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ORIGINAL ARTICLE

Gestational rhinitis: A multidisciplinary prospective cohort study on hormonal influence and maternal-neonatal outcomes

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ABSTRACT

Objectives: This multidisciplinary prospective study aims to evaluate nasal obstruction, hormonal changes, and neonatal outcomes in pregnant women with and without rhinitis compared to non-pregnant controls.

Patients and Methods: Between January 2025 and May 2025, a total of 90 female participants were included in the final analysis and divided according to pregnancy and symptomatic status into Group 1, 30 pregnant women with rhinitis (mean age: 28.53±7.70 years; range, 18 to 45 years), Group 2, 30 pregnant women without rhinitis (mean age: 30.70±6.75 years; range, 18 to 43 years), and Group 3, 30 non-pregnant women without rhinitis (mean age: 29.07±5.41 years; range, 19 to 42 years), and clinical outcomes were compared. Assessments included subjective measures such as the Nasal Obstruction Symptom Evaluation and Visual Analog Scale, objective nasal airflow through peak nasal inspiratory flow (PNIF), serum estradiol and progesterone levels, and neonatal outcomes including 5-min Apgar scores, low birth weight (LBW), and neonatal intensive care unit (NICU) admission. Statistical analysis was performed using one-way ANOVA and chi-square tests, with significance set at $p < 0.05$.

Results: Pregnant women with rhinitis had significantly higher NOSE scores (12.10±3.75) and VAS scores (59.27±20.64) compared to pregnant women without rhinitis (4.60±2.92 and 15.00±10.18, respectively; $p < 0.001$). Correspondingly, PNIF values were significantly lower in the rhinitis group (52.00±21.07) than in pregnant women without rhinitis (83.70±22.53; $p < 0.001$). Although serum estradiol (8065±804.1 pg/mL) and progesterone (136.0±14.56 ng/mL) levels were slightly higher in the rhinitis group compared to those without rhinitis (8058±935.9 pg/mL and 130.4±14.55 ng/mL), these differences were not statistically significant ($p = 0.999$ and $p = 0.093$).

Conclusion: Gestational rhinitis significantly affects maternal nasal symptoms, detectable by both subjective and objective assessments. While not directly linked to estradiol or progesterone levels, it requires clinical attention, patient education, and safe management strategies to optimize maternal comfort and ensure vigilant perinatal care.

Keywords: Estradiol, gestational rhinitis, neonatal outcome, peak nasal inspiratory flow, progesterone.

Gestational rhinitis is a common condition affecting approximately 20% of pregnant women, characterized by nasal congestion during the last six weeks of pregnancy without signs of infection or allergy and typically resolving within two weeks after delivery. The underlying mechanisms are not fully understood, although placental growth hormone has been proposed as a contributing factor.[1] Placental trophoblastic hormone is believed to stimulate hypertrophy of the nasal mucosa during pregnancy.[2] In addition, estradiol might play a role by increasing histamine receptors in the nasal epithelium and

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microvasculature.[3] Progesterone may further contribute by enhancing local nasal vasodilation through the physiologic increase in circulating blood volume during pregnancy.[4]

In recent years, gestational rhinitis has attracted attention largely due to its links to snoring and obstructive sleep apnea syndrome during pregnancy, as well as its potential indirect association with preeclampsia, a major contributor to maternal morbidity and mortality.[5] Oral breathing resulting from nasal obstruction may reduce the amount of nitric oxide, which is primarily produced in the maxillary sinuses, reaching the lungs and potentially affecting vascular resistance as well as local oxygenation.[6] Decreased inhalation of pulmonary nitric oxide may negatively impact the fetus, potentially contributing to maternal hypertension, intrauterine growth restriction, preeclampsia, and reduced Apgar scores in newborns.[7] Furthermore, nasal blockage that disrupts sleep quality may prompt overuse of topical nasal decongestants, potentially causing drug-induced rhinitis that often persists even postpartum.[8] Nonetheless, current evidence remains limited regarding a definitive link between gestational rhinitis and adverse pregnancy outcomes.[6]

Based on current evidence and treatment safety profiles, both otolaryngologists and obstetricians should remain vigilant for early diagnosis and management. We conducted a multidisciplinary, prospective study in otolaryngology and obstetrics to evaluate gestational rhinitis and its maternal and neonatal outcomes.

