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# Predictors of Respiratory Distress among Neonates Admitted to the Neonatal Intensive Care Unit in a Comprehensive Specialized Hospital, in South Ethiopia. Unmatched case- control

**Taye Mezgebu[1]*, Zerihun Demisse[1], Asnakech Zekiwos[1], Elias Ezo[1], Tadesse Sahle[2] and Getachew Ossabo[1]**

[1]School of Nursing, College of Medicine and Health Science, Wachemo University, Hosanna, Ethiopia
[2]Department of Nursing College of Medicine and Health Science, Wolkite University, Wolkite, Ethiopia

## Abstract

**Introduction:** Respiratory distress is the most common and serious complication following birth. RD in neonates is a worldwide public health concern. In Africa, particularly in Ethiopia, there are scanty data available regarding risk factors for respiratory distress among neonates.

**Objective:** To determine predictors of respiratory distress among neonates admitted to the Neonatal Intensive Care Unit (NICU) at Nigist Eleni Mohammed Memorial comprehensive specialized hospital.

**Methods:** A facility-based unmatched case-control study was conducted on 417 (139 cases and 278 controls) systematically selected subjects at the Neonatal Intensive Care Unit of Nigist Eleni Mohammed Memorial Comprehensive specialized hospital in South Ethiopia from September 1, 2018–August 30, 2021. After collection, the data were entered into EpiData version 4.4.2 and analyzed using SPSS version 25. Bivariable and multivariate analyses were done using binary logistic regression. In the multivariate logistic regression model, statistical significance was declared at p 0.05, and the presence and strength of associations were summarized using an adjusted odds ratio with 95% confidence intervals.

**Result:** Overall, 417 (139 cases and 278 controls) neonates who attended the NICU were included with a 100% response rate. Neonates who were born from meconium-stained amniotic fluid mothers (AOR = 12.56; CI: 5.47– 28.84), non-vertex presentation (AOR = 4.35; CI: 1.56–12.14), PROM (AOR = 3.21; CI: 1.010–10.18), obstructed labour (AOR = 3.04; CI: 1.477–6.28), maternal infection (AOR = 7.12; 95% CI: 3.04–16.64), and neonates with an Apgar score less than 7 in the first minute (AOR = 7.83; CI: 3.676–16.66) were found to have an independent association with respiratory distress.

**Conclusion:** The present data confirmed that meconium-stained amniotic fluid, the presence of infection, non-vertex presentation, premature rupture of membrane, obstructed labour, and a low Apgar score at the first minute was found to be determinant factors of Respiratory Distress among neonates. The health professions should closely monitor the mothers at risk during follow-up and encourage those with risk factors to deliver their babies where advanced healthcare services are available.

**Keywords:** Neonates; Risk factors; Respiratory distress; Ethiopia

## Introduction

The neonatal period is the most critical time in their life due to the possibility of acquiring serious life-threatening diseases and the complexity of the adaptive process of newborns [1]. Acute Respiratory distress is a devastating inflammatory lung disease or diffuse alveolar damage that increases the permeability of the alveolar-capillary membrane and results in impaired gas exchange [2]. Respiratory distress is a major contributor to respiratory failure in critically ill neonates. Typical clinical parameters of respiratory distress in neonates include any sign of difficulty breathing, tachypnea(more than 60 breaths per minute), intercostal retractions, nasal flaring, loud grunting, cyanosis, head nodding, poor feeding, and apnea or breathing pause [3].

Respiratory distress in neonates is a worldwide public health concern [4]. Respiratory Distress Syndrome mainly occurs in premature newborns [5]. However, published data have shown that RDS has led to a more common problem in term neonates. It is one of the Common reasons for neonates to be admitted to neonatal Intensive care and a major source of mortality and morbidity, particularly in developing countries. Globally, it is a common source of high mortality and morbidity in neonates However, there is a marked difference in mortality and morbidity of neonates with Respiratory distress around the world. Furthermore, it is highly prevalent in the low resource setting than in high-income countries [6].

Maternal mortality in neonatal respiratory distress varies widely from 20 to 61%. The incidence of respiratory distress is significantly higher in preterm neonates. Previous studies conducted showed that high prevalence of RD in France 18.5%, Cameroon 47.5%, and Ivory Coast 23%, and 29 % in India. However, in developing countries, there are scanty data available regarding risk factors, the incidence, and the outcome of neonates with Respiratory distress [7].

