

Review Article

# Literature Review of Factors Affecting Premature Rupture of Membranes

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**Abstract:** Prelabor rupture of membranes (PROM) remains one of the most frequently encountered obstetric complications and continues to contribute substantially to maternal and neonatal morbidity and mortality. Numerous factors have been associated with PROM; however, the available evidence presents considerable variation, highlighting the need to re-evaluate these determinants using recent empirical findings. This review aims to identify and synthesize the principal factors influencing PROM based on ten studies published within the last five years. A systematic search was conducted across PubMed, Scopus, Web of Science, and Google Scholar using predefined keywords, followed by screening through established eligibility criteria. Relevant data from each study including study design, geographical setting, assessed risk factors, and statistical outcomes such as odds ratios or relative risks were extracted and compared. The review indicates that reproductive and urinary tract infections, inadequate nutritional status, high-risk obstetric history, and short interpregnancy intervals consistently emerge as major determinants. Social factors and the quality of antenatal services were also shown to heighten the likelihood of PROM. Overall, the findings emphasize that PROM arises from a combination of medical and non-medical influences, reinforcing the need for preventive strategies that adopt a comprehensive and integrated approach.

**Keywords:** Antenatal Care; Nutritional Status; Obstetric Risk; Prelabor Rupture of Membranes; Reproductive Infections

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## 1. Introduction

Premature Rupture of Membranes (PROM), commonly referred to in Indonesian clinical practice as *ketuban pecah dini*, continues to represent a substantial global challenge in maternal–fetal health due to its consistent association with adverse perinatal outcomes. PROM occurs when the amniotic membranes rupture before the onset of uterine contractions, and its incidence ranges widely depending on population characteristics, healthcare quality, and maternal conditions. Because PROM can trigger infections such as chorioamnionitis, lead to umbilical cord compression, and significantly increase the likelihood of preterm birth, it has been the focus of extensive obstetric research. The object of the current study centers on pregnant women both at term and preterm who experience spontaneous rupture of membranes prior to labor, providing a framework to investigate biological, obstetric, and environmental determinants that influence the onset of this condition. In recent years, the body of research on PROM has expanded markedly, propelled by the need for more precise diagnostic, preventive, and clinical management strategies (Enjamo et al., 2022).

Beyond its clinical definition, PROM carries significant consequences for maternal–fetal health systems and has broader implications for midwifery practice and public health policy. Numerous studies have shown that PROM substantially increases the risk of maternal infection, neonatal sepsis, preterm delivery, and long-term developmental complications, making it a persistent contributor to perinatal morbidity and mortality (Hossain et al. 2023). In midwifery practice, the condition necessitates meticulous antenatal surveillance, early identification of modifiable risk factors, and timely referral pathways to prevent adverse

outcomes. Midwives play a crucial role in counseling women on infection prevention, nutritional adequacy, and birth preparedness elements recognized as essential components of PROM prevention strategies in both low- and middle-income settings (Rokhila, 2023). At the health-system level, governments have responded by strengthening antenatal care programs, expanding screening for genitourinary infections and anemia, improving nutritional supplementation policies, and implementing community-based maternal education initiatives. Such measures are intended to reduce the burden of PROM by addressing its underlying clinical and social determinants, particularly in resource-constrained populations where risk factors are more prevalent (Tiruye et al. 2021; Pecora et al., 2020)

Previous studies examining PROM have utilized diverse methodological approaches to quantify its prevalence and identify associated risk factors. Observational designs particularly cross-sectional and case-control studies have been instrumental in determining maternal characteristics linked with PROM. These studies often emphasize risk factors such as low maternal body mass index, closely spaced pregnancies, history of abortion, hypertensive disorders, and genital infections. A major meta-analysis published in 2024 synthesizing data from more than 18,000 pregnant women reinforced the relevance of these factors, highlighting additional contributors including gestational diabetes, fetal malpresentation, and increased intra-abdominal pressure as significant determinants (Dayal et al., 2024). Similarly, research conducted in hospital-based settings across South Asia and Africa has consistently shown associations between PROM and maternal age extremes, preterm gestation, occupational exposure to physical strain, and parity (Rokhila et al., 2023). Meanwhile, studies in Middle Eastern and Southeast Asian contexts demonstrate that inadequate antenatal care, nutritional deficiencies, and anemia may further compound the risk of PROM.

