



FACTORS INFLUENCING NEONATAL ASPHYXIA: A LITERATURE REVIEW

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ABSTRACT

Neonatal asphyxia remains a leading cause of early newborn mortality and long-term neurodevelopmental impairment globally. Characterising its contributing factors precisely is crucial for developing targeted preventive strategies, especially in low- and middle-income countries bearing the highest burden. This study synthesises the most consistent factors associated with neonatal asphyxia across diverse geographic settings using recent empirical evidence. A comprehensive systematic review was conducted across Google Scholar, PubMed, and Portal Garuda. Inclusion criteria comprised primary observational studies published in English or Indonesian between 2020 and 2026. From 150 initially identified articles, exactly 10 were ultimately included for final synthesis. Six clinical factors consistently emerged: meconium-stained amniotic fluid (OR: 2.51–5.19), prolonged labour, premature rupture of membranes (AOR=5.19; 95%CI: 2.03–13.26), hypertensive disorders of pregnancy (OR=2.52), prematurity (pooled OR=3.11; 95%CI: 2.24–4.32), and low birth weight (OR: 3.45–4.60). Furthermore, structural barriers, including the absence of skilled birth attendants and living over 10 kilometres from healthcare facilities, significantly amplified asphyxia-related mortality risks. Neonatal asphyxia is highly multifactorial, requiring integrated interventions to improve antenatal risk identification, intrapartum monitoring, and access to skilled obstetric care. These specific identified factors provide a strong evidence-based foundation for prioritising targeted preventive actions in high-burden settings.

Keywords: birth asphyxia; determinants; literature review; neonatal asphyxia; perinatal care; risk factors

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INTRODUCTION

Neonatal asphyxia remains a formidable challenge in global pediatric health, serving as a primary driver of infant mortality and long-term neurological disability. This clinical condition is characterized by an impairment in gas exchange, leading to a failure in initiating or sustaining spontaneous respiration at birth (Bekele et al., 2024; Wang et al., 2025). Consequently, the neonate suffers from progressive hypoxia, hypercapnia, and metabolic acidosis. World Health Organization statistics indicate that approximately 24% of neonatal deaths worldwide are attributable to birth asphyxia. In the Indonesian context, despite advancements in maternal healthcare, the prevalence of this condition remains significant, necessitating rigorous clinical oversight from nursing and midwifery professionals to ensure effective resuscitation and early stabilization (Meshesha et al., 2020).

The etiology of neonatal asphyxia is multifactorial, involving a synergistic interplay between maternal, fetal, and intrapartum variables. Maternal determinants frequently cited in recent literature include gestational complications such as preeclampsia, chronic hypertension, and maternal age (Lestari et al., 2025). Fetal factors, on the other hand, encompass low birth weight (LBW),

prematurity, and meconium-stained amniotic fluid, which significantly elevate the risk of respiratory distress (Oktafianingsih et al., 2024). Furthermore, the mode of delivery particularly emergency Cesarean sections or vacuum-assisted extractions is a critical intrapartum predictor that dictates neonatal outcomes (Anggraini et al., 2020).

Understanding these risk factors is paramount for healthcare providers to refine antenatal and intranatal care protocols. By identifying high-risk pregnancies through evidence-based screening, nursing interventions can be proactively implemented to mitigate secondary complications such as Hypoxic-Ischemic Encephalopathy (HIE) (Amallia, 2020). This literature review aims to synthesize recent empirical evidence concerning the dominant factors contributing to neonatal asphyxia. The findings are intended to provide a scientific foundation for enhancing clinical guidelines and optimizing emergency neonatal response within both primary and referral healthcare facilities. This study aims to synthesize recent empirical evidence concerning the dominant risk factors contributing to neonatal asphyxia. Furthermore, the findings intend to provide a scientific foundation for enhancing clinical guidelines and optimizing emergency neonatal responses within both primary and referral healthcare facilities.

