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SYSTEMATIC REVIEW AND META-ANALYSIS

# Prevalence and risk factors associated with birth asphyxia: a systematic review and meta-analysis

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## ABSTRACT

**Background.** Birth asphyxia continues to be a key health issue in the world especially in the low-/middle-income countries since resources are constrained to manage the problem effectively.

**Objective.** To determine the prevalence of birth asphyxia and maternal, fetal, and intrapartum risks of the condition.

**Methods.** This systematic review and meta-analysis synthesized data from 52 studies involving nearly 59,000 neonates to determine the prevalence and key risk factors associated with birth asphyxia.

**Results.** The pooled prevalence rate was about 19.37 and there was a high level of heterogeneity among the regions, settings and study designs. The resource limited environments like Ethiopia and Sudan were found to have higher prevalence rates. Maternal factors (eclampsia, anemia, infections), fetal factors (prematurity, low birth weight, fetal distress), and intrapartum complications (prolonged labor, meconium-stained amniotic fluid, cord prolapse) are identified as the risk factors.

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**Conclusions.** Birth asphyxia remains a major cause of neonatal morbidity and mortality. The extensive variation in prevalence rates underscores the role of varying clinical practices and standards of reporting. Enhancing antenatal and intrapartum services and capacity to provide neonatal resuscitation and enhancing regularity of diagnostic criteria can help decrease the incidence of birth asphyxia, especially in low-resource communities.

**Key words**

Birth asphyxia; neonatal morbidity; neonatal mortality; risk factors; prevalence.

## Introduction

Birth asphyxia is a significant health issue in the world, particularly in low-and middle-income states, where it ranks among the primary reasons of neonatal morbidity and mortality. Birth asphyxia can be defined as the condition witnessed due to absence of oxygen in the brain and other vital organs of the new born during the perinatal period, which is the leading cause of neonatal mortality in most countries of the world and causes about 23% of all deaths that are experienced in the neonatal care [1,2]. Despite the advances in the obstetric care, the morbidity of birth asphyxia is present, and the burden knowledge is essential in promoting interventions.

The socioeconomic, medical, and demographic problems are all contributing factors to the prevalence of the highly location-variable birth asphyxia in the world. It has also been estimated that 24.5% of live infants born in underdeveloped countries are born with some form of hypoxia with severe ones contributing to a significant percentage in neonatal deaths [3-5]. South Asia and sub-Saharan Africa have much higher prevalence rates which connotes inequity in access to emergency obstetric care, skilled delivery care and medical facilities [6,7]. In contrast, the prevalence is lower in high-income countries, predominantly because of improved prenatal care, prompted obstetric care and infant resuscitation [8].

Birth asphyxia is a multifaceted etiology that has intrapartum, fetal and maternal factors. Mothers may have disorders that endanger fetal oxygenation including infections, diabetes, high blood pressure, and anemia. The fetal growth retardation and congenital anomalies are factors that predispose asphyxia in fetuses. Birth asphyxia is mainly caused by intrapartum events (prolonged labor, cord prolapse, placental abruption, and obstructed labor) [9-11]. Once these conditions are not corrected at an early stage, they may cause hypoxia, acidosis and ultimately cause neuronal damage.

Related risk factors which relate to birth asphyxia are critical concepts which aid in the formation of preventive measures. The age of mother, parity and application of antenatal care have been determined to be critical determinants in a number of studies [12,13]. The following are the risk factors: teenage pregnancy, maternal age, or having an older age, i.e., presumably due to biological and social factors. The births of teenage pregnancy are more prone to asphyxia with a biological immaturity and a greater probability of substandard antenatal care leading to complications like obstructed birth and neonatal distress. The lack of adequate antenatal care is generally linked with the unidentified maternal conditions and the improper fetal monitoring that

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exposes the fetus to risks of developing deplorable perinatal outcomes [14,15]. In addition, the obstetric complications which are known to pose risks are antepartum hemorrhage, preeclampsia, and fetal distress. Eclampsia increases the risk of birth asphyxia due to the severe hypertension and convulsions in the maternal system, decreasing uteroplacental blood flow and fetal oxygenation [16].

Birth asphyxia etiology is complicated and needs comprehensive epidemiology analysis to guide health policies. One method that can be used to add the results of a number of studies together into meaningful estimates of prevalence and clarify the uniformity of risk factors across different populations, is systematic reviews and meta-analyses. Several systematic reviews have been conducted on the factors of birth asphyxia but variations in study designs, settings and definitions have a tendency of creating less comparable results [17-20]. Therefore, the systematic review and meta-analysis relating to both the global and regional prevalence and establishing the risk factors which can be altered is an urgent part of the planned intervention.

Despite the fact that a significance of birth asphyxia has been determined, there are still unanswered questions regarding in-depth understanding of birth asphyxia epidemiology. The heterogeneity of data is caused by variability in diagnostic criteria, standards of reporting, and the quality of healthcare. Additionally, not all of the low-resource settings have an efficient surveillance system leading to underreporting. In order to fill the gaps, a methodological review of the available evidence, assessment of the magnitude of the problem, and description of the most significant risk factors that can be reduced through policy and practice change is need.

The primary goal of the systematic review and meta-analysis is to establish the general prevalence of birth asphyxia in various populations and settings. The second objective of the study is to identify and summarize the most significant maternal, fetal, and obstetric risk factors concerning birth asphyxia and provide the general picture of the factors, which predetermine the results of a baby. Hopefully, this evidence synthesis will lead to the review informing clinical practice, be utilized to influence future policy-making and guide future research efforts to minimize the burden of birth asphyxia in the world. The ultimate objective is to have a role in the design of situation-specific, focused interventions that can ensure the effective prevention of incidences of birth asphyxia and better birth outcomes of infants and neurodevelopmental outcomes across the globe.

## Methodology

### Review Protocol and Reporting Standards

The systematic review and meta-analysis were conducted using PRISMA 2020 guidelines [21]. The research question was formulated based on the PICO approach, with the population of interest being neonates (live births), exposures being maternal, perinatal and neonatal risk factors (maternal age, parity, antenatal complications, mode of delivery, gestational age, and birth weight), the comparators being either the absence of exposure to the risk factors or the absence of birth asphyxia, and the outcomes being the prevalence of birth asphyxia and risk factors of birth asphyxia.

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### Literature Search Strategy

The search of the literature was carried out in PubMed/MEDLINE, Embase, Scopus, Web of Science, and CINAHL to find out the articles published between 2015 and 2025. The search strategy combined MeSH terms and free-text keywords related to birth asphyxia, prevalence, and risk factors.

The core search string used was:

(“birth asphyxia” OR “neonatal asphyxia” OR “perinatal asphyxia” OR “intrapartum asphyxia”)

AND (“prevalence” OR “incidence” OR “epidemiology”)

AND (“risk factors” OR “determinants” OR “associated factors”).

### Study Selection

All retrieved records were imported into reference management software, and duplicates were removed. Two reviewers independently screened titles and abstracts, followed by full-text assessment of studies that appeared eligible. Studies were included if they involved live-born neonates and reported either the prevalence of birth asphyxia or examined risk factors associated with birth asphyxia. Eligible designs comprised observational studies such as cross-sectional, case-control, and cohort studies, as well as randomized or quasi-experimental studies if they provided relevant data. Studies were required to define birth asphyxia using clear and standardized diagnostic criteria, including Apgar score <7 at 5 minutes, failure to initiate or sustain breathing, or clinical features consistent with neonatal encephalopathy based on WHO or ICD definitions. Only peer-reviewed, full-text articles published in English between 2015 and 2025 were considered.
Studies were excluded if they were case reports, small case series, reviews, editorials, commentaries, conference abstracts, or if they lacked extractable data on prevalence or risk factors. Studies without explicit diagnostic criteria for birth asphyxia or those based on duplicate datasets were also excluded. Any disagreements during screening were resolved through discussion or consultation with a third reviewer.

### Data Extraction

Data extraction was performed independently by two reviewers using a standardized template. For each study, authorship, publication year, country, study design and setting, sample size, neonatal and maternal characteristics, prevalence of birth asphyxia, diagnostic criteria applied, and the risk factors were examined (Table 1 & Table 2).

### Quality Assessment of included studies

The Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Analytical Cross-Sectional Studies was used to evaluate methodological quality [22]. Each item on the checklist was assessed using the standard JBI response options (Yes, No, Unclear, Not Applicable). In line with practices used in several systematic reviews, a numerical count of “Yes” responses was generated to provide a transparent summary of overall study quality. This did not modify the JBI tool itself but served only to classify studies into three descriptive categories: low risk of bias (7–

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8 items rated Yes), moderate risk (4–6 items), and high risk (≤3 items). Two reviewers performed the assessment independently, and disagreements were resolved through discussion.

### Data Synthesis and Statistical Analysis

For quantitative synthesis, first the pooled prevalence of birth asphyxia calculated using a random-effects meta-analysis model (DerSimonian and Laird method) to account for between-study variability. Prevalence estimates were expressed as percentages with 95% CI. For risk factors, we pooled adjusted or unadjusted effect estimates reported in at least three studies. Heterogeneity was assessed using the $I^2$ statistic, with thresholds of 25%, 50%, and 75% representing low, moderate, and high heterogeneity, respectively. Potential sources of heterogeneity were explored through subgroup analyses by study design, geographical region, and diagnostic criteria, and through meta-regression when sufficient data were available. Funnel plots were used to visually test publication bias and Begg and Egger tests used to test publication bias statistically, with the trim-and-fill method used in the case of observed asymmetry. MedCalc software was used in all analyses.

## Results

### Characterization of the Study

The studies included (n=52) are across different countries, with most of them being Ethiopian and other low- and middle-income nations, which represents a wide geographical distribution sphere. The different study designs were cross-sectional, case-control, cohort, retrospective, and prospective studies with a sample size of 18 to 9738 neonates (Table 1). The majority of studies evaluated infants with gestational ages of 28 weeks and above with some specific studies on preterm infants or term infants. The main instrument in all studies was Apgar score with a common cutoff of <7 to signify birth asphyxia. Middle and early 30s have been reported to be the mean ages of mothers, although there were widely varied ages. The delivery mode involved the vaginal, cesarean, instrumental, and assisted delivery mode wherein some studies indicated high rates of cesarean delivery particularly in hospitals. The prevalence of birth asphyxia was reported as low as 3.10% and as high as 41.2% with a number of studies showing strong relationships between birth asphyxia and a number of maternal, fetal and intrapartum risk factors. The evaluated outcomes were neonatal mortality, neonatal morbidity, neurological sequelae, hypoxic-ischemic encephalopathy (HIE) and other complications.