Many studies in developed countries have identified certain risk

***Corresponding author:** Taye Mezgebu, School of Nursing, College of Medicine and Health Science, Wachemo University, Hosanna, Ethiopia, E-mail: tayemezgebu26@gmail.com

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factors for increasing respiratory distress in neonates, including preterm low birth weight, pneumonia, respiratory distress syndrome, maternal infection, and meconium aspiration syndrome, mode of delivery, maternal age, male sex, gestational diabetes, a low first and fifth Apgar score, and Chorioamnionitis, congenital malformation. The etiologies and determinants associated with RD have not been well-reported in low-income countries, particularly in Africa. Indeed, in Africa, respiratory distress is one of the most common reasons for neonatal mortality and morbidity. However, in Africa, particularly in Ethiopia, there are scanty data available regarding risk factors for respiratory distress in neonates. Therefore, this study aimed to identify the determinants of respiratory distress among neonates admitted to the Neonatal Intensive Care Unit (NICU) of Wachemo University Nigist Eleni Mohammed Memorial comprehensive specialized hospital [8].

## Methods and Materials

### Study area and period

The study was conducted at Wachemo University Nigist Eleni Mohammed Memorial Comprehensive Specialized Hospital in Hadiya Zone, Southern Ethiopia, which is located approximately 230 km away from the capital city, Addis Ababa, and 185 km from the regional capital, Hawasa. The hospital serves a population of over 4 million people in southern Ethiopia. The NICU is a unit within the Department of Pediatrics and child health that provides an intensive care unit for neonates and has a capacity of approximately 20 beds at any time. The space also accommodates invasive and non-invasive ventilation for both pediatrics and neonates. The study was conducted from March to May 2022 [9].

### Study design

An institutional–based unmatched case-control study was conducted.

### Source population and study population

All neonates admitted to Neonatal ICU in Nigist Eleni comprehensive specialized hospital were the source of the population.

### Study population

All selected neonates admitted to Neonatal ICU WCUCSH during the study period were the study population. However, Neonatal charts, which Miss Key information, were excluded from the study.

### Operational definition

### Case definition

Neonates who were admitted to the NICU with a diagnosis of respiratory distress, which was based on clinical manifestation (difficulty breathing, tachypnea, respiratory grunting, nasal flaring, cyanosis, and chest retractions) and radiographic signs on chest x-rays (patchy infiltrates, hyper-expansion bilaterally) [10].

### Control definition

Neonates admitted to the neonatal intensive care unit in the hospital with a diagnosis of other than respiratory distress such as; very low birth weight, low birth weight, pre-term, sepsis, birth asphyxia, hypothermia, hypoglycemia, the congenital disease did not have any sign of respiratory distress under control [11].

### Data collection tools and procedures

Data were collected retrospectively using checklist extraction by chart review using a pretested structure and checklists that were designed from different literature. The data collection tool comprised socio-demographic characteristics, obstetric-related variables of indexed mothers, neonatal-related factors, and clinical variables. The obstetric-related data were obtained from their neonates' chart, which is recorded during the admission of neonates into the NICU. Three data collectors (BSc nurses) and one supervisor (MSc qualification) completed the data collection within two weeks [12].

### Data quality assurance

The Checklist was prepared in English. Two weeks before the data collection, the questionnaire was pre-tested on 5% of the samples (17 charts) that were not included in the actual data for analysis by the principal investigator to assure the consistency and clarity of the tool where unclear items were modified accordingly. One day of training was given to data collectors and the supervisor about the research objective, eligible study subjects, data collection tools and procedures, and checklist extraction. Data collection was coordinated and reviewed by the supervisor and principal investigator.

### Data processing and analysis

Data were cleaned and entered using Epi data version 4.4.2 and analyzed using SPSS version 25. An exploratory analysis was conducted to determine the nature of the data. Then, the data were described using relative frequency percent. Binary logistic regression was used to conduct both bi-variable and multivariate analyses. The model fitness to the data was checked using Hosmer and Lemeshow test and Multi-Collinearity was investigated using the variance inflation factor (VIF). In the bi-variable analysis, variables with p-values<0.25 were analyzed and fitted to multivariate analysis to identify the independent effects of each covariate on the outcome variable. In the final logistic regression model, statistical significance was declared at $p<0.05$, and the presence and strength of associations were summarized using an adjusted odds ratio with 95% confidence intervals. Finally, study findings were presented in texts and tables.