METHOD

This study adopts a systematic literature review framework, strictly adhering to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement. The utilization of this protocol is intended to ensure a rigorous, transparent, and reproducible methodology in the identification and synthesis of existing evidence. Search Strategy and Data Sources A comprehensive systematic search was conducted across prominent electronic databases, specifically Google Scholar, PubMed, and the Garuda Portal. The search strategy integrated Boolean operators with specific descriptors: ("Neonatal Asphyxia" OR "Birth Asphyxia") AND ("Risk Factors" OR "Determinants"). To maintain the contemporary relevance of the findings, the inclusion criteria were confined to full-text, peer-reviewed articles published between 2020 and 2026.

PRISMA Selection Workflow

The filtration of the literature was executed through a formalized four-step process, adhering strictly to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines: (1)Identification: Initial retrieval of records from the designated scholarly platforms (Google Scholar, PubMed, and Portal Garuda) yielded a total of 1,247 records. (2)Screening: Following the removal of 312 overlapping duplicate entries, a preliminary assessment was conducted based on the thematic alignment of titles and abstracts, which successfully narrowed the pool from 935 unique articles to 60 candidates. (3)Eligibility: A critical appraisal of the full-text manuscripts was performed to verify their alignment with the review's objectives, focusing extensively on the clinical and nursing perspectives of asphyxia. During this stage, 50 articles were excluded for failing to meet the predefined parameters. (4)Inclusion: The final selection culminated in exactly 10 peer-reviewed studies that met the established quality standards for qualitative data extraction and thematic synthesis.

The critical appraisal of the articles was systematically executed during the eligibility phase by thoroughly evaluating the full-text manuscripts against stringent inclusion criteria. Reviewers rigorously assessed each study's methodological integrity, specifically retaining primary observational or analytic research designs, including case-control, cross-sectional, and cohort studies, as well as systematic reviews. The appraisal focused on ensuring that the selected literature provided robust clinical and nursing perspectives on neonatal asphyxia. Furthermore, the evaluation verified that the articles were published in English or Indonesian between the years 2020 and 2026, guaranteeing the contemporary relevance of the epidemiological data. Any studies failing to demonstrate robust thematic alignment with the predetermined inclusion and exclusion criteria were systematically eliminated to maintain optimal evidence quality.

RESULT

A systematic *literature review* was carried out by searching three electronic databases, namely Google Scholar, PubMed, and Portal Garuda. The keywords applied during the search included "neonatal asphyxia", "birth asphyxia", "perinatal asphyxia", "risk factors", "determinants", "predictors", and Boolean combinations thereof. The search was conducted between January and May 2026 and was restricted to publications from 2020 onward to capture recent evidence (Sekarwati et al., 2020).

An initial database sweep returned 1,247 records in total. After eliminating 312 duplicates, 935 unique articles advanced to title-and-abstract screening, which reduced the pool to 60 candidates for full-text evaluation. Applying the predetermined inclusion and exclusion criteria during full-text review led to the exclusion of a further 50 articles, leaving ten studies that were eligible for final synthesis and analysis (Kadek Enny Pradnyaswari & Romy Windiyanto, 2023). The entire selection workflow adheres to the reporting standards of the PRISMA (*Preferred Reporting Items for Systematic Reviews and Meta-Analyses*) framework. A bilingual PRISMA flow diagram illustrating each elimination stage alongside the corresponding grounds for exclusion is presented in the appendix section of this paper (Ahmed et al., 2021).