### Prevalence of Birth Asphyxia

The incidence of birth asphyxia differed considerably in different settings and groups. As an example, Barreto et al. [23] found a prevalence of 8.7% in Brazil and neonatal mortality related to neonatal asphyxia of 35.9%. Likewise, Alfaifi et al. [25] reported a prevalence of 11.3% in Sudan, and more odds of asphyxia were associated with cesarean delivery, preterm births, and low birth weight. In Tanzania, Msisiri et al. [29] reported a prevalence of 25% and Bekele et al. [31] reported the prevalence of 34.6%. In other studies the prevalence rates were lower, including Wudu and Birehanu [40], with 13.1% and Parvin et al. [50], with 11.93%. The rate varied between 3.66% [74] in Nepal and 36.55% [42] in Zambia.

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### Risk Factors Associated with Birth Asphyxia

Several maternal, fetal, and intrapartum variables were found to be valuable predictors of birth asphyxia (Table 2). Motherly conditions like eclampsia, problems with pregnancy and labour, maternal anemia were repeatedly placed as at risk [23, 28, 35, 61]. Indicatively, Barreto et al. [23] identified labor complications and eclampsia, whereas Bekele et al. [31] pointed to maternal anemia and unattended antenatal services. Age of mothers was also a factor, with Alfaifi et al. [25] reporting increased chances of asphyxia in mothers who had either delivered through cesarean section, preterm birth and low birth weight. Low birth weight, preterm birth, fetal distress, and abnormal presentation were all fetal factors that were related to increased risk [30, 36, 49, 62]. As an example, Jena et al. [30] found induction of labor, prolonged labor and low birth weight to be important determinants, but Jimma et al. [49] emphasized the role of low birth weight and prematurity.

Labor-related issues including the presence of prolonged labor, an amniotic fluid being meconium-stained, fetal distress, and cord problems were also often involved [28, 36, 48, 70]. Fetal malpresentation, membrane rupture, and vacuum delivery were found to have a significant effect (Slaam and Elawam [28]) and antepartum hemorrhage and fetal distress were prioritized by Mulugeta et al. [62]. Also the mode of delivery had an effect on the risk; some studies showed that emergency cesarean sections were related to high odds of asphyxia [30, 57].

Additional significant risk factors were maternal infections - syphilis, urinary tract infections [44, 58], maternal education level [66] and the consumption of herbs during labor [29]. Increased risk was also brought about by the use of assisted delivery techniques such as the use of forceps or instrumental delivery [22, 49].

### Outcomes of Birth Asphyxia

Birth asphyxia had consequences of neonatal morbidity, and even neonatal mortality, with a few studies having neurological sequelae. Neonatal mortality rate of 35.9% among asphyxiated neonates was also reported by Barreto et al. [23], whereas neonatal mortality of 25.1% was reported by Jimma et al. [49], and this mortality is mainly caused by prematurity and low birth weight. The cases that were severe recorded high mortality rates; Jasin et al. [39] demonstrated 94.1% death rate in severe cases of asphyxia. Some studies reported neurodevelopmental abnormalities that were cerebral palsy, seizures, and intellectual disabilities [30, 62, 63].

Moreover, as Wosu et al. [71] stated, the age of Apgar scores was correlated with the risk of neurological sequelae, and timely resuscitation and management was significant. All the studies highlight that birth asphyxia bears major short-term and long-term health consequences that require early detection and treatment.

### Pooled Prevalence

A total of 52 articles have been used, comprising a big sample of 58,894 participants (Table 3, and Figure 2). The meta-analyses of prevalence showed a wide variance of results among the studies and the proportion of each study ranged between 3% and greater than 50%. The fixed and random-effects models were used to analyze the studies in order to explain heterogeneity.

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The fixed-effects model implied an overall prevalence rate of about 10.07%, whereas the random-effects model implied a larger prevalence rate of about 19.37%, which implies a lot of heterogeneity. The high levels of uncertainty of prevalence rates appeared through the broad range of confidence and the varying study groups, which indicates that the context condition and risk factors should be taken into consideration. This extensive synthesis offers useful information on the burden of birth asphyxia and emphasizes the necessity of specific interventions to reduce the risks in this domain.

The meta-analysis had a large degree of heterogeneity with a Q statistic of 6393.06 (DF = 51, P< 0.0001), and $I^2$ of 99.20% (95% CI: 99.13 to 99.27) which shows that there is large variation prevalence estimates of the included studies. This high heterogeneity indicates that having varying study populations, methodologies, or settings can have an effect on the prevalence of birth asphyxia observed. Moreover, the publication bias assessment showed significant values, and the intercept in Egger's test (10.5852, 95% CI: 6.2061 to 14.9642, P < 0.0001) and Begg's test (0.3064, P< 0.0013) tests indicate that there could be asymmetry and there could be the possibility of publication bias in the studies included. The results emphasize the need to interpret the pooled estimates cautiously based on the fact that there is a lot of heterogeneity and a possibility of bias in the data (Figure 3). In addition, Table 5 demonstrates the Risk of bias in included studies where few of the studies have moderate risk and major of the studies have been indicated as having low risk of bias.

The subgroup analysis showed significant differences in prevalence, according to the characteristics of the studies, sample size, and nation. Cross-sectional (n=23) studies reported a prevalence of 7.07% (95% CI: 6.76 to 7.39), which was of high heterogeneity ($I^2$=98.20%), whereas cohort (n=3) studies reported a higher prevalence of 24.05% (22.01 to 26.19), with high heterogeneity ($I^2$=98.44%). The case-control studies were found to have a prevalence of 17.59% (17.04 to 18.15) and very high heterogeneity ($I^2$=99.13%). The studies that used less than 1000 participants (n=40) had a prevalence of 21.77 (21.07 to 22.48), but larger studies (more than 1000 participants, n=12) had a lower prevalence of 6.69. Ethiopia made the most studies (n=26) and prevalence of 11.35% (10.89 to 11.81) and high heterogeneity ($I^2$=99.02) followed by Nigeria (n=2) and Indonesia (n=3). The Brazilian data (n=2) showed a prevalence of 11.96%. The heterogeneity and statistical significance were found to be significant (P<0.0001) in all the analyses and this indicates a high level of variability across the study designs, sample sizes, and regions (Table 4).

Altogether, the studies show that birth asphyxia is a significant societal issue in diverse contexts. Its prevalence varies depending on the quality of healthcare in the region, with higher prevalence rate found in the resource-restricted environments such as Ethiopia [29, 31, 62] and Sudan [25]. The risk factors are often divided into maternal ones (eclampsia, anemia), fetal (prematurity, low birth weight, fetal distress), and intrapartum (prolonged labor, meconium-stained amniotic fluid). The high death and morbidity rates attributed to birth asphyxia indicate that better prenatal, intrapartum, and neonatal care practices should be implemented to help reduce the burden of the condition throughout the world.

## Discussion

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Birth asphyxia prevalence and risk factors are a major health issue in the world, especially in low- and middle-income nations where resources are scarce to contain the menace. The systematic review and meta-analysis that involved 52 studies with a combined sample of almost 59000 neonates demonstrated that estimates of prevalence were highly varied, with some as low as 3% and others as high as more than 50. The overall prevalence was 19.37% and the heterogeneity was massive ($I^2$=99.20%), as the difference occurred between regions, healthcare systems, and study methods. Interestingly, researchers in resource limited environments like Ethiopia and Sudan have found high prevalence rates, which conforms to the results of foreign research, which highlights the influence of having poor access to quality obstetric and neonatal services [75,76].

The high heterogeneity in the results is also not a sign of random variation, but an indication that birth asphyxia is highly dependent on contextual disparities in healthcare resources, diagnostic procedures, and population factors. Specifically, an environment, where intrapartum surveillance is limited or diagnostic standards are not consistent, will have a higher prevalence rate, which reflects inefficiencies in the system, but not genuine epidemiological variations.

Several maternal, fetal, and intrapartum causes are observed as important factors of birth asphyxia. Maternal complications, such as eclampsia, anemia and infections (including syphilis), were usually associated with increased risk, along with obstetric complications, including a long labor, fetal malpresentation, and fetal distress. These links are also substantiated by the literature of other researchers, who emphasize that inadequate antenatal care and late intervention are becoming adding factors to this risk [77,78].

Despite the lack of quantitative pooling of risk factors because of irregular reported adjusted and unadjusted variables, the uniformity of the pattern across the studies suggests that most of the determinants are preventable and associated with the gaps in the maternal and intrapartum care that may be modified. This underlines the fact that the weight of birth asphyxia is not only clinical but also an expression of the inequity in the systemic access to quality and prompt care.

The prematurity, low birth weight, and birth defects are other fetal factors of birth asphyxia. Moreover, the primary causes are known to be intrapartum factors that could be meconium-stained amniotic fluid, cord prolapse, and obstructed labor that may lead to hypoxia and thus neuronal damage unless timely interventions are implemented [79,80]. Birth asphyxia has high outcomes and high prevalence of neonatal death and long-term neurodevelopmental disability such as cerebral palsy and cognitive impairment. Mortality rates of affected neonates approach 35.9% in some of our studies, and thus early detection and intervention are highly required. It is supported by a number of different studies that timely neonatal resuscitation, as well as better obstetric practices can considerably decrease adverse outcomes [81-83].

Nevertheless, this review is limited in a number of ways. The interpretation of pooled prevalence estimates is complicated by high heterogeneity of the included studies that is pre-determined by the differences in diagnostic criteria, healthcare settings, and reporting standards. Also, possible publication bias, as it is denoted by asymmetry of the funnel plots and large values of the Egger tests, implies that the studies may be underrepresented with prevalence rates that are either higher or lower, which would bias the results. Additionally, most of the studies were carried out

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in hospital based where the burden of birth asphyxia is not the same as in the community or in rural settings where most underreporting is witnessed. The difference in the quality of the studies, with other studies having moderate to high bias, also affects the strength of the results.

