

# Study of Maternal and Perinatal Outcomes in Pregnant Women with Respiratory Complications

Shashikala Karanth<sup>1</sup>, Christy Vijay<sup>2</sup>, C Jaya Sibi Mol<sup>3</sup>, Nirupama Vijaykumar<sup>4</sup>, Uma Devaraj<sup>5</sup>, Chaitanya Harita Balakrishnan<sup>6</sup>

## ABSTRACT

**Introduction:** The frequency and significance of acute and chronic respiratory disorders in pregnant women have increased in recent years. Clinicians must have an understanding of cardiopulmonary physiology to promptly recognize and treat pregnant women with respiratory conditions ranging from asthma to adult respiratory distress syndrome. Significant changes are seen in respiratory parameters as pregnancy progresses.

**Materials and methods:** Our study was a retrospective record study, which analyzed various respiratory diseases in pregnancy and its effects on the perinatal outcome. Hospital documents of pregnant women who delivered in the institution during the years 2015–2019 was studied. Pregnant women with respiratory complications in pregnancy including new onset/or exacerbations of preexisting respiratory disease like asthma, acute bronchitis, acute respiratory distress syndrome (ARDS), and pneumonia were noted.

**Results:** We identified 214 pregnant women with respiratory complications over a period of 5 years. The overall incidence was 2.3%; 94.4% were 20–35 years of age, and 82.2% delivered at term gestation (37–40 weeks). Respiratory complications like infective, restrictive, and obstructive lung diseases were seen. Bronchial asthma exacerbations in 155 (72%), respiratory tract infections (upper and lower respiratory tract infections) in 23 (10.7%), acute bronchitis in 16 (7.5%), ARDS in 8 (3.7%), pleural effusion in 3 (1.4%), tuberculosis in 2 (0.9%) and OSA in 1 (0.5%) were seen. A total of 3.2% had intensive care unit (ICU) admissions, and there was 1.4% maternal mortality. The following were observed in those with respiratory complications: a higher chance of preeclampsia in 31 (14.4%), increased rates of lower segment cesarian section (LSCS) in 99 (46.2%), intrauterine death (IUD) in 12 (5.6%), and poor appearance, pulse, grimace, activity, respiration (APGAR) and neonatal intensive care unit (NICU) admissions of 99 (46.3%) women.

**Conclusion:** Respiratory illnesses in pregnancy poses more risk to the mother than to the fetus. Close monitoring of the antenatal period with pulmonary function testing increases the chance of a good pregnancy outcome. Mothers with respiratory diseases should be screened antenatally as the chances of preterm and inrauterine growth restriction (IUGR) are high in the fetus.

**Keywords:** ARDS, Asthma, Bronchitis, Pregnancy.

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## INTRODUCTION

In recent years, not only the frequency but also the significance of acute and chronic respiratory diseases in pregnant women has surprisingly increased.<sup>1</sup> Pregnant women with respiratory conditions ranging from asthma to adult respiratory distress syndrome should be promptly recognized and treated for which clinicians should have an understanding of cardiopulmonary physiology during pregnancy.<sup>1</sup> Significant changes are seen in respiratory parameters as pregnancy progresses.<sup>1</sup> These include a reduction in the total lung capacity, expiratory reserve volume, and residual volume.<sup>1</sup> A 20% decline in functional residual capacity seen in the third trimester is the most important physiological change in normal pregnancy.<sup>1</sup> This change results from the elevation of the diaphragm because of the expanding uterus.<sup>1</sup> By the second half of the pregnancy, there are also changes in the various lung volumes.<sup>1</sup> Decreases in both the expiratory reserve volume and residual volume result in a 9.5–25% decrease in functional residual capacity.<sup>2,3</sup> Even, the total lung capacity is diminished slightly at term.<sup>2</sup> An understanding of the normal physiologic changes (basal atelectasis, venous congestion of the lungs, and airway hypersensitivity during pregnancy) is very essential to recognize and treat the most common pulmonary diseases, which complicate pregnancy.<sup>4</sup>