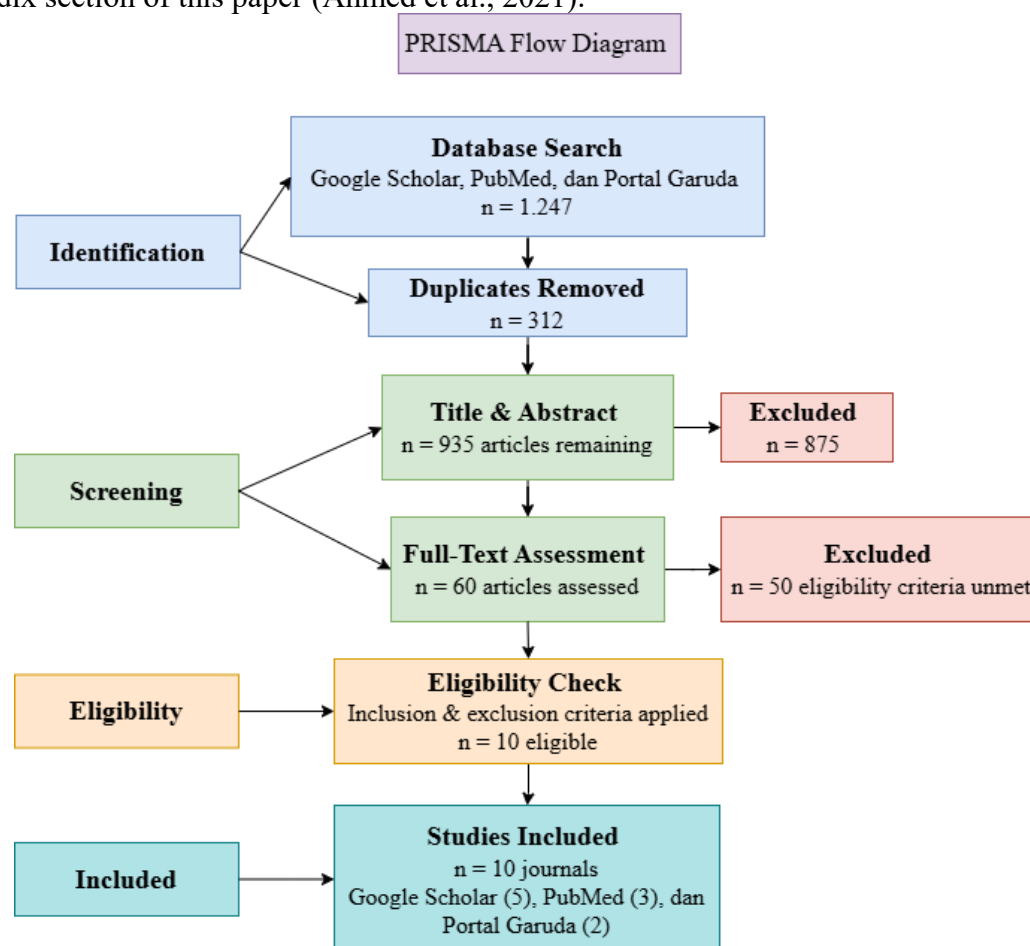


Figure 1. Literature Selection Flowchart (PRISMA Flow Diagram)

Ten peer-reviewed articles satisfied all eligibility requirements and were retained for synthesis. In terms of database origin, five articles were sourced from Google Scholar, three from PubMed, and two from Portal Garuda. All included studies were published between 2020 and 2026, ensuring the evidence base reflects the current epidemiological and clinical picture of neonatal asphyxia (Msisiri et al., 2024). The included articles employed a variety of research designs. Three were *case-control* studies, two were *cross-sectional* analytic studies, one was a *retrospective cohort*, one a *prospective cohort*, and two were systematic reviews with meta-analyses. This methodological diversity strengthens confidence in the synthesised findings by providing complementary forms of evidence

across different study contexts (Gizachew et al., 2024). Geographically, the reviewed studies were conducted across Indonesia (n=3), Ethiopia (n=4), Tanzania (n=1), and sub-Saharan Africa more broadly through pooled analyses (n=2). This spread reflects the global distribution of the asphyxia burden and lends contextual relevance to settings with comparable healthcare infrastructure, particularly within low- and middle-income countries (Alamneh et al., 2022).

Table 1.