Collectively, these limitations show that the existing evidence presented is indicative of a highly disproportionate research space, and one must be careful in extrapolating the results to other settings that were not the focus of the studies considered.

Based on these limitations, a number of recommendations are necessary in order to tackle the burden of birth asphyxia. The given recommendations are not based on the general assumptions but rather on the gaps found in the presented evidence. Due to the high level of heterogeneity in the evidence base, future studies must consider research methods that are standardized and consistent diagnostic parameters to enhance comparability and minimization of variability in reported prevalence. The uniformity in reporting of preventable maternal and intrapartum causes of maternal mortality is the reason why strengthened antenatal care, early detection of high-risk pregnancies, and timely intrapartum monitoring should be reinforced. Enhancing intrapartum surveillance such as continuous monitoring of fetal heart rate may also yield easy interventions during childbirth. Likewise, the high death rate of asphyxiated neonates justifies the importance of providing training in neonatal resuscitation and the provision of the relevant equipment, particularly in places that are characterized by this review as high burden areas. The resource allocation policies must be put in a more proactive position to improve the healthcare infrastructure in low-resource settings. Lastly, the fact that the majority of the included studies were located in hospitals makes it necessary to conduct research on a community level in order to obtain more representative estimates as well as to plan interventions that are specific to the context.

**Conclusion**

This systematic review and meta-analysis proves that birth asphyxia is a significant international public health concern, especially in low- and middle-income societies with scarce healthcare. The prevalence is also high in several regions primarily where the provision of good obstetric and neonatal care is inadequate. Factors such as maternal, fetal and intrapartum, such as maternal complications, gestational age, prematurity, low birth weight, obstructed labor, are consistent contributors to high-risk. The related neonatal mortality and long-term neurodevelopmental disability supports the necessity of timely and successful interventions. The inconsistency between the ability of health facilities to retrieve and document clinical charts could also affect reported estimates.

The review has its valuable insights however; it is limited by high heterogeneity, possible publication bias and underrepresentation of community-based data. To minimize the burden of birth asphyxia, the standardized diagnostic and reporting criteria, improved quality of antenatal and intrapartum care, and investment in perinatal health care infrastructure are needed. It is also necessary to increase the awareness of communities and access to skilled birth

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attendants. Future studies in underserved and rural areas are required to inform the context-specific interventions to enhance the neonatal survival and developmental outcomes.

**Author's contribution**

Y.N., S.B; Data Collection, Writing – original draft, S.M.Y.F., M.F.A; Formal Analysis, Supervision, Writing – original draft, M.M., S.M.Y.F., S.B; Writing – review & editing.

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The authors declare that they have no conflict of interests.

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**Table 1.** Basic Characterization of the included studies.

| **Author** | **Year** | **Country** | **Study Aim/Objectives** | **Study design** | **Measuring tools** | **Gestational age** | **Maternal age** | **Mode of delivery** | **sample size** | **Patients (n)** | **Prevalence** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Barreto et al., [23] | 2025 | Brazil | Investigate prevalence and analyze environmental/maternal-fetal risk factors for perinatal asphyxia | Cohort study | Apgar score <7 | Not specified exactly, but includes preterm and term | Mean: 32 ± 5.4 years; >35 years as cutoff | Cesarean (86.3%), Vaginal (13.8%) | 480 | 42 | 8.70% |
| Mergia & Melaku [24] | 2025 | Ethiopia | To identify risk factors for birth asphyxia among newborns in Ethiopia. | Case-Control | Apgar score <7 | 38 weeks (median), <37 weeks (preterm), >37 weeks (term) | Median maternal age of 27 years | Vaginal, Caesarean section (C/S) | 377 | 119 | 31.57% |
| Alfaifi et al., [25] | 2025 | Sudan | Determine prevalence and factors associated with perinatal asphyxia | Cross-sectional | Apgar score <7 | Includes preterm and term | Median 27 years (23–32) | Cesarean (28.2%), Vaginal (71.2%) | 619 | 70 | 11.30% |
| Lucy et al., [26] | 2025 | Kenya | Identify factors contributing to neonatal birth asphyxia at Naivasha | Cross-sectional | Apgar score <7 | Includes preterm and term | 13-25 years (38%), 26-35 years (26.25%), 36-50 | Not specified exactly, but includes vaginal | 240 | 27 | 11.30% |

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| | | | Sub-County Hospital | | | | years (35.83 %) | and cesarean | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Ali & Zaman [27] | 2025 | Pakistan | To determine the frequency of risk factors of birth asphyxia among neonates | Cross-sectional | Apgar score <7 | 28-41 weeks (included neonates with birth asphyxia) | 15-36 years | Vaginal (69.3%), Caesarean section (6.9%), Instrumental (4.0%) | 101 | 20 | 19.80% |
| Slaam & Elawam [28] | 2024 | Libya | To assess the prevalence of birth asphyxia and its associated factors among live births | Cross-sectional | Apgar score <7 | ≥28 weeks gestation; inclusion of neonates with birth weight ≥1000 g | Mean age 25.7 years | Vaginal (83.0%), Caesarean section (8.79%), Instrumental (7.69%) | 182 | 52 | 28.50% |
| Msisiriet al., [29] | 2024 | Tanzania | To determine risk factors of birth asphyxia in hospital-delivered neonates in Dodoma | Case-Control | Semi-structured questionnaire, antenatal care index card | ≥37 weeks | Mean age 26.9 years | SVD, assisted vaginal, cesarean | 400 | 100 | 25% |
| Jena et al., [30] | 2024 | Ethiopia | To elucidate determinants of birth asphyxia in | Case-Control | Apgar score <7 | ≥37 weeks | Mean age 27 years | Spontaneous, cesarean, | 590 | 118 | 20% |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | urban South Ethiopia | | | | | instrumental | | | |
| Bekele et al., [31] | 2024 | Ethiopia | To determine incidence and predictors of mortality among neonates with birth asphyxia | Cohort study | Apgar score <7 | Follow-up period within 28 days | Mean age 32.9 years | Not specified | 760 | 263 | 34.60% |
| Tarko et al., [32] | 2024 | Ethiopia | To assess the burden and factors associated with birth asphyxia among newborns admitted to NICU | Cross-sectional | Structured questionnaires, Apgar score, medical records, logistic regression | Within first 5 min of life (diagnosed with Apgar < 7) | most mothers 20-35 years | Spontaneous, induced, cesarean | 343 | 59 | 17.10% |
| Alsharif et al., [33] | 2024 | Yemen | To determine the prevalence and predictors of birth asphyxia during six years of conflict | Cross-sectional | APGAR scores, cord blood pH, clinical signs, multivariate regression | Based on first 24 hours, includes preterm and term | Mostly maternal age data included | Not specified; includes home and hospital deliveries | 5,193 | 312 | 6% |

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| Okyere [34] | 2024 | Ghana | To determine the incidence, maternal/neonatal factors, outcome, and hospital stay duration of birth asphyxia in neonates at St. Patrick's Hospital | Cross-sectional | Apgar score, maternal and neonatal folders, structured interviews | Apgar score 1-6 | Mean age 26 years | Spontaneous vaginal delivery, Cesarean section | 1,609 | 46 | 2.82% |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Getachew et al., [35] | 2023 | Ethiopia | Identify determinants of birth asphyxia among newborns at Bekoji Hospital | Case-Control | Apgar score <7 | ≥28 weeks; preterm, term, post-term | Mean age 28.26 years | SVD (78%), emergency CS (8%), elective CS (7%), instrumental (7%) | 198 | 72 | 36% |
| Darsareh et al., [36] | 2023 | Iran | Use machine learning to predict and identify risk factors for birth asphyxia | Cross-sectional | Electronic medical records, machine learning models | ≥28 weeks; preterm, term, post-term | Average maternal age not provided | Vaginal, cesarean, assisted | 8,888 | 382 | 4.30% |

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| Demisse et al., [37] | 2023 | Ethiopia | Assess prevalence of birth asphyxia and associated factors | Cross-sectional | Apgar score <7 | <37 weeks (preterm) and ≥37 weeks | Mean age 27 years | Spontaneous vaginal, cesarean, assisted | 290 | 52 | 17.90% |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Rattanaprom et al., [38] | 2023 | Thailand | Identify maternal, fetal, and health service factors contributing to birth asphyxia | Case-Control | Apgar score <7 | 34+0–41+6 weeks | Not specified (various maternal ages) | Vaginal, cesarean | 4,256 | 1625 | 38.19% |
| Jasin et al., [39] | 2023 | Indonesia | To analyze risk factors affecting severe perinatal asphyxia in a tertiary hospital | Case-Control | Secondary data from hospital records | <37 weeks (prematurity); various categories | High-risk age (<20, >35 years); 34.8% in asphyxia group | Spontaneous, cesarean, forceps | 2,885 | 113 | 3.90% |
| Wudu & Birehanu [40] | 2023 | Ethiopia | To determine the prevalence and predictors of birth asphyxia among newborns in Eastern Amhara | Cross-sectional | Face-to-face interviews, chart reviews, logistic regression | ≥28 weeks (most ≥37 weeks) | Mainly 21-34 years (68.7%) | SVD, CS, instrumental | 367 | 48 | 13.10% |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | public hospitals | | | | | | | | |
| Amsalu et al., [41] | 2023 | Ethiopia | To assess prevalence, determinants, and management of birth asphyxia among NICU neonates | Cross-sectional | Card review, interviewer questionnaires, Apgar scores | Birth ≥28 weeks; most ≥37 weeks | 15-49 years; majority 25-34 years | SVD, C-section, instrumental | 409 | 85 | 20.80% |
| Zulu et al., [42] | 2023 | Zambia | To identify maternal factors associated with birth asphyxia at UTH Lusaka | Case-Control | Apgar score <7 | Term infants ≥37 weeks | Not specified; mostly adult women | Spontaneous vaginal delivery, C-section, instrumental | 197 | 72 | 36.55% |
| Pradnyaswari & Windiyanto [43] | 2023 | Indonesia | To identify risk factors associated with perinatal asphyxia at Sanjiwani Hospital | Case-Control | Apgar score <7 | ≥37 weeks (term) | <20 or >35 years (30.7%) and 20-35 years (69.3%) | Instrumental (54.4%), non-instrumental (45.6%) | 114 | 18 | 15.80% |
| Ayebare et al., [44] | 2022 | Uganda | To determine the prevalence and factors associated with birth asphyxia among term | Cross-sectional | Apgar score <7, laboratory tests (malaria, syphili | Term (≥37 weeks) | ≤19 years (24.7%), 20+ years (75.3%) | Vaginal, cesarean, assisted vaginal | 2,930 | 155 | 5.30% |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | singleton births | | s, WBC, hemoglobin) | | | | | | |
| Abose et al., [45] | 2022 | Ethiopia | To assess prevalence and factors associated with birth asphyxia among neonates in public hospitals | Cross-sectional | Interviews, chart review, multivariate logistic regression | Preterm (12.1%), term (81.7%), and preterm (6.2%) | Median age 26 years | SVD, C-section, instrumental | 371 | 74 | 20.00% |
| Lemma et al., [46] | 2022 | Ethiopia | To determine determinants of birth asphyxia among live births in Gamo and Gofa zones | Case-Control | Apgar score <7, record review, interviews | ≥28 weeks | Mean age 27.79 years | SVD, CS, instrumental | 356 | 80 | 22.52% |
| Alamneh et al., [47] | 2022 | Ethiopia | To determine risk factors of birth asphyxia among neonates at Debre Markos Hospital | Case-Control | Apgar score <7, chart review, interviews | ≥28 weeks | Mean age 27.21 years | Assisted, cesarean, vaginal | 372 | 124 | 33.33% |
| Tegegnework et al., [48] | 2022 | Ethiopia | To determine determinants of birth asphyxia among newborns in | Case-Control | Interview, document review, questi | <37 weeks (preterm) and ≥37 weeks (term) | Mean age 27.86 years | Spontaneous, induced, cesarean | 276 | 100 | 33.33% |