Not just these anatomic changes, hormonal changes during pregnancy also affect respiratory mechanics. The hormone that progressively increases throughout the course of pregnancy is

<sup>1–4</sup>Department of Obstetrics and Gynaecology, St Johns Medical College and Hospital, Bengaluru, Karnataka, India

<sup>5</sup>Department of Pulmonary Medicine, St Johns Medical College, Bengaluru, Karnataka, India

<sup>6</sup>Department of Medicine, St Johns Medical College and Hospital, Bengaluru, Karnataka, India

**Corresponding Author:** Christy Vijay, Department of Obstetrics and Gynaecology, St Johns Medical College and Hospital, Bengaluru, Karnataka, India, Phone: +91 9591758737, e-mail: christyvijay92@yahoo.in

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serum progesterone.<sup>5</sup> The rise in progesterone is responsible for hyperventilation and a sense of dyspnea as it stimulates the respiratory centers in the brain. Respiratory alkalosis is universally present with the partial pressure of carbon dioxide dropping to approximately 30 mm Hg.<sup>6</sup> Pregnancy is a state of immunosuppression; despite this, the prevalence of pneumonia in pregnancy is between 0.04 and 1%; the rate of infection is indifferent from that in the nonpregnant individual.<sup>6,7</sup>

Therefore, the hormonal, anatomical, and physiological changes during pregnancy increase the work of breathing and make breathing for two—or for more than two—quite a task.

The most commonly encountered respiratory complications in pregnancy are bronchial asthma exacerbations (4–8%), pulmonary embolism (five-fold increase in risk), pulmonary edema, infections (pneumonia—0.04 and 1%), and acute respiratory distress syndrome (ARDS) (0.2–0.3%).<sup>6,7</sup> Less common conditions are<sup>6,7</sup> noninfectious pneumonia (eosinophilic) and with pharyngitis. Maternal malignancies are rare and occur in 0.1% of pregnancies.<sup>6,7</sup> Although rare, pregnancy is also associated with other embolic phenomenon including amniotic fluid embolism, air embolism, and trophoblastic embolism.<sup>6,7</sup>

Acute respiratory failure (ARF), secondary to infections, eclampsia, pulmonary edema, as well as more chronic conditions such as neuromuscular disorders and kyphoscoliosis, has been noted previously.<sup>6,7</sup> ARF occurs in only 0.1% of pregnancies, but still, it is one of the most common indications for obstetric admissions to the intensive care unit (ICU), carrying a very high morbidity and mortality for both the mother and fetus.<sup>6,7</sup> Conditions that require admission to an ICU during pregnancy are seldom due to critical illnesses and account for less than 1% of the ICU admissions.<sup>6,7</sup>

Therefore, preexisting respiratory diseases, like bronchial asthma, must be taken care of and kept under control during pregnancy: regular follow-up for coexisting respiratory condition and pregnancy, a good patient–doctor relationship, a healthy lifestyle, and adherence to controller treatment are the most effective measures and should be considered for an uncomplicated pregnancy and safe delivery.<sup>7</sup> Reassuring information regarding the safety of medication and sound data on the importance of disease control during pregnancy needs to be provided.<sup>8</sup>

## AIMS AND OBJECTIVES

To study the prevalence of respiratory diseases in pregnancy in a tertiary health-care hospital.

To study maternal and perinatal outcomes in pregnant women with respiratory disease and complications.

## MATERIALS AND METHODS

This retrospective study accessed the medical records of patients and analyzed various respiratory diseases in pregnancy and its effects on the perinatal outcome. The study was initiated after approval from the institutional ethics committee (Ref No. 148/2020). Data of pregnant women who delivered at the institution during the years 2015–2019 were accessed from their medical records. All pregnant women with any respiratory complication in pregnancy, new onset respiratory disease, exacerbations of preexisting respiratory disease like asthma and bronchitis were noted. Need for the induction of labor, mode of delivery, obstetric complications causing secondary effect on respiratory system like pulmonary edema, ICU admissions, and maternal mortality were noted. Treatment of patients during the antenatal, intrapartum, and postnatal period was also studied. Neonatal parameters like preterm births, birth weight, placental weight, APGAR, and NICU admissions were noted.