The aim of this study was to comprehensively evaluate gestational rhinitis in pregnant women by utilizing objective assessments such as peak nasal inspiratory flow (PNIF) and hormone levels, along with subjective evaluations including the Nasal Obstruction Symptom Evaluation (NOSE) and Visual Analog Scale (VAS) questionnaires. Additionally, the study aimed to assess the impact of gestational rhinitis on quality of life, to identify potential contributing factors involved in its development, and to investigate whether gestational rhinitis may have adverse effects on the fetus by analyzing neonatal outcomes such as Apgar scores, low birth weight (LBW), and neonatal intensive care unit (NICU) admission rates.

PATIENTS AND METHODS

Study design and participants

This prospective clinical study was conducted at the Departments of Otorhinolaryngology and Obstetrics and Gynecology, İzmir Bakırçay University Çiğli Training and Research Hospital, between January 2025 and May 2025. Initially, 106 participants were screened for eligibility, of whom 102 were assigned to the study groups. Following the exclusion of 12 participants during follow-up, the final analysis was conducted with a total of 90 participants. These participants were allocated into three groups according to pregnancy and symptomatic status: Group 1, 30 pregnant women with rhinitis (mean age: 28.53±7.70 years; range, 18 to 45 years), Group 2, 30 pregnant women without rhinitis (mean age: 30.70±6.75 years; range, 18 to 43 years), and Group 3, 30 non-pregnant women without rhinitis (mean age: 29.07±5.41 years; range, 19 to 42 years). Inclusion was limited to pregnant women at exactly 36 weeks of gestation to minimize hormonal variability and align with the typical onset of gestational rhinitis and non-pregnant women in their reproductive ages. Exclusion criteria included inability to communicate effectively, presence of septal deviation, allergic rhinitis, nasal polyps or other anatomical variations, rhinitis medicamentosa, severe cardiovascular and/or endocrinological disorders, menopause, multiple pregnancies, neuroendocrine tumors, and infants with congenital anomalies. Patients with pre-existing chronic rhinitis or non-pregnant individuals with rhinitis were excluded to avoid confounding and to specifically evaluate pregnancy-related hormonal effects on nasal obstruction. Regarding the 12 participants excluded during follow-up, seven were from the pregnant with rhinitis group, and five were from the pregnant without rhinitis group. Reasons for exclusion included pregnancy-related complications, cesarean delivery, loss to follow-up, or persistence of symptoms beyond the second postpartum week. Written informed consent was obtained from each patient. The permission of İzmir Bakırçay University Non-Invasive Clinical Research Ethics Committee (Date: 26.03.2025, Decision No: 2171). The study was conducted in accordance with the principles of the Declaration of Helsinki.

The final cohort comprised pregnant patients experiencing nasal obstruction symptoms starting in the last six weeks (Group 1), pregnant patients without nasal obstruction symptoms (Group 2), and non-pregnant women without nasal obstruction symptoms (Group 3).

Demographic data, including age, body mass index (BMI), smoking status, and serum estradiol and progesterone levels, were collected for all participants. To ensure physiological standardization, all pregnant participants were specifically recruited at their

36th gestational week. Body mass index was calculated based on current weight and height measurements recorded during the clinical evaluation at this time. Routine blood tests were performed as part of standard clinical care for both pregnant and non-pregnant women and were not requested solely for the purposes of this study.

To evaluate nasal obstruction, objective and subjective assessments were conducted using PNIF, the NOSE questionnaire, and the VAS.

Additionally, neonatal outcomes, including Apgar scores at birth and rates of NICU admission, were recorded. The presence or absence of LBW was also evaluated as a categorical variable. Maternal blood pressure monitoring was also performed throughout the study.

The PNIF meter (Clement Clarke International Ltd., Harlow, UK) is a device consisting of a variable-diameter tube calibrated in liters per minute (L/min) and equipped with an indicator ring, which measures the maximum flow achieved following an inspiratory maneuver, thereby allowing for objective evaluation of nasal obstruction in patients.

The NOSE scale is a validated five-item questionnaire that employs a 20-point scale to assess breathing symptoms; higher scores correlate with increased symptom severity. The Turkish-validated form of the NOSE questionnaire was utilized in the study.[9]

The severity of nasal obstruction was assessed using the VAS, a 10-cm line anchored by descriptive extremes such as "no nasal blockage" and "complete nasal blockage."