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| | | | Debre Berhan Hospital | | onnaire | | | | | | |
| Jimma et al., [49] | 2022 | Ethiopia | To identify determinants of birth asphyxia among newborns in Benishangul Gumuz hospitals | Case-Control | Questionnaires, clinical records | >28 weeks (preterm and term) | Mean age 25.68 years | Cesarean, spontaneous, other | 275 | 69 | 25.10% |
| Parvin et al., [50] | 2022 | Bangladesh | To determine the prevalence and predictors of birth asphyxia among neonates | Cross-sectional | Apgar score <7, face-to-face interviews | Term, preterm, post-term | Mean age 24.03 years | Cesarean section, vaginal | 377 | 45 | 11.93% |
| Mamo et al., [51] | 2022 | Ethiopia | To assess the magnitude of perinatal asphyxia and associated factors among neonates | Cross-sectional | Neonatal charts, APGAR score | >28 weeks (preterm & term) | Mean age 28.40 years | SVD, C-section, instrumental | 311 | 128 | 41.20% |
| Fekede & Fufa [52] | 2022 | Ethiopia | To investigate determinants of birth asphyxia at public hospitals | Case-Control | Structured questionnaires, chart review, logistic | Preterm (<37 weeks) and full term (≥37 | Mean age 25.71 years | SVD, CS, assisted delivery | 308 | 103 | 33.44% |

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| | | | | | regression | weeks) | | | | | |
| Tesfa et al., [53] | 2022 | Ethiopia | To develop and validate a prognostic risk score to predict birth asphyxia using maternal and fetal characteristics | Cohort study | Logistic regression, ROC curve, calibration plot, decision curve analysis | Preterm (<37 weeks) and term (≥37 weeks) | Mean age 26 years | Various (not specified in summary) | 404 | 108 | 26.73% |
| Ochoga et al., [54] | 2021 | Nigeria | To determine prevalence, risk factors, and outcomes of perinatal asphyxia | Retrospective review of clinical data | Apgar score <7 | Mean gestation: 37.30± 3.17 weeks | Mean age 26.93 years | Spontaneous vaginal and cesarean section | 1142 | 127 | 11.10% |
| Dubie et al., [55] | 2021 | Ethiopia | To assess prevalence and associated factors of perinatal asphyxia among NICU admitted newborns | Cross-sectional | Structured questionnaire, Apgar score, logistic regression | ≥28 weeks gestation | majority aged 25-29 years | SVD (65.7%), Instrumental (11.3%), C/S (23.1%) | 364 | 72 | 19.80% |
| Kune et al., [56] | 2021 | Ethiopia | To identify determinants of birth asphyxia among | Case-Control | Apgar score <7, structured | ≥28 weeks gestation | Mean age 26.4 years | SVD, C-section, | 174 | 58 | 33.90% |

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| | | | newborns in public hospitals | | questionnaires, medical record checklist | | | instrumental | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Chiabi et al., [57] | 2021 | Cameroon | To assess incidence, risk factors, and neonatal outcomes of perinatal asphyxia | Case - Control | APGAR scores, clinical assessments, medical records | Term neonates | Majority aged 18-29 years | Emergency cesarean, vaginal, instrumental | 740 | 72 | 9.70% |
| Hassan, et al., [58] | 2021 | Pakistan | To identify risk factors associated with birth asphyxia | Case - Control | Apgar score <7, clinical examination, maternal history | 28–41 weeks | Cases: ~29.66 ± 5.20 years; Controls: ~25.29 ± 3.95 years | Vaginal or C-section | 308 | 30 | 9.70% |
| Agbeko et al., [59] | 2021 | Togo | To identify antepartum, intrapartum, and fetal risk factors for birth asphyxia | Case - Control | Apgar scores, clinical assessments, obstetric records | ≥28 weeks | Mean ~26.95 years (cases), ~27.78 years (controls); no significant | Vaginal or cesarean | 2191 | 200 | 9.12% |

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| | | | | | | | difference | | | | |
| Nadeem, Rehman & Bashir [60] | 2021 | Pakistan | To identify risk factors associated with birth asphyxia in term neonates at a tertiary hospital | Case-Control | Apgar scores, clinical records, obstetric data | ≥37 weeks; specific ranges not provided | Mean: ~26.35 years (cases), ~25.76 years (controls) | Spontaneous vaginal or cesarean section | 426 | 39 | 9.13% |
| Gebregziabher et al., [61] | 2020 | Ethiopia | To assess prevalence and associated factors of perinatal asphyxia among neonates admitted to Ayder Hospital NICU | Cross-sectional | Medical records, checklist, clinical data | ≥28 weeks (based on medical records) | Majority 20–35 years | Mainly spontaneous, some induced | 267 | 48 | 18% |
| Mulugeta et al., [62] | 2020 | Ethiopia | To identify risk factors of perinatal asphyxia among newborns in public hospitals | Case-Control | Structured questionnaires, APGAR score, clinical records | ≥28 weeks | Median age ~27 years | SVD, cesarean, instrumental | 213 | 70 | 32.86% |
| Christopher [63] | 2020 | India | To determine incidence and risk factors of | Retrospective obser | Clinical records, Apgar | Peak at 39 weeks (cases), 38 | Mean age 26.18 years | Emergency LSCS most commo | 2,750 | 583 | 21.20% |

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| | | | birth asphyxia in South Indian newborns | vational | score, obstetric data | weeks (controls) | | n in cases; planned LSCS lower risk | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mehar et al., [64] | 2020 | Pakistan | To identify antenatal and intrapartum risk factors for perinatal asphyxia among neonates delivered at Nishtar Hospital Multan | Cross-sectional | Apgar scores, sociodemographic data, obstetric history, cardiotocography, ultrasonography | Term babies included | Includes term babies | Not specified | 150 | 57 | 38% |
| Abdo et al., [65] | 2019 | Ethiopia | Assess prevalence and contributing factors of birth asphyxia | Cross-sectional | Structured questionnaires, checklists, chart review, Apgar score | ≥37 weeks (90.3%), <37 weeks (15.8%) | ≥35 years (10%), 20-34 (83.9%) | Vaginal (80.3%), CS (14.3%) | 279 | 42 | 15.10% |
| Opitasari & Andayasari [66] | 2015 | Indonesia | To identify risk factors related to birth asphyxia in selected | Case-Control | Medical records, Apgar scores, | <38.6 weeks | Mean age 29.6 years | Not specified | 2777 | 180 | 6.50% |

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| | | | hospitals in Jakarta | | logistic regression analysis | | | | | | |
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| Ilah et al., [67] | 2015 | Nigeria | To determine prevalence, risk factors, and outcome of perinatal asphyxia in newborns at a specialist hospital | Cross-sectional | Medical records, Apgar scores, clinical features | Mostly term; some near-term and post-term | Not specified | Emergency caesarean section, spontaneous vaginal delivery | 223 | 67 | 30.10% |
| De-Souza et al., [68] | 2016 | Brazil | To identify risk factors for perinatal asphyxia in term newborns with record of the condition | Cross-sectional | Medical records, Apgar scores, clinical data | 37 weeks to 41+6 weeks | 16-35 years (78%) | Mainly cesarean (61.8%), some vaginal | 55 | 28 | 50.90% |
| Ibrahim et al., [69] | 2017 | Ethiopia | To determine prevalence and associated factors of birth asphyxia | Retrospective hospital-based review | APGAR <7 at 5 min, maternal and neonatal records | Not specified | Mean age 26 years | SVD: 72.0, Vacuum delivery: 7.7%. Forceps delivery: 3.3%, C/S: 17.1% | 9738 | 302 | 3.10% |