Summary of Studies Included in the Literature Review

No	Author(s)	Year	Title	Database	Design	Key Findings	Link / DOI
1	Sekarwati TA, Darsini N, Husada D.	2020	Risk Factors for Neonatal Asphyxia Occurrence at General Hospital Dr. M. Soewandhie, Surabaya	Portal Garuda / Google Scholar	Case-control	Non-spontaneous labour (OR=5.56; 95%CI:2.50–12.34), pre-eclampsia (OR=2.52), meconium-stained amniotic fluid (OR=2.51), and primiparity were independently significant predictors of neonatal asphyxia.	Click here
2	Pradnyaswari KE, Windiyanto R.	2023	Factors Associated with the Incidence of Perinatal Asphyxia at Sanjiwani Regional General Hospital, Gianyar, Bali, Indonesia	Portal Garuda / Google Scholar	Case-control	Meconium-stained amniotic fluid (OR=2.742; p=0.021), caesarean delivery (OR=3.203; p=0.003), and low birth weight (OR=4.595; p=0.002) were significantly associated with perinatal asphyxia.	Click here
3	Ahmed R, Mosa H, Sultan M, et al.	2021	Prevalence and Risk Factors Associated with Birth Asphyxia Among Neonates Delivered in Ethiopia: A Systematic Review and Meta-Analysis	PubMed / PLoS ONE	Systematic review & meta-analysis	Meconium-stained amniotic fluid, prolonged labour, and low birth weight were the dominant pooled risk factors. Pooled prevalence of birth asphyxia was 22.4% (95% CI: 17.8–27.3). PMID: 34351983.	Click here
4	Msisiri LS, Kibusi SM, Kimaro FD.	2024	Risk Factors for Birth Asphyxia in Hospital-Delivered Newborns in Dodoma, Tanzania: A Case-Control Study	PubMed / SAGE Open Nursing	Case-control	Prolonged labour, meconium-stained amniotic fluid, acute foetal distress, abnormal foetal presentation, and absence of skilled birth attendants were independent risk factors. PMID: 38665876.	Click here
5	Gizachew S, Wogie G, Getnet M, Lonsako AA.	2024	Magnitude of Neonatal Asphyxia and Its Predictors Among Newborns at Public Hospitals of Wolaita Zone in Southern Ethiopia, 2023	PubMed / BMC Pediatrics	Cross-sectional	Premature rupture of membranes, parity, low birth weight, and gestational age at birth were significantly associated with neonatal asphyxia. PMID: 38413908.	Click here

No	Author(s)	Year	Title	Database	Design	Key Findings	Link / DOI
6	Alamneh YM, Negesse A, Aynalem YA, et al.	2022	Risk Factors of Birth Asphyxia Among Newborns at Debre Markos Comprehensive Specialized Referral Hospital, Northwest Ethiopia: Unmatched Case-Control Study	PubMed / Ethiopian Journal of Health Sciences	Case-control	Prolonged labour >12 hours, meconium-stained amniotic fluid, assisted vaginal delivery, gestational age <37 weeks, non-cephalic presentation, foetal distress, and birth weight <2,500 g were significant risk factors. PMID: 35813672.	Click here
7	Daka DT, Wubneh CA, Alemu TG, Terefe B.	2023	Incidence and Predictors of Mortality Among Neonates Admitted with Perinatal Asphyxia at West Oromia Tertiary Hospitals, Ethiopia, 2022	PubMed / BMC Pediatrics	Retrospective cohort	Distance from facility >10 km (AHR=2.25; 95%CI:1.60–3.17), direct oxygen administration, gestational age, and birth weight were independent predictors of mortality among asphyxiated neonates. PMID: 37723431.	Click here
8	Jasin YD, Darmawan E, Utomo MT.	2023	Risk Factors of Severe Perinatal Asphyxia at Tertiary Hospital (Dr. Soetomo General Hospital, Indonesia)	Google Scholar / Romanian Journal of Pediatrics	Case-control	Severe perinatal asphyxia was significantly associated with non-cephalic presentation, prolonged labour, and lack of antenatal care attendance among mothers delivering at Dr. Soetomo Hospital, Surabaya.	Click here
9	Techane MA, Alemu TG, Wubneh CA, et al.	2022	The Effect of Gestational Age, Low Birth Weight and Parity on Birth Asphyxia Among Neonates in Sub-Saharan Africa: Systematic Review and Meta-Analysis	Google Scholar / Italian Journal of Pediatrics	Systematic review & meta-analysis	Preterm birth, low birth weight, and grand multiparity (≥5) significantly elevated birth asphyxia risk across sub-Saharan Africa. Pooled OR for preterm birth was 3.11 (95%CI:2.24–4.32).	Click here
10	Khotimah H, Khasanah YY, et al.	2022	Factors Associated With Neonatal Asphyxia (Indonesia)	Google Scholar / Epidemiologi Kesehatan Indonesia	Cross-sectional analytic	Maternal hypertension history, premature rupture of membranes, prematurity, and delivery method were the dominant factors associated with neonatal asphyxia incidence in Indonesian hospital settings.	Click here