### Ethical considerations

The study was conducted after being approved by the Institutional Review Board (IRB) (ref=WCURCSVPO 531/14) of Wachemo University. A letter of cooperation was received from the research coordinator offices and permission to conduct the study was offered by the chief clinical director, matron officer, and Neonatal Intensive Care unit coordinators of the Wachemo University Nigist Eleni comprehensive specialized hospital. The study was conducted per the declaration of Helsinki. Informed consent was waived since the nature of the data collection was retrospective. Confidentiality of the information was secured throughout the study process by using code instead of any personal identifier & is meant only for the study.

## Result

Overall 417 (139 cases and 278 controls) neonates who were admitted to the intensive care unit were included in this study with a response rate of 100%.

### Socio-demographic characteristics of mothers

The current study findings showed that the age distribution was 48 (32%) mothers of cases and 47(51%) mothers of controls were between the age group of 25-29 years in which 34.5% of the mothers in this age group had their neonates with RD. Two-hundred-eleven (50.6%)

participants came from urban areas of that 37.8% of neonates from urban were diagnosed with RD. Regarding the maternal educational status 36.5 of the participants could not read and write but, 23.3% of the participants completed higher education. Again, 385 (92.3%) of the mothers were married **(Table 1).**

## Obstetrics related variables

Among all mothers enrolled in this study, 224 (53.7%) were multiparous. The majority of the neonates were born to mothers with multiparty. Three hundred ten (74.3%) of the mothers had a history of antenatal care follow-up during pregnancy; 31.9% were in the case group, and 68.1% were in the control group. Regarding the gestational age, most of the mothers were delivered between 37 and 42 weeks of their pregnancy, 31% of in the case group and 69% in the control group. Regarding the pregnancy-induced hypertension of the mothers, the proportion of mothers with preeclampsia was higher among cases 39 (63.9%) than among controls 22 (36.1%). The findings revealed that 47 (50.5%) of the mothers of the cases and 46 (49.5%) of the mothers in the control group had a history of antepartum hemorrhage during the pregnancy of the current neonates. Case 31 had a higher proportion of women with a history of gestational diabetes (52.5%) of the total than Control 28 (47.5%). The findings showed that the proportion of maternal infection was about three times higher among cases (76.2%) than among controls (24.8%). Furthermore, the majority of the mothers 310 (74.1%) had spontaneous vaginal deliveries, with 80 (24.9%) being cases and 229 (74.1%) being controls. The proportion of non-vertex presentation recorded among cases during pregnancy was 26 (56.7%), which was higher than the proportion recorded among the control group of 20 (43.3%). Regarding the place of delivery, the study showed that the majority of the mothers delivered their neonates at hospitals (76.7%), and only 18 (4.3%) of the mothers conducted home deliveries. The proportion of mothers with premature rupture of membranes among the case group was 74 (67.3%), which is higher than the control group of 36 (32.7). Only 33 (7.9%) of neonates born to mothers with comorbidities are proportionally high in case group 21 (63.6%). According to the findings of this study, the majority 74 (60.2%) of the neonates were born from mothers who had obstructed labour among the cases group **(Table 2).**

**Table 1**: Socio-demographic characteristics of mothers of neonates admitted to the NICU at Wachemo University Nigist Eleni Mohammad memorial comprehensive specialized hospital, Ethiopia, 2022.