### Analysis

Data were analyzed using the SPSS versions 16 after it was manually entered in Microsoft Excel. Interquartile ranges were deduced for variables such as gestational age, gestational age of diagnosis,

etc. for analysis of pregnancy outcomes. The Pearson's Chi square and Fisher's exact test were used as the tests for significance, and a value <0.05 was considered significant.

## RESULTS

### General Population Characteristics

We identified 214 (2.3%) pregnant mothers with respiratory complications over a period of 5 years. Demographic details of women enrolled in the study are illustrated in Table 1. A majority of those having respiratory complications were 20–35 years old (94.4%), 51.4% were multiparous, and 44.4% were primiparous. A majority (67.3%) of them booked at our hospital, 28% booked outside, and seven (3.3%) patients were referred from other health-care centers.

The most common modality of induction was with misoprostol in 42 (19.62%) women and 99 (32.24%) of them underwent LSCS while 115 (53.7%) of them had vaginal delivery. One hundred and seventy women (79.4%) had a preexisting respiratory condition, bronchial asthma being the most common 155 (91.1%), and 2 patients with bronchial asthma had an acute exacerbation during pregnancy, due to noncompliance to controller medication. Fortyfour (20.5%) women had a new onset respiratory complication in pregnancy of which infections (pneumonia—52.2%) were the most common.

### Effect of Respiratory Disorders in Pregnancy

Out of the 214 patients, most patients (110 [51.4%]) were multigravida. A majority were booked for antenatal checkups in our institution, whereas two mothers (1%) were unbooked and seven mothers (3.3%) were referred from a medical facility elsewhere. Hypothyroidism was the most commonly associated medical complication (20.6%). It was observed that women with asthma had coexisting complications like hypertensive disorders (16.7%), gestational diabetes mellitus (11.2%), increased rate of cesarean section (18.2%), anemia (7.9%), and oligohydramnios (11.7%) in pregnancy. The study showed increased incidence of H1N1 (2.8%) in asthma patients. ARDS was seen as a complication in three (37.5%,  $p < 0.001^b$ ) pregnant mothers with H1N1. The various respiratory complications in pregnancy are represented in Table 2.

Anemia (16.7%) was associated with pulmonary edema and ARDS in two (25%,  $p < 0.001^b$ ) women. Thrombocytopenia associated with ARDS was seen in two (12.5%,  $p < 0.001^b$ ). Obstructive sleep apnea in one (100%) was associated with mild preeclampsia ( $p < 0.001^b$ ). A significant association was seen with immune thrombocytopenia and allergic bronchitis in one (6.2%). Complications like premature rupture of membranes (PROM) was seen in 7 (4%,  $p < 0.001^b$ ) women and

**Table 1:** Demography of pregnancies complicated by respiratory illness

Variable (N = 214)	Frequency	Percentage	
Age	<19 years	1	0.5
	20–25 years	202	94.4
	>35 years	11	5.1
Parity	Primigravida	95	44.4
	Multigravida	110	51.4
	Grand multigravida	9	4.2
Gestational Age	Preterm (<36 + 6 weeks)	32	14.9
	Term (>37 weeks)	182	85