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| Kibret et al., [70] | 2018 | Ethiopia | To identify determinants of birth asphyxia among newborns | Case - Control | Structured questionnaires, clinical records | <39.1 weeks | Mean age 27.4 years | Spontaneous, assisted (vacuum, forceps), cesarean | 380 | 76 | 20% |
| Wosenu et al., [71] | 2018 | Ethiopia | To determine factors associated with birth asphyxia | Case - Control | Questionnaires, medical record review | ≥28 weeks | 27.8 ± 5.2 years | Spontaneous, induced, CS | 270 | 90 | 33.30% |
| Gebreheat et al., [72] | 2018 | Ethiopia | To determine prevalence and factors associated with perinatal asphyxia | Cross - sectional | Questionnaires, medical records | ≥35 weeks (exclusions for preterm) | Mean age 27.7 years | Spontaneous, cesarean, assisted | 421 | 93 | 22.10% |
| Tasew et al., [73] | 2018 | Ethiopia | To identify risk factors of birth asphyxia among newborns | Case - Control | Structured questionnaires, chart review | Not explicitly specified but includes neonates ≥35 weeks | Not explicitly specified | Spontaneous, cesarean, assisted | 264 | 88 | 33.30% |
| Manandhar & Basnet [74] | 2019 | Nepal | To determine the prevalence of perinatal asphyxia at | Cross - sectional | Blood gas analysis, APGAR | 37.57±2 weeks (range 32-40) | Mean 25.5±3.2 years | Vaginal, cesarean, instrumental | 1284 | 47 | 3.66% |

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| | | | a tertiary hospital | | scorin g | | | | | | |

**Table 2.** Risk Factors and outcome associated with Birth Asphyxia from 52 Included Studies.

| Author | Risk factors | Outcomes (Mortality/Complications) | Key Findings |
|---|---|---|---|
| Barreto et al., [23] | Eclampsia, labor complications, cesarean sections | Neonatal mortality rate 35.9% in PA cases | High prevalence linked to labor complications, eclampsia; emphasizes importance of prenatal and labor care to reduce PA |
| Mergia & Melaku [24] | Caesarean section (AOR: 4.706), Unclear amniotic fluid (AOR: 4.991) | Birth asphyxia outcomes, neonatal mortality | Birth asphyxia is significantly associated with C/S delivery and unclear amniotic fluid. Higher risk with emergency C/S and meconium-stained fluid. |
| Alfaifi et al., [25] | Cesarean delivery, preterm birth, low birth weight | Neonatal morbidity and mortality; odds of asphyxia higher with cesarean, preterm, low birth weight | High prevalence (11.3%), associated with cesarean delivery (AOR: 2.31), preterm birth (AOR: 6.37), low birth weight (AOR: 2.29) |
| Lucy et al., [26] | Maternal age (13-25 years), marital status, ANC attendance, employment; foetal factors like low birth weight, prematurity, male sex; obstetric factors such as PROM, meconium-stained liquor, infections, pre-eclampsia, prolonged labour | Focus on neonatal mortality and morbidity | Significant contributors include maternal sociodemographic factors (young age, unemployment, low ANC attendance), maternal obstetric factors (PROM, meconium-stained liquor, pre-eclampsia), and foetal factors (low birth weight, prematurity, male sex) |
| Ali & Zaman [27] | Instrumental delivery, primiparous mothers, induction of labor, prolonged labor (≥24 hrs), meconium- | Focus on associated risk factors, neonatal morbidity | Significant risk factors: instrumental delivery, primiparity, labor induction, prolonged labor, meconium- |

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| | stained amniotic fluid, referral from other facilities | | stained amniotic fluid, referral status. Emphasizes need for improved intrapartum monitoring and timely interventions. |
| Slaam & Elawam [28] | Fetal malpresentation, rupture of fetal membranes preterm, meconium-stained amniotic fluid, vacuum delivery | Neonatal complications included health issues at birth, but specific mortality data not detailed | Significant factors associated with birth asphyxia: fetal malpresentation (AOR=6.96), rupture of membranes (AOR=6.30), meconium-stained fluid (AOR=7.15), vacuum delivery (AOR=6.21). Emphasis on strengthening obstetric and neonatal care to reduce incidence. |
| Msisiriet al., [29] | Antepartum: maternal age, residence, anemia, ANC visits, herbal use during labor, previous pregnancy complications; Intrapartum: labor duration, meconium-stained fluid, mode of delivery | Neonatal complications | Identified maternal age (<20, >35), rural residence, anemia, fewer ANC visits, herbal medicine use, prolonged labor, meconium-stained fluid, assisted delivery as significant risk factors. Most predictors are preventable. |
| Jena et al., [30] | Induction of labor, prolonged labor, cesarean & instrumental delivery, low birth weight | Neonatal disabilities, seizures, intellectual and motor impairments | Key determinants include induction, prolonged labor, cesarean & instrumental delivery, and low birth weight. These obstetric factors significantly increase birth asphyxia risk. Emphasis on careful labor management and maternal nutrition is recommended to reduce incidence. |
| Bekele et al., [31] | Khat chewing, home delivery, lack of antenatal care, hypothermia, | Neonatal death within 28 days | Incidence of mortality was 10.6/100 person-days; predictors include khat chewing, home delivery, no |

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| | hypoglycemia, obstructed labor | | ANC, hypothermia, hypoglycemia, obstructed labor. Addressing these factors can reduce neonatal mortality. |
| Tarko et al., [32] | Cord accident, prolonged labor, meconium-stained amniotic fluid | Neonatal birth asphyxia | Birth asphyxia prevalence 17.1%; predictors include cord accident, prolonged labor, meconium-stained fluid; priority on timely intervention and management recommended. |
| Alsharif et al., [33] | Illiteracy, referred mothers, advanced maternal age, home delivery, prematurity, low birth weight | Mortality, neurological impairment | Birth asphyxia prevalence 6%; predictors include illiteracy, referral status, maternal age, home delivery, prematurity, low birth weight; emphasizes need for improved prenatal and intrapartum care. |
| Okyere [34] | Pre-eclampsia, maternal age, parity, delivery method, meconium-stained liquor, maternal illness | Discharges (84.62%), deaths (15.38%) | Incidence of birth asphyxia 2.82%; maternal factors like pre-eclampsia, neonatal factors like male sex, cephalic presentation, meconium-stained liquor; improved neonatal resuscitation linked to better outcomes. |
| Getachew et al., [35] | Prolonged labor, non-cephalic presentation, stained amniotic fluid, mode of delivery, male sex | Focus on determinants | Prolonged labor, non-cephalic presentation, male neonates, stained amniotic fluid, and mode of delivery are significant determinants of birth asphyxia. |
| Darsareh et al., [36] | Maternal hypertension, anemia, diabetes, drug addiction, gestational age, newborn weight, sex, placental abruption, | Focus on risk prediction and factors | Machine learning, especially Random Forest, effectively predicted BA; maternal hypertension, anemia, diabetes, preeclampsia, |

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| | malpresentation, delivery method | | placental abruption, fetal weight, sex, presentation, and delivery method are significant risk factors. |
| Demisse et al., [37] | Prolonged labor, meconium-stained fluid, complication during labor, premature rupture of membranes (PROM) | Not specified | Prolonged labor, meconium-stained fluid, labor complications, PROM are significantly associated with birth asphyxia. |
| Rattanaprom et al., [38] | Maternal age, gestational age, birth weight, intrapartum care quality, maternal comorbidities, delivery provider, fetal and maternal complications | Not specified | Late-preterm, late-term, low birth weight, macrosomia, maternal comorbidities, obstetric emergencies, non-reassuring fetal status significantly increase risk; high-quality care reduces risk |
| Jasin et al., [39] | Prematurity (especially extremely preterm), low birth weight, maternal conditions (e.g., pre-eclampsia, anemia) | Higher mortality rate (94.1%) in severe asphyxia cases | Most dominant risk factor is prematurity; extremely preterm infants have 232.8 times higher risk; low birth weight and maternal complications also significant |
| Wudu & Birehanu [40] | Maternal illiteracy, primiparity, prematurity (<37 weeks), low birth weight, CS delivery | Neonatal mortality (~94% in asphyxic neonates) | High maternal illiteracy, prematurity, low birth weight, primiparity, and CS delivery are significant predictors of birth asphyxia. Maternal illiteracy increased risk nearly 10-fold. |
| Amsalu et al., [41] | Instrumental delivery, maternal PIH, PROM, chorioamnionitis | Neonatal management included oxygen, ventilation, intubation | 1 in 5 neonates had birth asphyxia; determinants include instrumental delivery, maternal PIH, PROM, chorioamnionitis; management adhered to guidelines |

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| Zulu et al., [42] | High parity, birth weight >3500g, mode of delivery (C-section), maternal parity | Neonatal morbidity including potential neurological deficits | High parity and birth weight >3500g linked to birth asphyxia; vaginal delivery associated with reduced risk; maternal parity and mode of delivery are significant factors |
| Pradnyaswari & Windiyanto [43] | Meconium-stained amniotic fluid, mode of delivery, low birth weight, prematurity | Focus on risk factors of perinatal asphyxia | Significant associations found with meconium-stained amniotic fluid (OR=2.742), mode of delivery (OR=3.203), low birth weight (OR=4.595), prematurity (OR=4.732). Multivariate analysis identified meconium-stained amniotic fluid as the strongest predictor. |
| Ayebare et al., [44] | Maternal age ≤19, syphilis infection, high WBC, referral, induction/augmentation, prolonged labor, obstructed labor, malpresentation/malposition, assisted vaginal delivery, male sex, low birth weight | Mortality highest in HIE stage III (100%), overall morbidity includes neurodevelopmental impairments | Birth asphyxia prevalence was 5.3%. Significant factors include young maternal age, maternal infections (syphilis), intrapartum complications, male sex, and low birth weight. Addressing maternal infections and improving intrapartum care could reduce rates. |
| Abose et al., [45] | Induction, prolonged labor, meconium-stained amniotic fluid, referral status, instrumental delivery, primiparity | Not explicitly specified, but associated factors indicate increased risk with adverse intrapartum events | The prevalence of birth asphyxia was 20%. Associated factors include induction, prolonged labor, meconium-stained fluid, referral, instrumental delivery, and primiparity. Improving intrapartum care is essential. |
| Lemma et al., [46] | Anemia, breech, meconium-stained fluid, cord prolapse, | Neonatal morbidity, mortality | Significant determinants include maternal anemia, breech position, meconium- |