| Variable | Category | Disease status of the neonates | | Total (%) |
|---|---|---|---|---|
| | | Case (n=139) N (%) | Control (n=278) N (%) | |
| Age of mother | <24 | 44(48.4) | 47(51.8) | 91(21.8%) |
| | 25-29 | 48(32.0) | 102(68.0) | 150(36.0%) |
| | 30-34 | 31(25.0) | 93(75.0) | 124(29.7%) |
| | >35 | 16(30.8) | 36(69.2) | 52(12.5%) |
| Residence of mothers | Urban | 69(32.7) | 142(67.3) | 211 (50.6%) |
| | Rural | 70(34.0) | 136(66.0) | 206 (49.4%) |
| Educational status | Illiterate | 60(39.5) | 92(60.5) | 152(36.5%) |
| | Primary | 31(38.3) | 50(61.7) | 81(19.4%) |
| | Secondary | 24(27.6) | 63(72.4) | 87(20.9%) |
| | Higher | 24(24.7) | 73(75.3) | 97(23.3%) |
| Marital status | Married | 131(34.0) | 254(66.0) | 385(92.3%) |
| | Single | 4(22.2) | 14(77.8) | 18(4.3%) |
| | Widowed | 3(27.3) | 8(72.7) | 11(2.6%) |
| | Divorce | 1(33.3) | 2(66.7) | 3(0.7%) |

**Table 2**: Obstetrics characteristics of mothers of neonates admitted to the NICU at Wachemo University Nigist Eleni Mohammad memorial comprehensive specialized hospital, Ethiopia, 2022.

| | | Disease status | | |
|---|---|---|---|---|
| Variable | Category | Case n= 139 | Control n=278 | Total (%) |
| | | N (%) | N (%) | |
| Parity of the mother | Primipara | 70(42.9) | 93(57.1) | 163(39.1%) |
| | Multipara | 69(27.2) | 155(72.8) | 224 (53.7%) |
| Gestational age | <37 weeks | 28(42.4) | 38(57.6) | 66(15.8%) |
| | 37-42 weeks | 102(31.0) | 227(69.0) | 329(78.9%) |
| | >42 weeks | 9(40.9) | 13(59.1) | 22(5.3%) |
| Antenatal care follow up | Yes | 99(31.9) | 211(68.1) | 310 (74.3%) |
| | No | 40(37.4) | 67(62.6) | 107(25.7%) |
| | Yes | 51(39.2) | 79(60.8) | 130(31.2%) |
| Anaemia during | No | 88(30.7) | 199(69.3) | 287 (68.8%) |
| pregnancy | | | | |
| Preeclampsia | Yes | 39(63.9) | 22(36.1) | 61(14.6%) |
| | No | 100(28.1) | 256(71.9) | 356(85.4%) |
| Antepartum hemorrhage | Yes | 47 (50.5) | 46(49.5) | 93(22.3%) |
| | No | 92(28.4) | 232(71.6) | 324(77.7%) |
| Gestational DM | Yes | 31(52.5) | 28(47.5) | 59(14.1%) |
| | No | 108(30.2) | 250(69.8) | 358(85.9%) |
| Oligohydramnios | Yes | 20(50.0) | 20(50.0) | 40(9.6%) |
| | No | 119(31.6) | 258(68.4) | 377(90.4%) |
| Induction of labour | Yes | 24(47.1) | 27(52.9) | 51(12.2%) |
| | No | 115(31.4) | 251(68.6) | 366(87.8%) |
| Maternal infection | Yes | 76(75.2) | 25(24.8) | 101(24.2%) |
| | No | 63(19.9) | 253(80.1) | 316(75.8%) |
| Mode of delivery | SVD | 80(25.9) | 229(74.1) | 309(74.1%) |
| | Cs | 45(51.1) | 43(48.9) | 88(21.1%) |
| | Instrumental | 14(70.0) | 6(30.0) | 20(4.8%) |
| Duration of labour | >12 Hours | 69(50.0) | 69(50.0) | 138(33.1%) |
| | <12 Hours | 70(25.1) | 209(74.9) | 279(66.9%) |
| Fetal presentation | Vertex | 113(30.5) | 258(69.5) | 371(89.0%) |
| | Non-vertex | 26(56.5) | 20(43.5) | 46(11.0%) |
| Place of delivery | Home | 2(11.1) | 16(88.9) | 18(4.3%) |
| | Health center | 18(24.3) | 56(75.7) | 74(17.7%) |
| | Private clinic | 1(20.0) | 4(80.0) | 5(1.2%) |
| | Hospital | 118(36.9) | 202(63.1) | 320(76.7%) |
| PROM | Yes | 74(67.3) | 36(32.7) | 123(29.5%) |
| | No | 65(21.2) | 242(78.8) | 307(73.6%) |
| Obstructed labour | Yes | 74(60.2) | 49(39.8) | 123(29.5%) |
| | No | 65(22.1) | 229(77.9) | 294(70.5%) |
| Maternal comorbidity | Yes | 21(63.6) | 12(36.4) | 33(7.9%) |
| | No | 118(30.7) | 266(69.3) | 384(92.1%) |