Despite the insights provided by these methodologies, there are inherent limitations that warrant critical attention. Observational designs, while valuable in revealing population-level correlations, cannot establish causal pathways due to the potential influence of uncontrolled confounders, recall bias among participants, and non-random sampling strategies. In contrast, meta-analyses enhance statistical validity by aggregating findings across heterogeneous studies; however, they remain heavily dependent on the methodological quality and reporting consistency of included research. As noted by Lin et al. (2024), studies often vary in PROM definitions, diagnostic procedures, and data adjustment techniques, which complicates accurate comparison and synthesis. Furthermore, biological research on PROM has developed substantially through the exploration of membrane structural integrity, identifying the roles of collagen breakdown, oxidative stress, and subclinical infection in weakening the amniotic sac described how inflammatory mediators stimulate matrix metalloproteinases capable of degrading collagen fibers, thereby increasing vulnerability to rupture. Parry & Strauss (1998) despite this valuable mechanistic insight, such biological findings are often positioned separately from epidemiological analyses, leaving a fragmented understanding of how clinical, environmental, and molecular contributors intersect (Li et al. 2020).

A deeper gap becomes visible when examining the global distribution of PROM research. Findings from high-income countries frequently reflect strong antenatal care systems, advanced diagnostic tools, and reduced rates of malnutrition conditions that differ markedly from those in low- and middle-income countries, including Indonesia (Tiruye et al., 2021). Consequently, epidemiological patterns observed in wealthier countries cannot be directly applied to populations with different socioeconomic and healthcare realities. Local Indonesian studies, for example, often involve samples drawn from single facilities with limited generalizability and rely on variable measurement strategies that do not incorporate biomarkers, microbiological assessments, or detailed nutritional profiles (Getnet et al., 2023). Additionally, the influence of cultural practices, occupational exposures, and environmental stressors factors highly relevant in rural and peri-urban Indonesian settings remains understudied. These gaps collectively demonstrate a need for more integrative research that connects epidemiological data with physiological, environmental, and health-system determinants (Lv et al., 2024).

The present review thus introduces a comprehensive analytical approach intended to bridge these methodological and conceptual divides. Instead of focusing solely on statistical associations or solely on biological mechanisms, this review integrates evidence across clinical, physiological, and socio-demographic domains to build a multifactorial understanding of PROM (Granero et al., 2025). Such an approach acknowledges that membrane rupture does not result from a single risk factor but from the interaction of maternal health status, environmental strain, immunological responses, obstetric history, and biochemical integrity

of the membranes. By synthesizing these dimensions, this paper aims to illuminate causal patterns that are more robust and clinically meaningful than those derived from isolated research domains. Moreover, the review incorporates findings from both high-resource and low-resource settings, emphasizing differences that may shape risk profiles and clinical outcomes across global populations (Hossain et al., 2023).

The proposed contribution of this review is threefold. First, it consolidates epidemiological findings from a broad array of countries, offering a panoramic perspective on established risk factors while highlighting inconsistencies that require further inquiry (Menon et al., 2021). Second, it advances a conceptual model connecting maternal demographics, obstetric history, behavioral factors, and membrane physiology to the onset of PROM, thereby providing a theoretically grounded framework for both research and clinical practice. Third, it identifies critical research gaps such as the scarcity of biomarker-based studies in developing countries, limited evaluation of nutritional influences, and underexplored interactions between chronic maternal stress and membrane integrity. These insights aim not only to reinforce current scientific understanding but also to guide future investigations, antenatal care interventions, and policymaking, especially in regions where PROM prevalence and neonatal complications remain disproportionately high (Pecora et al., 2020).

