obstructive Sleep Apnea) causes hypertensive mechanisms such as hypoxia, oxidative stress, metabolic dysregulation, hypercoagulation, systemic inflammation, hemodynamic effects of OSA (Obstructive Sleep Apnea), increased intrathoracic negative pressure and sleep deprivation (25,26).

The effect value of OSA as a mediator of the relationship between environmental risk and preeclampsia is positive at 0.029. This effect value means that if OSA is caused by the environment, it will have an impact on increasing the preeclampsia incidence by 0.029 times. Based on the results of the relationship significance test, it was

concluded that the value has no significant influence (t-statistics of 1,318) (27,28). Familial risk factors play a role in the individual risk of OSA. Therefore, an alternative model is created by adding a family risk moderator variable to the relationship between individual risk factors and OSA (28–30).

This screening card can be given easily and quickly in clinical practice without depending on the awareness of the apnea patient. Symptoms were successfully used to determine the risk of OSA during pregnancy and to demonstrate an acceptable predictive value (12,29). This tool has limited symptoms related to OSA in such a way that not all health workers understand. The sensitivity value of 86% means that the scorecard for early detection of the risk of preeclampsia is 86% capable of detecting pregnant women who are at high risk of experiencing preeclampsia, so that by using this screening score, pregnant women will immediately receive early therapy to prevent preeclampsia and maternal death.

This tool can be administered easily and quickly in clinical practice without depending on the patient's consciousness of experiencing apnea. Symptoms are successfully used to determine the risk of OSA during pregnancy and to show an acceptable predictive value (12,31). This tool has limited symptoms related to OSA in such a way that not every health worker understands.

CONCLUSION

The OSA risk factor has a positive linear effect, that is, the OSA risk factor (family OSA risk) influences the tendency of preeclampsia. The incidence of OSA has a positive linear effect, which means that its incidence will affect the tendency of preeclampsia. If a pregnant woman does not experience the risk factor and incidence of OSA, she does not have preeclampsia. The screening tool is used by entering the formula.

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