## Neonatal related factors

More than half of the participants 58.8% were females. Females were lower in proportion among the cases group 78(31.8%) than the control group176 (68.2%). Regarding fetal distress during labour, the proportion was higher among the cases group 103(60.2%) than control group 68(39.8). Additionally, in more than half of the cases, 125(52.3%) of the neonates have meconium-stained amniotic fluid which is higher than control groups 114(47.7). The study findings showed that neonates in the first minute with low APGAR scores were recorded among the neonates with cases which was a higher proportion 117(58.2) than in the control group 84(41.8). Similarly, the proportion of recorded less than 7Apgar score in the 5th minutes of the new-borns among the cases

group106 (57.6%) was higher than the control group78 (42.4%) **(Table 3).**

### Risk factors of respiratory distress

After the description of the data, the bi-variable analysis was performed using the binary logistic regression model to determine the variables that should be fitted to the final model for multivariate analysis. During the bi-variable analysis variables including preeclampsia, fetal presentation, fetal distress, antepartum hemorrhage, gestational DM, Oligohydramnios, place of delivery, mode of delivery induction of labour, infection, duration of labour, premature rupture of membrane, obstructed labour, comorbidity, Meconium-stained amniotic fluid, and neonates who have low APGAR score in the first one and five minutes were statistically significant at P-value <0.25 and were collectively entered to the multivariate logistic regression model. After checking the model fitness the multivariate analysis was run.

Finally, in the multivariate analysis, maternal infection, premature rupture of membrane, obstructed labour, fetal presentation, meconium-stained amniotic fluid, and in the first minute Apgar score showed statistically significant association with the development of respiratory distress of the neonate at p-value ≤0.05.The multivariate analysis revealed that neonates born to mothers with meconium-stained amniotic fluid were 12.56 times more likely to develop respiratory distress compared to those neonates born to mothers with no MSAF (AOR=12.56; CI: 5.47-28.84). In addition, Neonates who had sepsis were 7.12 times (AOR= 7.12; 95% CI: 3.04- 16.64) more likely to develop RDS as compared to those who infection free. Similarly, neonates who had been born from mothers with the non-vertex presentation were 4.35 times (AOR= 4.35; CI: 1.56-12.14) increased chance of developing respiratory distress compared to their counterparts. Neonates who were born to mothers with obstructed labour were at a Threefold increased risk to acquire Respiratory Distress than those born to non- obstructed mothers (AOR= 3.04; CI: 1.48-6.28). Likewise, Neonates with Apgar scores less than 7 in the First minutes were nearly 8 times more likely to have respiratory distress than their counterpart (AOR=7.83; CI: 3.68- 16.66). Lastly, neonates born to mothers with pre-rapture of the membrane were significantly associated with the development of Respiratory Distress (AOR=3.21; CI: 1.01-10.18) **(Table 4).**

**Table 3:** Characteristics of neonates admitted to the NICU at Wachemo University Nigist Eleni Mohammad memorial comprehensive specialized hospital, Ethiopia, 2022.

| | | Disease status | | |
|---|---|---|---|---|
| **Variable** | **Category** | **Case n= 139** | **Control n=278** | **Total (%)** |
| | | N (%) | N (%) | |
| Birth weight | <2.49kg | 29(36.7) | 50(63.3) | 79(18.9) |
| | 2.5-4kg | 100(33.0) | 203(67.0) | 303(72.7) |
| | >4kg | 10(28.6) | 25(71.4) | 35(8.4) |
| labour | Yes | 103(60.2) | 68(39.8) | 171(41.0) |
| | No | 36(14.6) | 210(85.4) | 246(59.0) |
| Gender of the neonate | Male | 61(35.5) | 111(64.5) | 172(41.2) |
| | Female | 78(31.8) | 167(68.2) | 245(58.8) |
| MSAF | Yes | 125(52.3) | 114(47.7) | 239(57.3) |
| | No | 14(7.9) | 164(92.1) | 178(42.7) |
| APGAR Score at 1st minute | Score <7 | 117(58.2) | 84(41.8) | 201(48.2) |
| | score > 7 | 22(10.2) | 194(89.8) | 216(51.8) |
| APGAR scored at 5th minute | Score <7 | 106(57.6) | 78(42.4) | 184(44.1) |
| | score > 7 | 33(14.2) | 200(85.8) | 233(55.9) |

Abbreviation: MSAF, Meconium stained amniotic fluid; APGAR, Appearance pulse grimace Activity respiratory; Kg, Kilo gram.