Serum estradiol and progesterone levels were assessed in all patients included in the study. In literature, at gestational week 36 and beyond, mean serum estradiol levels have been reported as approximately 7009.2±3251.5 pg/mL, while mean serum progesterone levels were around 120.7±41.5 ng/mL, indicating substantial interindividual variability during late pregnancy.[10]

During the study, patients were evaluated for a history of hypertension, including home blood pressure measurements. Mild hypertension during pregnancy is defined as systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg, confirmed on at least two occasions (consecutive office visits or at least four h apart), using validated devices and techniques.[11]

With parental consent, neonatal Apgar scores and rates of admission to the NICU were obtained from patient records. The Apgar score is a rapid method for assessing a neonate immediately after birth and in response to resuscitation. Elements of the Apgar score include color, heart rate, reflexes, muscle tone, and respiration. Apgar scoring is designed to assess for signs of hemodynamic compromise, including cyanosis, hypoperfusion, bradycardia, hypotonia, respiratory depression, or apnea. Each element is scored 0, 1, or 2. Score ranges from a minimum of 0 to a maximum of 10. The score is recorded at 1 min and 5 min after delivery in all infants, with expanded recording at 5-min intervals for infants who score ≤ 7 at 5 min and in those requiring resuscitation as a method for monitoring response; scores of 7 to 10 are considered reassuring. In this study, only the 5-min Apgar score was used, as it is a more reliable indicator of neonatal adaptation and short-term outcomes. The scores were categorized dichotomously as "good" (≥ 7) and "poor" (< 7), in accordance with recommendations from the American Academy of Pediatrics and the American College of Obstetricians and Gynecologists, which emphasize that infants with a 5-min Apgar score below 7 require close monitoring due to an increased risk of morbidity.[12] This approach was chosen to ensure clinical relevance, statistical clarity, and simplicity in study design. Due to potential differences in Apgar scores between neonates delivered by cesarean section and those born via vaginal delivery, only neonates delivered by vaginal delivery were included in this study to minimize confounding variables.[13]

Low birth weight is defined as a birth weight of less than 2500 g (up to and including 2499 g), as per the World Health Organization.[14]

In this study, gestational rhinitis was diagnosed in pregnant participants who developed nasal congestion during the last six weeks of pregnancy, without evidence of infection or allergy, and whose symptoms resolved by the second week postpartum. Diagnosis was confirmed using the NOSE and VAS questionnaires to assess symptom severity, along with PNIF measurements to evaluate nasal airflow. In pregnant participants with rhinitis, questionnaires and PNIF measurements were performed twice: first during an outpatient clinic visit at the 36th week of gestation, and again at the postpartum second week follow-up. Those whose symptoms had not resolved by the second postpartum week were excluded from the study. In non-pregnant women, the same assessments were performed once during a routine outpatient visit, regardless of the menstrual cycle phase.

Statistical analysis

A sample size calculation using the OpenEpi software, Version 3.01 (www.openepi.com), determined

that 30 patients per group were required to detect a 50% reduction in the incidence of gestational rhinitis with 80% power at a 5% significance level. To account for potential dropouts, 37, 35, and 30 participants were initially enrolled in Groups 1, 2, and 3, respectively. Statistical analysis was performed using IBM SPSS Statistics for Windows, Version 22.0 software (IBM Corp., Armonk, NY, USA), with significance set at $p < 0.05$. Normality was assessed using the Kolmogorov Smirnov test, while nominal data were analyzed using Pearson's chi-square test with Bonferroni correction. Differences between study groups were examined using one way ANOVA followed by Tukey's post-hoc test.

RESULTS

The clinical and demographic characteristics of the participants, including age and body mass index, were found to be comparable across the three study groups, as summarized in Table 1. The participant selection and exclusion processes throughout the study period are illustrated in the study flow diagram shown in Figure 1.

The mean NOSE score was 12.10±3.75 in the pregnant women with rhinitis group, 4.60±2.92 in the pregnant women without rhinitis group, and 6.73±4.34 in the non-pregnant controls. Pregnant women with rhinitis had significantly higher NOSE scores compared with both pregnant women without rhinitis ($p < 0.001$) and non-pregnant controls ($p < 0.001$). However, there was no statistically significant difference between pregnant women without rhinitis and non-pregnant controls ($p = 0.073$), as shown in Table 2.

Pregnant women with rhinitis exhibited significantly higher VAS scores (59.27±20.64) compared to both pregnant women without rhinitis (15.00±10.18) and non-pregnant women without rhinitis (24.43±21.13). The differences between pregnant women with rhinitis and the other two groups were statistically significant ($p < 0.001$ for both comparisons). No statistically significant difference was observed between pregnant women without rhinitis and non-pregnant women without rhinitis ($p = 0.112$) (Table 2).