**Table 2:** Various respiratory complications in pregnancy (preexisting and new onset)

Variable (N = 214)		Frequency	Percentage
Respiratory complications	Allergic bronchitis	16	7.5
	Acute respiratory distress syndrome	8	3.7
	Bronchial asthma	155	72.5
	Obstructive sleep apnea	1	0.5
	Pulmonary edema	6	2.8
	Pleural effusion	3	1.4
	Respiratory tract infections	23	10.7
	Tuberculosis	2	0.9

induction with misoprostol was seen in 36 (20.5%,  $p < 0.001^b$ ) patients with asthma. Emergency LSCS was the mode of delivery in 56 (31.8%,  $p = 0.013^b$ ) patients and was the most common mode of delivery at term for 1 (100%) patient with obstructive sleep apnea and 3 (100%,  $p < 0.001^b$ ) patients with pleural effusion. Perimortem LSCS was done in two patients with ARDS ( $p < 0.001^b$ ). A total of 72.4% pregnancies resulted in a placenta weighing 500–1000 g possibly (mention normal weight of the placenta also for comparison) due to maternal steroid intake for respiratory disorders during pregnancy. Seven (3.2%) patients had ICU admissions, and there was 1.4% maternal mortality; ARDS was the final complication of all ICU admissions.

A poor perinatal outcome like preterm (14.9%), IUGR (7%), and IUD (5.6%) was seen commonly in women with lower respiratory tract infections with sepsis and ARDS. IUD significantly occurred at 32–36 weeks of gestation in four (15.4%,  $p = 0.001^b$ ) patients, and not during a later gestational age. Pregnancies complicated with ARDS 4(50%), tuberculosis 1(%), when associated with bronchitis in the mother, had a significant outcome of IUD and still births ( $p < 0.001^b$ ).

Neonatal outcomes like APGAR and complications at birth were studied. Neonatal parameters like birth weight, preterm births, NICU admissions, and treatment for respiratory complications were noted. Of all babies born, 46.3% had an admission into the NICU in view of poor APGAR at birth and 6.1% were treated for respiratory distress syndrome. Most babies (117 [54.6%]) had a birth weight of 2.5–3.5 kg. Only 54.7% had an APGAR score  $>8$  at 1 minute, and even after adequate measures,  $>10\%$  had an APGAR score  $<8$  even at 5 minutes.

APGAR scores were  $<5$  in five (62.5%) pregnancies complicated with ARDS and tuberculosis in one (50%) patient even at 5 minutes with adequate resuscitative measures ( $p < 0.001^b$ ). Those 13 (81.25,  $p < 0.001^b$ ) pregnancies complicated with bronchitis had neonates with a good APGAR score at 1 minute ( $>8$ ) as described in Table 3.

APGAR scores were  $<5$  in five (62.5%) pregnancies complicated with ARDS and tuberculosis in one (50%) even at 5 minutes.

## DISCUSSION

Many studies have tried to determine the incidence of respiratory conditions in pregnancy. Our study had an occurrence of 2.3% respiratory complications.<sup>8</sup>

### Asthma

Kwon et al., in their study, estimated the prevalence of asthma as 3.7–8.4% of all pregnancies.<sup>9</sup> Our study had an incidence of 1.7%.

Jana et al. showed that out of 79 pregnant women, 46.8% were primigravidae, 49.4% were booked, and 62% of them were diagnosed with tuberculosis.<sup>10</sup> This study showed low birth weight babies and preterm deliveries in the study group (34.2%) which was significant.<sup>10</sup> Our study had 44.4% primigravida, with 72% of the subjects who had bronchial asthma, which when compared to other respiratory illnesses seemed to be relatively more common.

Getahun et al. showed acute respiratory conditions (bacterial/viral) were associated with PROM, but acute bronchitis (3.4%) was not.<sup>11</sup> Bronchial asthma (6%) was associated with PROM but chronic bronchitis (2.1%) was not, possibly due to the effects of drugs like steroid usage in pregnancy.<sup>11</sup> It is seen in our study that women with bronchial asthma had obstetric complications like PROM (4%,  $p < 0.001^b$ ), hypertensive disorders (16.7%), idiopathic thrombocytopenia (1.4%), gestational diabetes mellitus (11.2%), cesarean section (18.2%), anemia (7.9%), and oligohydramnios (11.7%). The study showed increased incidence of H1N1 (2.8%) in asthma patients. Induction with misoprostol (20.5%,  $p < 0.001^b$ ) was significantly more common in asthmatic patients at 37–40 weeks of the gestational age.