## Discussion

The current study intended to investigate the factors that determine Respiratory Distress among neonates admitted to WCU Nigist Eleni Mohammed Memorial Comprehensive Specialized Hospital. According to the study result, maternal infection, premature rupture of membrane, obstructed labour, fetal presentation, meconium-stained amniotic fluid, and in the first minute Apgar score were predictors of developing RD among neonates. The study finding revealed that neonates delivered with meconium-stained amniotic fluid were 12.56 times (AOR=12.56; CI: 5.47-28.84) more likely to develop Respiratory Distress compared to those who had clear amniotic fluid. This was supported by another study conducted in India revealed that MSAF had a significant association with the development of respiratory distress. The possible justification for this might be that neonates born from mothers with MSAF were more likely to aspirate the meconium, which can affect the alveolar gas exchange negatively, and decrease alveolar recruitment for gas exchange due to alveolar space occupied by meconium. In addition, inhaled meconium might result in mechanical obstruction of the small airways leading to mismatched ventilation-perfusion due to increase dead space, inflammation, and infection which inhibit surfactant function of the lung, leads to respiratory distress which is the common etiology of RD. This study's findings showed that neonates born from mothers who had infection were 7.12 times (AOR= 7.12; 95% CI: 3.04-16.64) more likely to develop RD as compared to those born from mothers with infection free. This finding is in line with the study conducted in Addis Ababa, Gondar, and China. The possible explanation might be infection can result from direct lung injury of the neonates and alveolar type II cells which decrease the synthesis of pulmonary surfactant. In addition, inflammation of the lung due to infection increases the permeability of the alveolar-capillary membrane to both protein and fluids. Hence, plasma protein occupied the alveolar space inhibiting the gas exchange and resulting in neonatal hypoxia which leads to respiratory distress. Therefore, infection is one of the important risk factors for developing Respiratory distress among neonates which increase the chance of neonatal mortality of respiratory distress; thus clinician should give special attention to the management of RD with infection particularly, working in the NICU.

Similarly, this study also identified those neonates born from mothers who had premature rupture of the membrane were 3 times more likely to develop respiratory distress compared to their counterparts. This is in line with the study conducted in Gondar Egypt and Poland. We hypothesize that there are some explanations for why PROM is one of the risk factors for increasing the development of RD among neonates. Mothers with PROM might be at high risk of easily acquiring intrauterine infection and Chorioamnionitis that result in early neonatal infection, neonatal sepsis is also correlated to the development of RD due to increased inflammation of the lung tissue, which leads to increased lung edema and secretion that the result will be hypoxic neonates. Premature rupture of the membrane is one of the common risk factors for developing a bacterial infection, which leads to pneumonia and sepsis. In addition, Pre rupture of the membrane leads delivering of the pre matured newborns that are highly susceptible to developing respiratory distress due to deficiency of lung surfactant, which might delay fluids absorption and impair gas exchange. The current study showed that neonates born to mothers with the non-vertex presentation were 4 times more likely to develop respiratory distress than neonates born to mothers with vertex presentation.

**Table 4**: Bi-variable and multivariate logistic regression analysis for risk factors of RD among neonates who had been admitted to the NICU of Wachemo University Nigist Eleni Mohammed Memorial, Southern, Ethiopia, 2022. (N=417).