Pregnant women with rhinitis had lower PNIF values (52.00±21.07) compared to pregnant women without rhinitis (83.70±22.53) and non-pregnant women without rhinitis (63.60±32.18). The difference between pregnant women with rhinitis and pregnant women without rhinitis was statistically significant ($p < 0.001$), as was the difference between pregnant women without rhinitis and non-pregnant women without rhinitis ($p = 0.009$). No statistically significant difference was observed between pregnant women with rhinitis and non-pregnant women without rhinitis ($p = 0.194$) (Table 2).

Serum estradiol levels were slightly higher in pregnant women with rhinitis (8.065±804.1 pg/mL) compared to pregnant women without rhinitis (8.058±935.9 pg/mL), no statistically significant difference was observed ($p = 0.999$). However, both pregnant groups exhibited significantly higher estradiol levels compared to non-pregnant women without rhinitis (94.79±152.6 pg/mL; $p < 0.001$ for both comparisons), as shown in Table 3.

Similarly, serum progesterone levels were slightly higher in pregnant women with rhinitis (136.0±14.56 ng/mL) compared to pregnant women without rhinitis (130.4±14.55 ng/mL), although this difference was not statistically significant ($p = 0.093$). Both pregnant groups had significantly higher progesterone levels compared to non-pregnant women without rhinitis (0.555±0.455 ng/mL; $p < 0.001$ for both comparisons) (Table 3).

The 5-min Apgar scores were assessed as a nominal variable (< 7 *vs.* ≥ 7). Two infants out of 30 in the rhinitis group and one out of 30 in the without rhinitis group had scores < 7, with only one rhinitis-group infant requiring NICU admission. Low birth weight was observed in three infants in the rhinitis group and two in the without rhinitis group; all infants except the NICU-admitted case had Apgar scores ≥ 7 and did not require NICU care. The occurrence of

Table 1. Characteristics of the study population

	Group 1 (n = 30)		Group 2 (n = 30)		Group 3 (n = 30)		
Parameters	n	Mean±SD	n	Mean±SD	n	Mean±SD	*p*
Age (year)		28.53±7.70		30.70±6.75		29.07±5.41	0.429
Smoking	2		2		3		0.856
Body mass index (kg/m^2) ≥ 25	12		8		4		0.065

SD, standard deviation; $p < 0.05$ was considered statistically significant.