Schatz et al. showed that there was no increased prevalence in preterm labor (5.8%) in asthmatic pregnant women when compared to controls.<sup>12</sup> A study in Tennessee on a cohort included 59.2% white and 40.8% black pregnant women and showed that bronchial asthma was not associated with preterm births.<sup>13</sup> Our study showed similar findings where preterm (14.9%) had no statistical significance, and preterm neonates had a low APGAR score at 1 minute (28.1%) and even at 5 minutes (25%) compared to those born at term. Getahun et al. studied the perinatal outcomes of pregnancies complicated by bronchial asthma and showed low APGAR scores  $<6$  at 1 minute (4%) and low birth weight babies (20.5%) of less than 2.5 kg.<sup>12</sup>

A US study showed 20.4% of deliveries of pregnant asthmatic mothers has meconium-stained liquor, and 11.1% had oligohydramnios.<sup>14</sup> Our study had other obstetric complications in mothers with asthma-like oligohydramnios (11.7%) gestational diabetes mellitus (11.2%), idiopathic thrombocytopenia (1.4%), etc.

A US study on perinatal outcomes in asthmatic pregnancies showed an increased risk of preterm and low birth weight babies with high cesarean section rates.<sup>14</sup> In our study too, asthma was not associated with increased prevalence of preterm labor; however, emergency LSCS was the mode of delivery for patients with asthma and obstructive sleep apnea (100%,  $p < 0.001^b$ ), probably due to the reason that such women were not able to withstand the stresses of induction and normal labor.

A review study showed lower mean placental weight among asthmatic pregnancies

concluding the cause to be fetal hypoxia and use of oral steroids due to asthmatic exacerbations were two primary reasons for the same.<sup>15</sup> Our study had contradictory findings as 72.4% pregnancies resulted in a placenta weighing 500–1000 g possibly due to overcompensation of the placental surface in order to prevent IUGR in view of respiratory disorders during pregnancy. Mild preeclampsia was three times more common in pregnant women hospitalized for asthma.<sup>16</sup> Our study showed obstructive sleep apnea with asthma was associated with mild preeclampsia ( $p < 0.001^b$ ).

### ACUTE RESPIRATORY DISTRESS SYNDROME

Hartert et al. noticed seven women requiring an ICU admission after the second trimester.<sup>17</sup> Another study by Wong et al. noticed

**Table 3:** Neonatal outcomes of pregnancies complicated by respiratory illness

Variable		APGAR at 1 minute			p value
		<5	6–7	>8	
Gestational age	<32 weeks	466.7%	233.3%	00.0%	<0.001 <sup>b</sup>
	32 + 1–36 + 6 weeks	519.2%	1038.5%	1142.3%	
	37–39 + 6 weeks	158.6%	5732.6%	10358.9%	
	>40 weeks	116.7%	233.3%	350.0%	
Variable		APGAR at 5 minutes			p value
		<5	6–7	>8	
Gestational age <sup>e</sup>	<32 weeks	350.0%	233.3%	116.7%	<0.001 <sup>b</sup>
	32 + 1–36 + 6 weeks	519.2%	00.0%	2180.8%	
	37–39 + 6 weeks	95.1%	42.3%	16292.6%	
	>40 weeks	00.0%	116.7%	583.3%	

<sup>a</sup>Chi-square; <sup>b</sup>Fisher's exact; <sup>c</sup>Statistically significant at  $\alpha = 5\%$  and  $p < 0.05$

six patients who were admitted in the ICU because of decreased blood oxygenation.<sup>18</sup> A study by Lapinsky et al. showed that the overall prevalence of obstetric patients that require critical care ranges from 1 to 9 in 1,000 gestations.<sup>19</sup> In our study, five (62.5%,  $p < 0.001$ ) pregnancies complicated by ARDS required an ICU admission. A study by Panchal et al.<sup>20</sup> reported mortality rates as 2–20% in critically ill patients with respiratory compromise; our study had a mortality rate of 1.45%.