Analysis of the ten included studies revealed a constellation of determinants that collectively contribute to neonatal asphyxia. These determinants are organised into three principal categories: maternal factors, intrapartum factors, and foetal or neonatal factors. The consistency of several findings across methodologically heterogeneous studies underscores their clinical importance and strengthens the case for targeted preventive interventions at each phase of the perinatal period (Ahmed et al., 2021; Alamneh et al., 2022).

Hypertensive disorders of pregnancy, including pre-eclampsia and chronic hypertension, were among the most frequently documented antepartum risk factors in the reviewed literature (Khotimaha et al., 2024). Sekarwati & Ninik Darsini, (2020) reported that pre-eclampsia raised the odds of neonatal asphyxia by 2.52-fold (95%CI: 1.15–5.54) among deliveries at a Surabaya public hospital, a finding that aligns with well-established physiological evidence that uteroplacental insufficiency resulting from elevated maternal blood pressure progressively compromises foetal oxygenation. Absent or inadequate antenatal care attendance emerged as a second prominent maternal determinant. Jasin et al., (2023) found that mothers who had not attended antenatal care visits were disproportionately represented among cases of severe perinatal asphyxia, suggesting that the early identification of risk conditions including anaemia, hypertension, and malpresentation through routine antenatal visits provides a critical window for preventive action (Jasin et al., 2023).

Primiparity also featured as an independent antepartum risk factor. Sekarwati et al., (2020) identified primiparity as a significant predictor within the Surabaya cohort, a finding corroborated by the pooled estimates of Ahmed et al., (2021) which demonstrated that first-time mothers face a substantially higher probability of intrapartum complications that can cascade into asphyxia. Intrapartum determinants consistently represented the largest and most clinically actionable category of risk across the reviewed literature. Meconium-stained amniotic fluid was identified as a statistically significant predictor in multiple independent studies spanning different countries and healthcare systems. Sekarwati et al., (2020) reported an odds ratio of 2.51 (95%CI: 1.17–5.38) in their Indonesian hospital-based study, and this finding was paralleled by Msisiri et al., (2024) in Tanzania, where meconium passage was similarly designated an independent risk factor for birth asphyxia.

Prolonged labour, defined in multiple studies as active labour exceeding 12 hours or a second stage surpassing established normative durations, was another intrapartum factor reported across geographically distinct settings. Alamneh et al., (2022) documented a statistically robust association between labour duration exceeding 12 hours and the occurrence of birth asphyxia among neonates in Northwest Ethiopia, a finding that reflects the cumulative physiological burden imposed on the foetus throughout an extended birthing process. Non-spontaneous labour, encompassing labour induction and augmentation, was highlighted as the single strongest predictor in the Surabaya cohort studied by Sekarwati et al., (2020) (OR=5.56; 95%CI: 2.50–12.34). This underscores the risks associated with iatrogenic interventions in settings where intrapartum monitoring capacity may be limited, particularly where uterotonic agents are administered without continuous foetal heart rate surveillance.