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| | fetal distress, instrumental delivery | | stained fluid, cord prolapse, fetal distress, and instrumental delivery. Emphasis on active detection and management. |
| Alamneh et al., [47] | Prolonged labor >12h, meconium-stained fluid, assisted delivery, gestational age <37 weeks, non-cephalic presentation, comorbidity, birth weight <2500g | Neonatal morbidity, mortality, hypoxic-ischemic encephalopathy | Key risk factors include prolonged labor, meconium-stained amniotic fluid, assisted delivery, preterm birth, non-cephalic presentation, maternal comorbidity, low birth weight; holistic care recommended |
| Tegegnework et al., [48] | Maternal illiteracy, antepartum hemorrhage, prolonged labor, meconium-stained amniotic fluid, breech presentation, preterm birth | Neonatal morbidity including hypoxic-ischemic encephalopathy, death | Key risk factors include maternal illiteracy, antepartum hemorrhage, prolonged labor, meconium-stained fluid, breech presentation, preterm birth; maternal education and labor monitoring emphasized. |
| Jimma et al., [49] | Anemia during pregnancy, no ANC, cord prolapse, low birth weight | Neonatal complications, mortality | Key determinants: anemia, no ANC visits, cord prolapse, cesarean birth, low birth weight. Focus on preventability and maternal health care. |
| Parvin et al., [50] | Young maternal age (15-20), term period, low birth weight, C-section, abortion, prolonged labor | Neonatal morbidity, mortality | Higher prevalence associated with young maternal age, low birth weight, C-section, prolonged labor, abortion; emphasizes awareness and parental training |
| Mamo et al., [51] | Preeclampsia, antepartum hemorrhage, gestational DM, PROM, fetal distress, meconium-stained fluid | Neonatal morbidity, mortality | High prevalence (41.2%) linked to maternal hypertensive disorders, PROM, fetal distress, low birth weight; emphasizes |

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| | | | early detection and management |
| Fekede & Fufa [52] | Prolonged labor, non-cephalic presentation, preterm birth, low birth weight | Neonatal mortality, morbidity | Prolonged labor, non-cephalic presentation, preterm, low birth weight are key determinants; improving labor management can reduce risk |
| Tesfa et al., [53] | Premature rupture of membranes, meconium aspiration syndrome, malpresentation, prolonged labor, preterm birth, tight nuchal cord | Neonatal birth asphyxia | Developed a highly discriminative risk score with AUROC ~88.6%, able to predict birth asphyxia effectively using simple maternal and neonatal factors |
| Ochoga et al., [54] | Meconium-stained amniotic fluid, fetal presentation, birth attendants | 5.5% case fatality rate, some neurological complications | Main risk factors: meconium-stained liquor, unskilled birth attendants; most cases discharged without complications |
| Dubie et al., [55] | Absence of maternal formal education, pregnancy-induced hypertension, antepartum hemorrhage, prolonged labor, instrumental delivery, meconium-stained amniotic fluid | Not specified, but significant associations with maternal and labor factors | The study identified several maternal and labor-related factors significantly associated with perinatal asphyxia, emphasizing the importance of improving maternal care and labor management to reduce incidence |
| Kune et al., [56] | Prolonged labor, breech presentation, caesarean section, assisted vaginal delivery, not using partograph, low birth weight | Not specified, but determinants include prolonged labor, breech presentation, mode of delivery, partograph use, low birth weight | Prolonged labor, breech presentation, delivery mode, non-use of partograph, low birth weight significantly increased odds of birth asphyxia; emphasizing need for proper labor monitoring and |

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| | | | management to reduce incidence |
| Chiabi et al., [57] | Single mothers, UTI during pregnancy, prolonged rupture of membranes, prolonged labor, emergency cesarean | 20.8% mortality among asphyxiated neonates; many developed hypoxic-ischemic encephalopathy (HIE) | Risk factors include maternal infections, prolonged labor, emergency cesarean, and prolonged rupture of membranes. Neonatal mortality is significant; early detection and management recommended. High incidence and case fatality highlight need for improved perinatal care. |
| Hassan, et al., [58] | Father's education, oligohydramnios, preterm, gravidity, breech, gestational diabetes, hypertension, ANC visits, maternal age | Neonatal deaths (~21%), neurodevelopmental issues, hypoxic-ischemic encephalopathy | Risk factors include maternal infections, fetal presentation, preterm birth, pregnancy complications, delivery mode. Managing these can reduce birth asphyxia and neonatal mortality. |
| Agbeko et al., [59] | Maternal age < 25, primigravidity, maternal fever, chronic pathology, abnormal amniotic fluid, prolonged rupture of membranes, long labor, use of oxytocin, mode of delivery, fetal gender, preterm birth, low birth weight | 20.5% mortality among BA cases; high incidence of hypoxic-ischemic encephalopathy (Sarnat stages I-III) | Multiple maternal, intrapartum, and fetal risk factors significantly contribute to birth asphyxia; early detection and improved perinatal care can reduce mortality and neurological sequelae. |
| Nadeem, Rehman & Bashir [60] | Primiparity, prolonged labor (>24 hrs), fetal distress, meconium-stained liquor | Not specified; focus on identifying risk factors | Major risk factors include meconium-stained liquor, prolonged labor, fetal distress; early obstetric intervention recommended to reduce neonatal asphyxia. |

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| Gebregziabher et al., [61] | Prolonged labor (AOR=5.19), presence of meconium (AOR=4.17), preeclampsia (AOR=7.94) | 37.5% case fatality rate; high prevalence and mortality linked to labor complications and maternal preeclampsia | High prevalence (18%) with significant mortality; key factors include prolonged labor, meconium-stained amniotic fluid, and preeclampsia. Early detection and management recommended. |
| Mulugeta et al., [62] | Antepartum hemorrhage (AOR=7.17), low birth weight (AOR=2.87), preterm birth (AOR=3.4), cesarean (AOR=2.75), instrumental (AOR=4.88), fetal distress (AOR=4.77), meconium-stained amniotic fluid (AOR=9.02) | Short-term: neonatal morbidity; Long-term: neurodevelopmental issues, but specifics not detailed | Multiple maternal, fetal, and delivery factors significantly associated. Antepartum hemorrhage, low birth weight, preterm, fetal distress, meconium-stained fluid, cesarean, instrumental delivery all increase risk of perinatal asphyxia. Emphasizes improving prenatal and intrapartum care to reduce cases. |
| Christopher [63] | Breech presentation (OR=20.6), meconium staining (OR=29), oligohydramnios (OR=29), cord abnormalities (OR=2.9), prematurity <37 weeks (OR=1.36), low birth weight <2500g (OR=1.51), emergency LSCS (OR=4.91), vacuum delivery (OR=11.7), abnormal cord (OR=2.9), male sex (OR=1.51) | Neonatal morbidity, long-term neurological deficits (cerebral palsy, seizures, cognitive impairment) | High incidence linked to antepartum, intrapartum, neonatal factors; peak at 39 weeks; emergency LSCS, breech, meconium, oligohydramnios, cord abnormalities, prematurity are significant risk factors; intervention at 38 weeks recommended |
| Mehar et al., [64] | Maternal causes (e.g., PIH), placental causes (e.g., placental insufficiency), fetal causes (e.g., IUGR) | Not specified in detail; focus on risk factors and prevalence | Maternal factors like PIH, placental causes like placental insufficiency, and fetal causes like IUGR are significant contributors to perinatal asphyxia; prevalence of 38% at 1 minute |

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| Abdo et al., [65] | Mothers aged ≥35, primigravida, prolonged second stage, preterm birth, meconium-stained amniotic fluid, tight nuchal cord | No specific mortality data; focus on prevalence and complications | Birth asphyxia prevalence: 15.1%; associated with maternal age ≥35, primigravida, prolonged labor, preterm delivery, meconium-stained fluid, tight nuchal cord |
|---|---|---|---|
| Opitasari & Andayasari [66] | Maternal low education, prematurity, fetal distress, PROM, maternal occupation, parity | Higher risk associated with low/middle maternal education, preterm birth; mortality not specifically detailed | Lower maternal education and prematurity significantly increase risk of birth asphyxia; emphasizes importance of maternal education and managing prematurity. |
| Ilah et al., [67] | Unbooked mothers, prolonged obstructed labor, maternal eclampsia, primiparity, delivery in hospital | 25.5% case fatality rate; 12 died; neurological sequelae in some | High prevalence linked to maternal complications, especially unbooked status, prolonged labor, and emergency deliveries. Better antenatal care could reduce incidence. |
| De-Souza et al., [68] | Maternal age, pregnancy complications, labor duration, fetal distress | Most infants required resuscitation; some had meconium aspiration; low Apgar scores linked to worse outcomes | Most mothers and infants did not have risk factors; poor quality of care during labor and delivery contributed to asphyxia; need for improved monitoring and resuscitation protocols. |
| Ibrahim et al., [69] | Young maternal age (15-25), unskilled delivery, prolonged labor, lack of ANC, low Apgar scores | 11% neonatal mortality among asphyxiated; 89% discharged | Prevalence of birth asphyxia ~2.5%; associated factors include young maternal age, unskilled delivery, prolonged labor. Emphasizes need for improved maternal care and timely intervention. |
| Kibret et al., [70] | Short maternal stature, MUAC <23cm, prolonged labor, labor complications, assisted delivery | Not specified; neonatal mortality and morbidity implied | Major determinants include maternal height ≤153cm, MUAC <23cm, assisted delivery, prolonged labor, labor complications. Fetal |

| | | | factors were not independently associated. |
|---|---|---|---|
| Wosenu et al., [71] | Prolonged labor, CS, meconium-stained AF, fetal distress, low birth weight | Neonatal death, neurodevelopmental disabilities | Significant factors: prolonged labor (AOR=2.75), CS (AOR=3.58), meconium AF (AOR=7.69), fetal distress (AOR=5.74), low birth weight (AOR=7.72). |
| Gebreheat et al., [72] | Low birth weight, cesarean section, meconium-stained amniotic fluid, prolonged labor | Neonatal morbidity/mortality | Prevalence of 22.1%; associated factors include low birth weight (OR=12.75), cesarean delivery (OR=6.97), meconium-stained fluid (OR=8.55), prolonged labor (OR=3.33). |
| Tasew et al., [73] | Maternal illiteracy, low birth weight, preterm birth, primiparity, antepartum hemorrhage, meconium-stained amniotic fluid | Possible neonatal morbidity/mortality | Maternal illiteracy (AOR=6), low birth weight (AOR=6.9), preterm (AOR=2.2), primiparity (AOR=3.1), antepartum hemorrhage (AOR=12), meconium-stained AF (AOR=7.88) |
| Manandhar & Basnet [74] | Intrapartum risk factors (e.g., prolonged labor, meconium stain, fetal distress), antenatal risk factors (e.g., IUGR) | Neurodevelopmental sequelae, mortality (2 deaths), HIE staging | Prevalence lower than other hospitals; intrauterine growth restriction and prolonged labor were common risk factors; 68% developed HIE, with 6% in stage III; most babies discharged, 2 deaths, some neurological sequelae. |