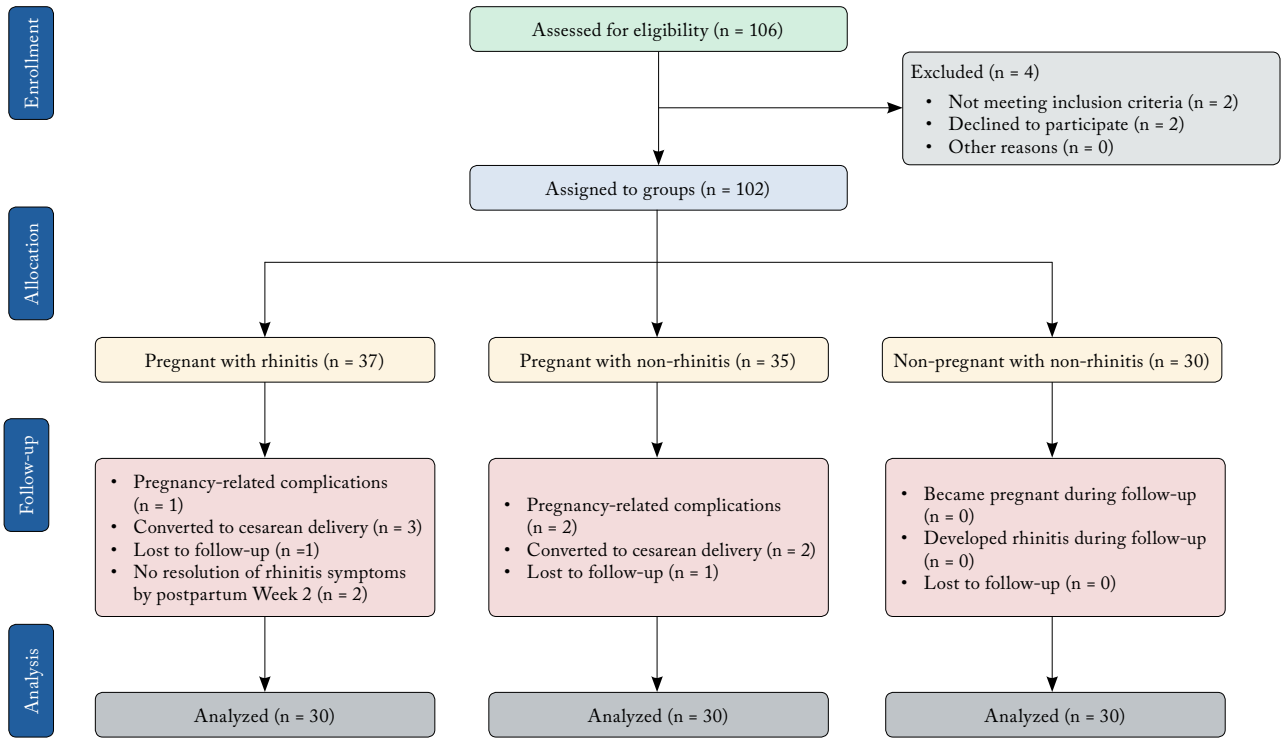

Figure 1. Flow diagram of the study design and patient inclusion process.

Apgar scores < 7 and the difference in LBW between the groups did not represent statistically significant differences (p = 1.0 for both), as shown in Table 4.

Among the four mothers who smoked, the first mother in the rhinitis group gave birth to an infant with LBW, a 5-min Apgar score < 7, and NICU admission, while the second mother in the same group had an infant with LBW but normal Apgar score and no NICU admission; in the without rhinitis group, both infants of smoking mothers had normal birth weight, normal 5-min Apgar scores, and did not require NICU care. Statistical analysis indicated that neither the differences in LBW nor in Apgar scores between infants of smoking mothers across the two groups were statistically significant (p = 1.0 for both comparisons) (Table 4).

Table 2. Mean NOSE, VAS, and PNIF scores of the groups

	Group 1	Group 2	Group 3	Group 1 *vs.* Group 2	Group 1 *vs.* Group 3	Group 2 *vs.* Group 3
	Mean±SD	Mean±SD	Mean±SD	p	p	p
NOSE	12.10±3.75	4.60±2.92	6.73±4.34	< 0.001	< 0.001	0.073
VAS	59.27±20.64	15.00±10.18	24.43±21.13	< 0.001	< 0.001	0.112
PNIF	52.00±21.07	83.70±22.53	63.60±32.18	< 0.001	0.194	0.009

NOSE, nasal obstruction symptom evaluation; VAS, Visual Analog Scale; PNIF, peak nasal inspiratory flow; SD, standard deviation; p < 0.05 was considered statistically significant.

Table 3. Mean serum estradiol and progesterone levels

	Group 1	Group 2	Group 3	Group 1 *vs.* Group 2	Group 1 *vs.* Group 3	Group 2 *vs.* Group 3
	Mean±SD	Mean±SD	Mean±SD	p	p	p
Estradiol	8.065±804.1	8.058±935.9	94.79±152.6	0.999	< 0.001	< 0.001
Progesterone	136.0±14.56	130.4±14.55	0.555±0.455	0.093	< 0.001	< 0.001

SD, standard deviation; p < 0.05 was considered statistically significant. Serum estradiol unit: pg/mL; serum progesterone unit: ng/mL.

Table 4. Apgar, NICU, LBW characteristics of infants (n = 30)

	Group 1	Group 2	
Parameters	n	n	*p*
Apgar	2	1	1.00
NICU	1	0	1.00
LBW	3	2	1.00

NICU, Neonatal intensive care unit; LBW, Low birth weight; $p < 0.05$ was considered statistically significant. Only the 5-min Apgar score was used. The scores were categorized dichotomously as "good" (≥ 7) and "poor" (< 7). NICU admission was evaluated as a dichotomous variable. LBW was defined as a birth weight of less than 2500 g (up to and including

Among the 60 mothers included in the study, four had hypertension, with the first two in the rhinitis group and the other two in the without rhinitis group; all infants born to these hypertensive mothers had normal 5-min Apgar scores and normal birth weight and did not require NICU admission.