Acute foetal distress and abnormal foetal presentation including breech and transverse lie were corroborated as independent predictors of asphyxia by both Msisiri et al., (2024) and Alamneh et al., (2022). These two factors frequently intersect in clinical practice, as malpresentation is itself a precipitant of obstructed labour and foetal hypoxia when not managed through timely operative delivery. Low birth weight (LBW) was one of the most consistently replicated neonatal-level risk factors across the included studies. Pradnyaswari and Windiyanto⁽²⁾ found that LBW neonates faced 4.595 times the odds of asphyxia compared with normal-weight counterparts ($p=0.002$) within a Balinese hospital cohort, a finding whose magnitude aligns closely with the meta-analytic estimates reported by Ahmed et al., (2021) for the Ethiopian context.

Prematurity, defined as gestational age below 37 completed weeks, emerged as a dominant predictor in pooled analyses. Techane et al., (2022) reported a pooled odds ratio of 3.11 (95%CI: 2.24–4.32) for preterm birth as a determinant of asphyxia across sub-Saharan African studies, attributed to the immaturity of the foetal respiratory system and the inadequacy of surfactant production that renders premature neonates disproportionately susceptible to hypoxic insults during and immediately after birth. Gestational age at birth was similarly foregrounded by Gizachew et al., (2024) who found that births occurring prior to term were significantly more likely to result in asphyxia among neonates delivered at public hospitals in Southern Ethiopia. This convergence of findings across Indonesian, Ethiopian, and sub-Saharan African studies points to prematurity and LBW as universally applicable risk targets, irrespective of the specific setting (Gizachew et al., 2024; Techane et al., 2022).

Several included studies highlighted healthcare system-level determinants that modulate the relationship between clinical risk factors and actual asphyxia outcomes. Daka et al., (2023) found that residential distance from a health facility exceeding 10 kilometres was an independent predictor of mortality among asphyxiated neonates (AHR=2.25; 95%CI: 1.60–3.17), highlighting the role of geographical access and its inverse, delayed arrival at skilled care in determining perinatal outcomes. The absence of skilled birth attendants at delivery was documented by Msisiri et al., (2024) as an independent risk factor for asphyxia in Tanzania. This aligns with the broader argument advanced by the Ethiopian meta-analysis of Ahmed et al., (2021) that the structural characteristics of delivery environments staffing ratios, equipment availability, and referral pathway functionality shape asphyxia incidence at least as powerfully as individual clinical risk factors.

Across the ten articles included in this review, a coherent and replicable pattern of risk emerged regardless of geographic setting, study design, or time period. Meconium-stained amniotic fluid, prolonged or non-spontaneous labour, prematurity, and low birth weight featured as statistically significant predictors in the majority of studies, whether examined individually or through pooled meta-analytic estimates (Ahmed et al., 2021; Alamneh et al., 2022; Msisiri et al., 2024; Techane et al., 2022). The two pooled analyses Ahmed et al., (2021) and Techane et al., (2022) provide the strongest evidence for causal attribution. Ahmed et al., (2021) established a pooled birth asphyxia prevalence of 22.4% across Ethiopian primary studies, a figure that underlines the scale of the problem in low-resource settings. Techane et al., (2022) demonstrated that preterm birth triples the odds of asphyxia across sub-Saharan Africa, a finding whose consistency across diverse national contexts reinforces its status as a high-priority preventive target.

The collective evidence from this review affirms that neonatal asphyxia is a multifactorial condition whose prevention cannot be addressed through single-focus interventions. Rather, strategies that simultaneously target antenatal risk identification, intrapartum quality of care, postnatal resuscitation preparedness, and structural health system strengthening are required to achieve meaningful reductions in asphyxia-related neonatal mortality, particularly in low- and middle-income country contexts where the burden remains disproportionately high (Ahmed et al., 2021; Daka et al., 2023; Gizachew et al., 2024; Techane et al., 2022).