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**Table 3.** Meta-analysis of Prevalence and Risk Factors Associated with Birth Asphyxia from 52 Included Studies.

| Study | Sample size | Proportion (%) | 95% CI | Weight (%) | |
|---|---|---|---|---|---|
| | | | | Fixed | Random |
| Barreto et al., [23] | 480 | 8.750 | 6.379 to 11.643 | 0.82 | 1.94 |
| Mergia & Melaku [24] | 377 | 31.565 | 26.902 to 36.521 | 0.64 | 1.93 |
| Alfaifi et al., [25] | 619 | 11.309 | 8.922 to 14.071 | 1.05 | 1.95 |
| Lucy et al., [26] | 240 | 11.250 | 7.546 to 15.945 | 0.41 | 1.91 |
| Ali & Zaman [27] | 101 | 19.802 | 12.535 to 28.912 | 0.17 | 1.82 |
| Slaam & Elawam [28] | 182 | 28.571 | 22.132 to 35.723 | 0.31 | 1.89 |
| Msisiriet al., [29] | 400 | 25.000 | 20.830 to 29.544 | 0.68 | 1.93 |
| Jena et al., [30] | 590 | 20.000 | 16.845 to 23.459 | 1.00 | 1.95 |
| Bekele et al., [31] | 760 | 34.605 | 31.223 to 38.108 | 1.29 | 1.95 |
| Tarko et al., [32] | 343 | 17.201 | 13.360 to 21.620 | 0.58 | 1.93 |
| Alsharif et al., [33] | 5193 | 6.008 | 5.377 to 6.689 | 8.81 | 1.97 |
| Okyere [34] | 1609 | 2.859 | 2.101 to 3.795 | 2.73 | 1.96 |
| Getachew et al., [35] | 198 | 36.364 | 29.661 to 43.481 | 0.34 | 1.89 |
| Darsareh et al., [36] | 8888 | 4.298 | 3.886 to 4.740 | 15.08 | 1.97 |
| Demisse et al., [37] | 290 | 17.931 | 13.691 to 22.840 | 0.49 | 1.92 |
| Rattanaprom et al., [38] | 4256 | 38.181 | 36.719 to 39.660 | 7.22 | 1.97 |
| Jasin et al., [39] | 2885 | 3.917 | 3.239 to 4.690 | 4.90 | 1.97 |
| Wudu & Birehanu [40] | 367 | 13.079 | 9.803 to 16.965 | 0.62 | 1.93 |
| Amsalu et al., [41] | 409 | 20.782 | 16.951 to 25.042 | 0.70 | 1.93 |
| Zulu et al., [42] | 197 | 36.548 | 29.819 to 43.689 | 0.34 | 1.89 |
| Pradnyaswari & Windiyanto [43] | 114 | 15.789 | 9.635 to 23.802 | 0.20 | 1.84 |
| Ayebare et al., [44] | 2930 | 5.290 | 4.508 to 6.163 | 4.97 | 1.97 |
| Abose et al., [45] | 371 | 19.946 | 15.999 to 24.380 | 0.63 | 1.93 |

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| Lemma et al., [46] | 356 | 22.472 | 18.240 to 27.168 | 0.61 | 1.93 |
|---|---|---|---|---|---|
| Alamneh et al., [47] | 372 | 33.333 | 28.558 to 38.376 | 0.63 | 1.93 |
| Tegegnework et al., [48] | 276 | 36.232 | 30.555 to 42.208 | 0.47 | 1.91 |
| Jimma et al., [49] | 275 | 25.091 | 20.078 to 30.649 | 0.47 | 1.91 |
| Parvin et al., [50] | 377 | 11.936 | 8.841 to 15.644 | 0.64 | 1.93 |
| Mamo et al., [51] | 311 | 41.158 | 35.635 to 46.850 | 0.53 | 1.92 |
| Fekede & Fufa [52] | 308 | 33.442 | 28.192 to 39.013 | 0.52 | 1.92 |
| Tesfa et al., [53] | 404 | 26.733 | 22.478 to 31.332 | 0.69 | 1.93 |
| Ochoga et al., [54] | 1142 | 11.121 | 9.356 to 13.089 | 1.94 | 1.96 |
| Dubie et al., [55] | 364 | 19.780 | 15.811 to 24.249 | 0.62 | 1.93 |
| Kune et al., [56] | 174 | 33.333 | 26.381 to 40.865 | 0.30 | 1.88 |
| Chiabi et al., [57] | 740 | 9.730 | 7.691 to 12.096 | 1.26 | 1.95 |
| Hassan, et al., [58] | 308 | 9.740 | 6.669 to 13.612 | 0.52 | 1.92 |
| Agbeko et al., [59] | 2191 | 9.128 | 7.955 to 10.412 | 3.72 | 1.97 |
| Nadeem, Rehman & Bashir [60] | 426 | 9.155 | 6.591 to 12.302 | 0.72 | 1.93 |
| Gebregziabher et al., [61] | 267 | 17.978 | 13.563 to 23.119 | 0.45 | 1.91 |
| Mulugeta et al., [62] | 213 | 32.864 | 26.600 to 39.613 | 0.36 | 1.90 |
| Christopher [63] | 2750 | 21.200 | 19.685 to 22.776 | 4.67 | 1.97 |
| Mehar et al., [64] | 150 | 38.000 | 30.208 to 46.276 | 0.26 | 1.87 |
| Abdo et al., [65] | 279 | 15.054 | 11.070 to 19.799 | 0.48 | 1.91 |
| Opitasari & Andayasari [66] | 2777 | 6.482 | 5.594 to 7.462 | 4.71 | 1.97 |
| Ilah et al., [67] | 223 | 30.045 | 24.105 to 36.524 | 0.38 | 1.90 |
| De-Souza et al., [68] | 55 | 50.909 | 37.071 to 64.646 | 0.095 | 1.71 |
| Ibrahim et al., [69] | 9738 | 3.101 | 2.766 to 3.465 | 16.52 | 1.97 |
| Kibret et al., [70] | 380 | 20.000 | 16.094 to 24.381 | 0.65 | 1.93 |
| Wosenu et al., [71] | 270 | 33.333 | 27.736 to 39.301 | 0.46 | 1.91 |

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| Gebreheat et al., [72] | 421 | 22.090 | 18.217 to 26.361 | 0.72 | 1.93 |
|---|---|---|---|---|---|
| Tasew et al., [73] | 264 | 33.333 | 27.673 to 39.372 | 0.45 | 1.91 |
| Manandhar & Basnet [74] | 1284 | 3.660 | 2.702 to 4.838 | 2.18 | 1.96 |
| Total (fixed effects) | 58894 | 10.068 | 9.827 to 10.314 | 100.00 | 100.00 |
| Total (random effects) | 58894 | 19.369 | 15.795 to 23.213 | 100.00 | 100.00 |

**Table 4**. Subgroup analysis based on study characteristics.

| **Group** | **Sub-groups** | **Number of studies** | **Prevalence (%)** | **95% CI** | **I²** | **Q** | **df** | **P** |
|---|---|---|---|---|---|---|---|---|
| **Sampling Method** | Cross-sectional | 23 | 7.07 | 6.76 to 7.39 | 98.20 | 1224.29 | 22 | < 0.0001 |
| | Cohort study | 3 | 24.05 | 22.01 to 26.19 | 98.44 | 128.42 | 2 | < 0.0001 |
| | Case-Control | 23 | 17.59 | 17.04 to 18.15 | 99.13 | 2527.36 | 22 | < 0.0001 |
| **Sample size** | Less than n=1000 | 40 | 21.77 | 21.07 to 22.48 | 94.82 | 753.61 | 39 | < 0.0001 |
| | More than n=1000 | 12 | 6.689 | 11.38 | 99.71 | 3827.21 | 11 | < 0.0001 |
| **Country** | Brazil | 2 | 11.963 | 9.340 to 15.012 | 97.95 | 48.67 | 1 | < 0.0001 |
| | Ethiopia | 26 | 11.346 | 10.891 to 11.813 | 99.02 | 2563.82 | 25 | < 0.0001 |
| | Indonesia | 3 | 5.278 | 4.716 to 5.886 | 94.20 | 34.47 | 2 | < 0.0001 |
| | Nigeria | 2 | 13.755 | 11.972 to 15.695 | 97.69 | 43.36 | 1 | < 0.0001 |
| | Pakistan | 4 | 13.948 | 11.848 to 16.265 | 95.39 | 65.09 | 3 | < 0.0001 |

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**Table 5.** Risk of bias in included studies (n=52).

| Author | Sample representativeness | Sample technqiue | Sample size | Subjects settings | Ascertainment of condition | Measurement of the condition | Statistical analysis | Response rate | Total Score | Risk of bias |
|---|---|---|---|---|---|---|---|---|---|---|
| Barreto et al., [23] | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | Low |
| Mergia & Melaku [24] | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | Low |
| Alfaifi et al., [25] | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 7 | Low |
| Lucy et al., [26] | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | Low |
| Ali & Zaman [27] | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | Low |
| Slaam & Elawam [28] | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | Low |
| Msisiriet al., [29] | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 6 | Moderate |
| Jena et al., [30] | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | Low |
| Bekele et al., [31] | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 6 | Moderate |
| Tarko et al., [32] | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | Low |
| Alsharif et al., [33] | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | Low |
| Okyere [34] | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | Low |

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| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Getachew et al., [35] | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | Low |
| Darsareh et al., [36] | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 6 | Moderate |
| Demisse et al., [37] | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | Low |
| Rattanaprom et al., [38] | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | Low |
| Jasin et al., [39] | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | Low |
| Wudu & Birehanu [40] | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | Low |
| Amsalu et al., [41] | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | Low |
| Zulu et al., [42] | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 7 | Low |
| Pradnyaswari & Windiyanto [43] | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 7 | Low |
| Ayebare et al., [44] | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | Low |
| Abose et al., [45] | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 6 | Moderate |
| Lemma et al., [46] | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | Low |