DISCUSSION

In the present study, pregnant women with rhinitis had significantly higher NOSE and VAS scores compared to both pregnant women without rhinitis and non-pregnant controls. The PNIF values were significantly lower in the rhinitis group compared to pregnant women without rhinitis, whereas the difference between the rhinitis group and non-pregnant controls did not reach statistical significance. These findings indicate that subjective measures such as the NOSE and VAS consistently reflect the burden of gestational rhinitis, while PNIF provides additional but group-dependent information on nasal airflow limitation.

Serum estradiol and progesterone levels were slightly higher in pregnant women with rhinitis than in pregnant women without rhinitis, though the difference was not statistically significant, while both hormones were significantly higher in all pregnant women compared to non-pregnant controls. This suggests that gestational rhinitis may not be directly attributable to differences in maternal estradiol or progesterone levels, as although both hormones were slightly higher in pregnant women with rhinitis compared to pregnant women without rhinitis, the lack of statistical significance indicates that symptom development cannot be solely explained by these factors, and other hormonal or local inflammatory mechanisms may contribute.

Despite existing evidence indicating a correlation between BMI and nasal congestion, no significant difference was observed in our analysis when comparing the pregnancy with rhinitis and pregnancy with non-rhinitis groups.[15]

While the exact etiology of gestational rhinitis cannot be conclusively determined from our results, previous studies suggest potential roles for various hormones, including placental trophoblastic hormones, which could be explored in future research.[2] Limitations in hospital resources precluded hormonal assessments beyond estradiol and progesterone in this study.

Previous studies have demonstrated that its presence may predispose patients to gestational hypertension and negatively impact neonatal health, as evidenced by intrauterine growth retardation and reduced Apgar scores.[7] However, there were no statistically significant differences in 5-min Apgar scores, LBW, or NICU admissions between infants of mothers with rhinitis and mothers without rhinitis, suggesting that gestational rhinitis itself was not associated with adverse perinatal outcomes in this cohort. NICU admissions were rare and limited to a single infant born to a smoking mother who had LBW and a low Apgar score, while infants of hypertensive mothers and other smoking mothers had normal Apgar scores and birth weights. Nevertheless, these neonatal outcomes cannot be exclusively attributed to gestational rhinitis, as they are likely influenced by multiple maternal, fetal, and environmental factors. Furthermore, the study was underpowered to detect rare adverse neonatal events due to the small sample size, highlighting the need for larger studies to more rigorously investigate potential associations between gestational rhinitis and neonatal outcomes.

Non-pregnant, without rhinitis individuals were selected as the control group to isolate the effects of pregnancy-related hormonal changes on gestational rhinitis, as including non-pregnant rhinitic participants could confound the results. Gestational rhinitis was defined as new-onset nasal symptoms in the last six weeks of pregnancy, excluding chronic or non-pregnancy-related rhinitis.

As gestational rhinitis reduces quality of life and possibly also affects the fetus, there is often a need for treatment.[1] Most studies agree that educational interventions should be the primary and supportive approach for managing gestational rhinitis, particularly since symptoms typically resolve spontaneously postpartum.[16] In one study, nasal corticosteroids were not shown to be effective.[17] Systemic administration should be avoided, but nasal corticosteroids may be considered during pregnancy

when indicated for other sorts of rhinitis. [1] Physical exercise is known to effectively improve nasal obstruction.[18] The use of topical decongestants has been associated with congenital malformations, particularly during the first trimester of pregnancy. Limited evidence suggests safety for one or a few doses of oxymetazoline after the first trimester.[19] Systemic decongestant use during the first trimester may be associated with fetal anomalies and maternal adverse effects.[20]

This study has several limitations that should be considered. First, the sample size was relatively small, which may have limited the statistical power to detect rare adverse neonatal outcomes. Second, hormonal evaluation was restricted to serum estradiol and progesterone due to institutional resource constraints, potentially overlooking other contributing factors such as placental growth hormone or local inflammatory mediators. Third, the cross-sectional nature of the measurements at the 36th week provides a limited snapshot rather than a longitudinal view of symptom progression. Finally, excluding cesarean deliveries and focusing on a specific gestational window, while increasing internal validity, may limit the generalizability of the findings to the broader pregnant population.

In conclusion, gestational rhinitis significantly affects maternal nasal symptoms and is detectable with both subjective and objective measures. While not directly linked to serum estradiol or progesterone levels, it warrants clinical attention to optimize maternal well-being and ensure vigilant perinatal care. Subjective tools such as NOSE and VAS may aid clinicians in the diagnosis, while PNIF can serve as a useful objective assessment.

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