| | | Disease status | | | | |
|---|---|---|---|---|---|---|
| **Variable** | **Category** | **Case** | **Control** | **COR** | **AOR** | **P-VALUE** |
| Preeclampsia | Yes | 39(63.9) | 22(36.1) | 4.54(2.56- 8.04) | 1.491(0.585-3.800) | 0.403 |
| | No | 100(28.1) | 256(71.9) | 1 | 1 | |
| Antepartum | Yes | 47 (50.5) | 46(49.5) | 2.577(1.606-4.134) | .987(0.428-2.276) | 0.975 |
| hemorrhage | No | 92(28.4) | 232(71.6) | 1 | 1 | |
| Gestational DM | Yes | 31(52.5) | 28(47.5) | 2.563(1.466-4.480) | .434(0.157-1.201) | 0.108 |
| | No | 108(30.2) | 250(69.8) | 1 | 1 | |
| Oligohydramnios | Yes | 20(50.0) | 20(50.0) | 2.168(1.124-4.181) | 0.370(0.122-1.122) | 0.079 |
| | No | 119(31.6) | 258(68.4) | 1 | 1 | |
| Induction of labour | Yes | 24(47.1) | 27(52.9) | 1.940(1.073-3.509) | 0.797(0.314-2.025) | 0.633 |
| | No | 115(31.4) | 251(68.6) | 1 | 1 | |
| Maternal infection | Yes | 76(75.2) | 25(24.8) | 12.208(7.189-20.730) | 7.109(3.038-16.639) | 0.000* |
| | No | 63(19.9) | 253(80.1) | 1 | 1 | |
| Mode of delivery | SVD | 80(25.9) | 229(74.1) | 1 | 1 | |
| | Cs | 45(51.1) | 43(48.9) | 6.679(2.483-17.969) | 4.241(0.818-21.995) | 0.085 |
| | Instrumental | 14(70.0) | 6(30.0) | 2.230(0.785-6.332) | 5.362(0.999-28.783) | 0.05 |
| Duration of labour | >12 Hours | 69(50.0) | 69(50.0) | 2.943(1.943-4.588) | 0.484(0.177-1.330) | 0.159 |
| | <12 Hours | 70(25.1) | 209(74.9) | 1 | 1 | |
| Fetal presentation | Vertex | 113(30.5) | 258(69.5) | 1 | 1 | |
| | Non-vertex | 26(56.5) | 20(43.5) | 2.968(1.591-5.537) | 4.350(1.558-12.143) | 0.005 |
| Place of delivery | Home | 2(11.1) | 16(88.9) | 4.673(1.056-20.682) | 0.386(0.045-3.343) | 0.387 |
| | Health center | 18(24.3) | 56(75.7) | 1.817(1.020-3.238) | 0.916(0.006-132.348) | 0.972 |
| | Private clinic | 1(20.0) | 4(80.0) | 2.337(0.258-21.152) | 0.189(0.025-1.410) | 0.104 |
| | Hospital | 118(36.9) | 202(63.1) | 1 | 1 | |
| Premature rupture | Yes | 74(67.3) | 36(32.7) | 7.653(4.720-12.409) | 3.206(1.010-10.177) | 0.048* |
| of membrane | No | 65(21.2) | 242(78.8) | 1 | 1 | |
| Obstructed labour | Yes | 74(60.2) | 49(39.8) | 5.321(3.379-8.378) | 3.044(1.477-6.275) | 0.003* |
| | No | 65(22.1) | 229(77.9) | 1 | 1 | |
| Meconium-stained | Yes | 125(52.3) | 114(47.7) | 12.845(7.036-23.448) | 12.563(5.473-28.837) | 0.000* |
| amniotic fluid | No | 14(7.9) | 164(92.1) | 1 | 1 | |
| Fetal distress during | Yes | 103(60.2) | 68(39.8) | 8.84(5.53- 14.10) | 1.695(0.613-4.687) | 0.309 |
| labour | No | 36(14.6) | 210(85.4) | 1 | 1 | |
| APGAR Score at 1st | Score<6 | 117(58.2) | 84(41.8) | 12.282(7.284-20.711) | 7.827(3.676-16.664) | 0.000* |
| minute | score ≥ 7 | 22(10.2) | 194(89.8) | 1 | 1 | |
| APGAR SCORE at | Score 4-6 | 106(57.6) | 78(42.4) | 8.236(5.147-13.181) | 0.748(0.307-1.822) | 0.523 |
| 5th minute | score ≥ 7 | 33(14.2) | 200(85.8) | 1 | 1 | |
| Maternal | Yes | 21(63.6) | 12(36.4) | 3.945(1.879-8.282) | 2.099(0.630-6.994) | 0.227 |
| comorbidity | No | 118(30.7) | 266(69.3) | 1 | 1 | |