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| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Alamneh et al., [47] | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 7 | Low |
| Tegegne work et al., [48] | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | Low |
| Jimma et al., [49] | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | Low |
| Parvin et al., [50] | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 7 | Low |
| Mamo et al., [51] | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 7 | Low |
| Fekede & Fufa [52] | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | Low |
| Tesfa et al., [53] | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | Low |
| Ochoga et al., [54] | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 7 | Low |
| Dubie et al., [55] | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 7 | Low |
| Kune et al., [56] | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | Low |
| Chiabi et al., [57] | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | Low |
| Hassan, et al., [58] | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | Low |
| Agbeko et al., [59] | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | Low |
| Nadeem, Rehman & Bashir [60] | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | Low |

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| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Gebregziabher et al., [61] | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 6 | Moderate |
| Mulugeta et al., [62] | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | Low |
| Christopher [63] | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 7 | Low |
| Mehar et al., [64] | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | Low |
| Abdo et al., [65] | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | Low |
| Opitasari & Andayasari [66] | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | Low |
| Ilah et al., [67] | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | Low |
| De-Souza et al., [68] | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 7 | Low |
| Ibrahim et al., [69] | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 7 | Low |
| Kibret et al., [70] | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | Low |
| Wosenu et al., [71] | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | Low |
| Gebreheat et al., [72] | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | Low |
| Tasew et al., [73] | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | Low |
| Manandhar & | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | Low |

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| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Basnet [74] | | | | | | | | | | |

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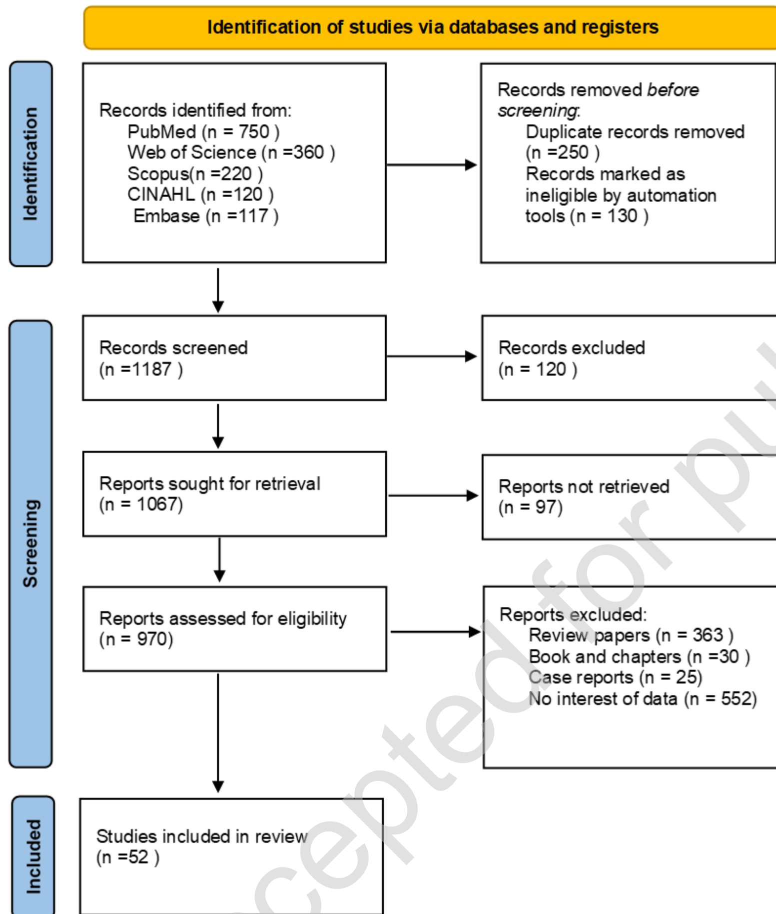


**Figure 1.** PRISMA diagram for selection of inclusion studies

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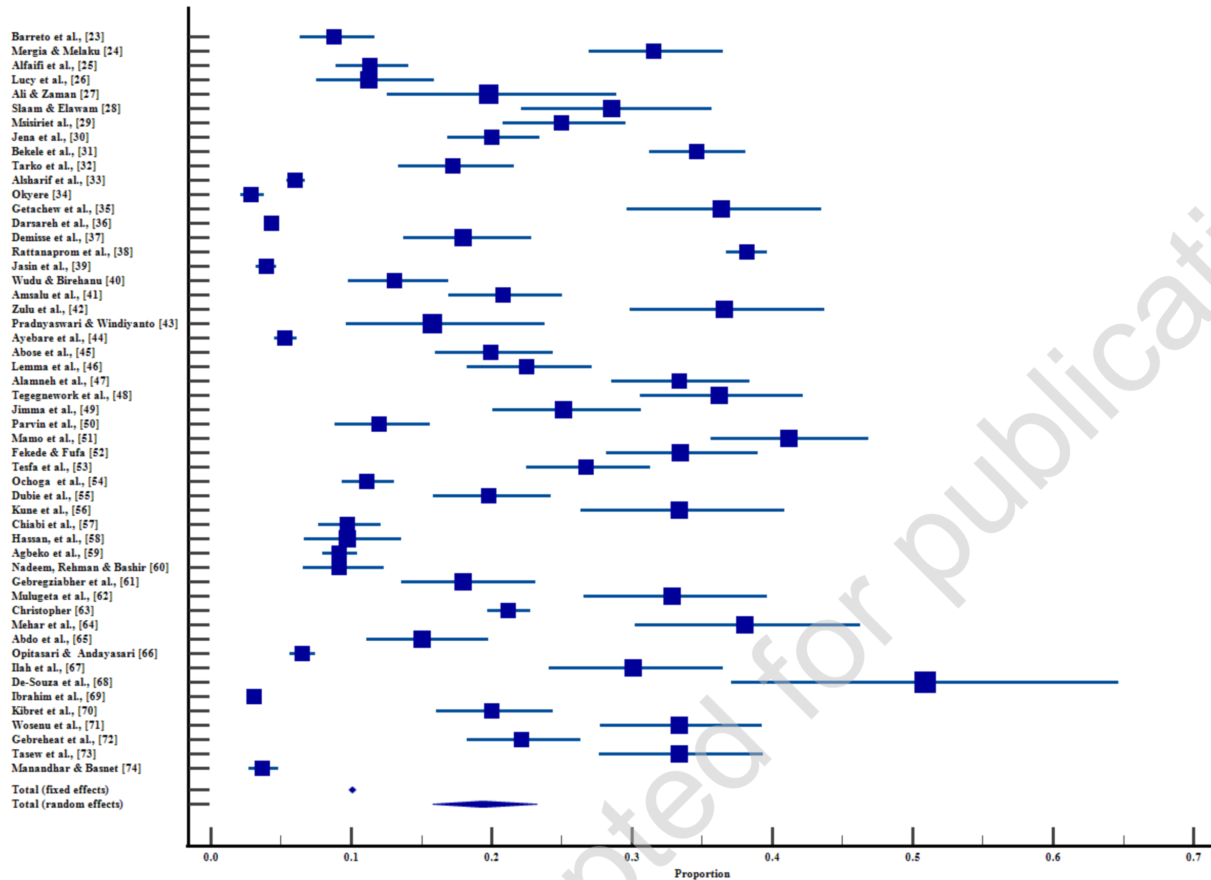


**Figure 2.** Meta-analysis of Prevalence and Risk Factors Associated with Birth Asphyxia from 52 included studies.

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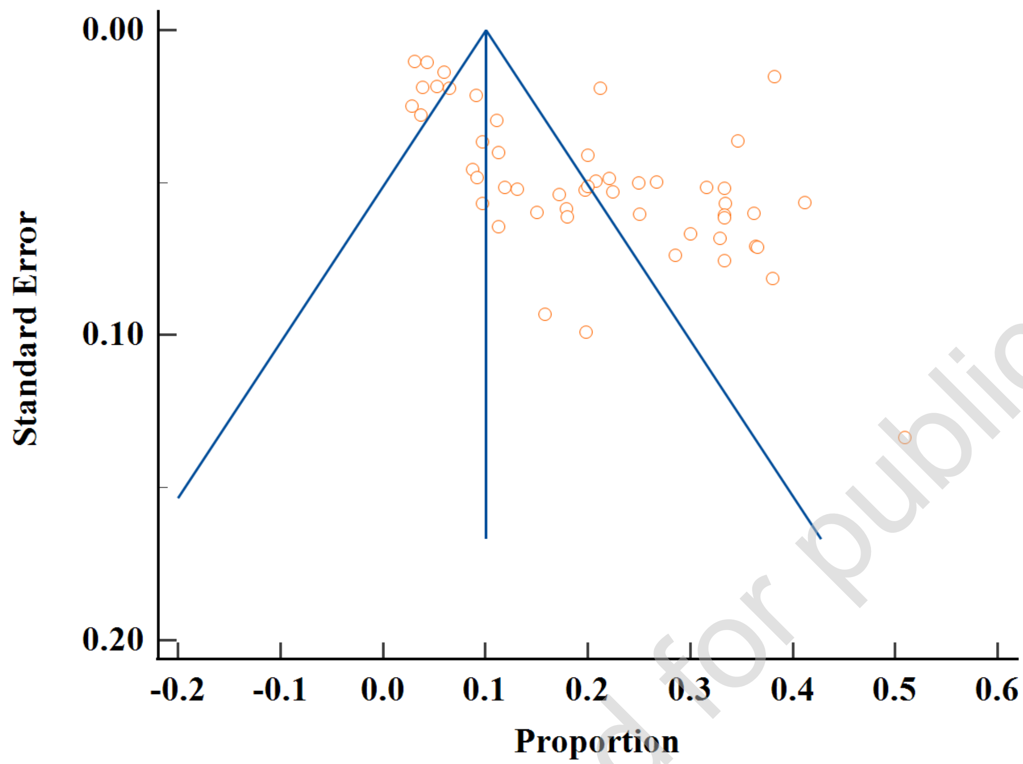


**Figure 3.** Funnel plot for publication bias

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