IUD was seen in four (50%) mothers with ARDS and one (6.2%) mother with tuberculosis and still births were associated with mothers with allergic bronchitis ( $p < 0.001^b$ ). IUD significantly occurred mostly at 32–36 weeks of gestation (15.4%,  $p = 0.001^b$ ), and not during a later gestational age. Schatz et al.<sup>12</sup> showed that 4.1% of the babies born to have a birth weight of <2.5 kg; our study showed 31.4% had babies of low birth weight of <2.5 kg.

APGAR scores were <5 in five (62.5%) pregnancies complicated with ARDS even at 5 minutes with adequate resuscitative measures ( $p < 0.001^b$ ).

### Infections

In our study, respiratory tract infections 23 (10.7%) were the second most common cause of respiratory complications in pregnancy after asthma. Madinger et al.<sup>21</sup> showed a significant association of pneumonia with preterm labor (44%). An Israel study noted hospitalization of 246 women for upper respiratory tract infections (URTI), showing a significant higher rate of preterm deliveries (15.9%) and low birth babies (20.3%).<sup>22</sup> However, our study showed no significant relation of infections with preterm labor. No significant scores were seen with relation to URTI in pregnancy and low APGAR scores of less than 7 at 1 minute (5.8%).<sup>22</sup> Similar findings were seen in our study wherein only 54.7% had an APGAR score >8 at 1 minute, and even after adequate measures, >10% had an APGAR score <8 even at 5 minutes, but most babies 117 (54.6%) had a birth weight of 2.5–3.5 kg and 40 (18.6%) had birth weight less than 2.5 kg, possibly due to adequate and timely intervention during the antenatal period for the various type of respiratory illnesses they experienced.

### Tuberculosis

A Mexican study on 13 pregnant women with tuberculosis showed that those women who were on treatment after the second trimester of their pregnancy had a higher frequency of obstetric complications (37.5%) and preterm labor (25%).<sup>23</sup>

Four (50%) pregnancies complicated with ARDS and one (50%) with tuberculosis had a significant outcome as an IUD ( $p < 0.001^b$ ) in our study. APGAR scores were <5 in one (50%) pregnancy complicated with tuberculosis even at 5 minutes with adequate resuscitative measures ( $p < 0.001^b$ ).

### Bronchitis

Chronic bronchitis was significantly associated with abruption (25.09%) in a Columbian study.<sup>24</sup> Our study showed significant association with immune thrombocytopenia with allergic bronchitis (6.2%) and ARDS (12.5%,  $p < 0.001^b$ ), without any occurrence of abruption. Those pregnancies complicated with allergic bronchitis (81.25,  $p < 0.001^b$ ) had neonates with a good APGAR score at 1 minute >8. Eleven (68.8%,  $p = 0.009^b$ ) pregnancies complicated with allergic bronchitis were able to withstand the stress of a normal vaginal delivery.

### CONCLUSION

Chronic respiratory illnesses in pregnancy pose more risks to the mother and fetus as seen with the higher chance of IUD, NICU admissions, preeclampsia, etc. Mothers with respiratory illnesses should be screened antenatally as the chances of LSCS are more, and they are unable to withstand the stress of a normal delivery. LSCS continues to still remain as the gold standard mode of delivery for patients with respiratory illnesses. Close monitoring of antenatal period with pulmonary function testing increases the chance of a good outcome of the present pregnancy.

### Importance of the Paper

Our study was the first of its kind to see the association of the various respiratory illnesses and the outcomes of pregnancy in a South Asian population in contrast to the numerous studies on bronchial asthma complicating pregnancies. Maternal and Child Health Mission should accentuate the need for consideration of a separate scheme for lung illnesses and pregnancy, with incentives to relieve burden of illness on mothers and their families.

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