*statistically significant at p<0.05, Abbreviation: CS, cesarean section; SVD, spontaneous vaginal delivery; APGAR, Appearance pulse grimace activity respiratory

This might be due to the presence of abnormal presentation before delivery had a probability of being obstructed labour. Thus, might increase fetal distress, which leads to cesarean section delivery which is a high risk for the development of respiratory distress. The possible justification might be neonates who were born by cesarean section unlike spontaneous vaginal delivery; cesarean section delivery did not involve chest compression, thus reducing fluid clearance. Even though we could not find any former reports regarding the association between respiratory distress and non-vertex presentation. Therefore, further study should be recommended to confirm the association between non-vertex presentation and respiratory distress. Again, neonates with an Apgar score of less than 7 in the first minute were nearly 8 times more at risk to develop RD than neonates with an Apgar score in the first minute equal to or greater than 7. This finding was compatible with studies conducted in Addis Ababa and Cameroon. The possible reason might be due to neonates with low Apgar scores at the first 1 minute were born from meconium-stained amniotic fluid would always be considered a marker of fetal distress due to aspiration. Hence, there was a significant effect on the outcome of the neonates with low Apgar scores, leading to a high morbidity and mortality burden. Therefore, it is better to pay attention to the management of neonates with low Apgar scores in the first minute. Lastly, the odds of Respiratory Distress increased three times more comparing neonates born from mothers with obstructed labour than neonates born from mothers who did not obstruct. We could not find any published articles reporting regarding the direct association between obstructed labour and Respiratory Distress among neonates. However, we hypothesize that obstructed labour might increase the intrauterine meconium release, leading to meconium inhalation. This is supported by a study that reported that labour dystocia, which was one of the common causes of obstructed labour was significantly associated with the development of meconium aspiration syndrome. Hence, the reason might be due to the prevalence of meconium-stained amniotic fluid and premature rupture of the membrane leads to the possibility of fetal inhalation of meconium and

amniotic fluid. In addition, the possible reason might be obstructed labour explained by a high rate of prolonged labour and CPD, which are the main indicators of operative delivery (cesarean section) that is one of the risk factors for developing respiratory distress. However, further study is needed to settle the actual association between obstructed labour and respiratory distress among neonates.

### Limitations of the study

Since the current study was conducted in a single institution, generalizability to other institutions found in the region is not possible. Besides, the general limitation of retrospective studies could be another point to be reminded of while applying the study findings in this study. This study also did not address the outcome and the survival status of neonates with respiratory distress.

## Conclusion

The present data confirmed that meconium-stained amniotic fluid, presence of infection, non-vertex presentation, and premature rupture of membrane, obstructed labour, and low Apgar score at the first minute were found to be predictors of Respiratory Distress among neonates. The health professions should closely monitor the mothers at risk during follow-up and encourage those with risk factors to deliver their babies where advanced healthcare services are. Neonates who are at risk of developing respiratory distress syndrome will need special attention and quality care in the facility by well-trained health providers.

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### List of abbreviations used

AOR, Adjusted Odd Ratio; ARDS, Acute Respiratory Distress Syndrome; CI, Confidence Interval; DM, Diabetics Mellitus; NICU, Neonatal Intensive Care Unit; IRB, Institutional Review Board; MSc, Master of Science; MRN, Medical Record Number; RD, Respiratory Distress; WCUCSH, Wachemo University comprehensive specialized hospital.

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### Authors' contributions

Initially, TMA conceived the study. ZDB, AZH, and EE were involved in the study design and tool preparation. TMA and ZDB wrote the research proposal. AZH, TSA, & EE edited and revised the proposal. Then, TMA, ZDB, AZH, TSA, and EE participated in the data quality control and data entry. TMA, & ZDB conducted the statistical analysis and TMA drafted the manuscript. AZH, TSA & EE edited the manuscript and formatted it for publication. Afterwards, all the authors read, critically revised, approved the manuscript, and agreed to be accountable for all aspects of this work.

### Data sharing statement

Extra data that support the findings of this study are accessible from the corresponding author upon reasonable request and can be shared upon legal request.

### Consent for publication

Not applicable

### Disclosure

The authors declared no conflict of interest and the used references are acknowledged.

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