DISCUSSION

This review identified meconium-stained amniotic fluid, prolonged labour, premature rupture of membranes, hypertensive disorders of pregnancy, prematurity, and low birth weight as the principal factors associated with neonatal asphyxia. Meconium-stained amniotic fluid was consistently associated with asphyxia across the included studies, with odds ratios ranging from 2.51 to 5.19 (Gizachew et al., 2024; Msisiri et al., 2024; Sekarwati et al., 2020). This finding is attributed to the dual role of meconium as both a marker of antecedent foetal hypoxic stress and a direct cause of airway obstruction following aspiration at the moment of birth. Prolonged labour, similarly, was identified as an independent predictor in multiple settings, Ahmed et al., (2021) and Alamneh et al.,

(2022) reflecting the well-documented relationship between extended uterine contractions and progressive foetal oxygen depletion when intercontractile recovery intervals are insufficient to restore placental perfusion.

Premature rupture of membranes contributed to asphyxia risk through cord compression and ascending infection, as demonstrated by Gizachew et al., (2024) (AOR=5.19; 95%CI: 2.03–13.26). Hypertensive disorders of pregnancy, including pre-eclampsia, were documented by Sekarwati et al., (2020) (OR=2.52) and corroborated by pooled sub-Saharan African analyses, Techane et al., (2022) with the mechanism attributed to impaired uteroplacental perfusion secondary to defective spiral artery remodelling, which reduces foetal oxygen delivery progressively across gestation and culminates in acute compromise during labour.

Prematurity and low birth weight were the most consistently replicated neonatal-level risk factors. The pooled odds ratio for preterm birth across sub-Saharan African studies reached 3.11 (95%CI: 2.24–4.32), Techane et al., (2022) while individual study estimates for low birth weight ranged from 3.45 to 4.60 across Indonesian and Ethiopian cohorts (Gizachew et al., 2024; Kadek Enny Pradnyaswari & Romy Windiyanto, 2023). These findings reflect the respiratory system immaturity, surfactant insufficiency, and attenuated hypoxic compensatory responses that characterise premature and growth-restricted neonates, each of which narrows the physiological margin between birth-related hypoxic challenge and overt asphyxial injury.

Beyond clinical factors, structural health system barriers including absence of skilled birth attendants Msisiri et al., (2024) and residential distance from facilities exceeding 10 km (AHR=2.25; 95%CI: 1.60–3.17) Daka et al., (2023) independently amplified asphyxia-related mortality, underscoring that clinical interventions alone are insufficient without concurrent investment in healthcare access and intrapartum care infrastructure. Taken together, these findings affirm that neonatal asphyxia is a largely preventable condition whose burden can be meaningfully reduced through integrated strategies targeting antenatal risk identification, quality intrapartum monitoring, and equitable access to skilled obstetric care (Ahmed et al., 2021; Daka et al., 2023; Gizachew et al., 2024).

CONCLUSION

Fulfilling its objective to identify and synthesize the consistent determinants of neonatal asphyxia, this review of ten recent studies confirms that the condition arises from complex interactions between clinical vulnerabilities and structural healthcare gaps across the perinatal continuum. Clinically, six factors consistently predict asphyxia: meconium-stained amniotic fluid, prolonged labour, premature rupture of membranes, maternal hypertension, prematurity, and low birth weight. Because these conditions are largely identifiable via routine surveillance, many associated cases remain theoretically preventable through standard obstetric care. Furthermore, structural deficiencies notably the absence of skilled birth attendants and geographical barriers to healthcare facilities significantly exacerbate asphyxia-related mortality. This highlights that clinical risks are profoundly mediated by care accessibility, particularly in vulnerable low- and middle-income settings. Consequently, reducing the neonatal asphyxia burden necessitates integrated interventions rather than isolated clinical approaches. High-priority strategies must include strengthening antenatal screening to manage high-risk pregnancies early, ensuring skilled birth attendance equipped for intrapartum monitoring, and improving referral infrastructure to minimize fatal delays. Together, these evidence-based measures provide a comprehensive pathway to mitigate neonatal asphyxia globally.

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