The remainder of this paper is structured to guide readers through the multifaceted landscape of PROM research. The subsequent section examines the epidemiology and clinical classifications of PROM across global contexts. This is followed by an extensive discussion of maternal, fetal, environmental, and biological factors identified in the literature. A dedicated section explores the molecular and physiological mechanisms underlying membrane rupture, providing insight into how biochemical disruptions translate into clinical manifestations. The review then integrates findings from Indonesia and comparable regions to contextualize PROM within low-resource health systems. Finally, the discussion synthesizes key themes and outlines pressing priorities for future research and policy implementation.

Given these gaps, the present review seeks to synthesize the most recent scientific advances concerning factors associated with PROM, highlighting consistent findings, methodological differences, and emerging research directions. By integrating theories of membrane biomechanics with current epidemiological and environmental evidence, this review aims to provide a more complete explanatory model for PROM and to identify future opportunities for targeted clinical and public health interventions.

## 2. Research Method

### Study Design and Approach

A systematic literature review with a narrative synthesis approach was adopted. This method allows the integration of findings from various observational studies and supports the identification of consistent risk patterns linked to PROM.

### Literature Search Strategy

A comprehensive search was conducted in scientific databases such as PubMed, Scopus, Web of Science, and Google Scholar. Keywords were combined using Boolean operators, including: “premature rupture of membranes,” “PROM,” “risk factors,” and “determinants.” The search was restricted to studies published within the last 5 years to maintain contemporary relevance.

### Inclusion and Exclusion Criteria

#### *Inclusion Criteria:*

- a. Observational studies (cohort, case-control, and cross-sectional).
- b. Studies examining risk factors associated with PROM.
- c. Availability of interpretable statistical or quantitative data.
- d. Full-text articles accessible.

#### *Exclusion Criteria:*

- a. Case reports, editorials, non-systematic reviews, and animal studies.
- b. Studies lacking data on relevant determinants of PROM.

### Study Selection Procedure

#### *The selection process consisted of:*

- a. Removing duplicate records.
- b. Screening titles and abstracts.
- c. Conducting full-text assessments using predefined criteria.

d. Two independent reviewers screened the studies to reduce selection bias.

### Data Extraction and Classification

The data collected included: author name, year of publication, research area, study design, sample size, definition of KPD used, risk factors assessed, and statistical outcomes such as odds ratios or relative risks were extracted and compared.

### Quality Assessment

The methodological quality of included studies was evaluated using validated tools such as the Newcastle–Ottawa Scale (NOS) or JBI Critical Appraisal Checklists. Assessments were performed independently by two reviewers.

### Data Synthesis

The findings were synthesized narratively. Recurrent risk factors identified across multiple studies were grouped into thematic categories such as infectious causes, obstetric conditions, maternal characteristics, and lifestyle-related determinants.

## 3. Results and Discussion

The literature search conducted across PubMed, Scopus, Web of Science, and Google Scholar yielded a substantial number of studies related to determinants of Premature Rupture of Membranes (PROM). Following a multi-stage screening process including removal of duplicate records, evaluation of titles and abstracts, and assessment of full texts 8 studies were identified as meeting all predefined inclusion criteria.

Overall, the selected studies demonstrate considerable variation in research design, sample size, and geographical scope. Despite these differences, several recurring patterns emerged, particularly regarding the influence of infections, obstetric history, maternal health conditions, and lifestyle-related factors on the likelihood of PROM. Preliminary appraisal of the extracted data also revealed that most studies reported effect estimates through measures such as Odds Ratios (OR) or Risk Ratios (RR), allowing for meaningful comparison of risk magnitude across studies.

These findings are summarized in the following table to facilitate a clearer comparison of methodological characteristics and core outcomes across the ten included publications

**Table 1.** Summary of Characteristics and Key Findings of Included Studies on Premature Rupture of Membranes

No	Author & Year	Title	Research Area	Study Design	Sample Size	Risk Factors Assessed	Results
1	Lin et al. (2024)	Risk factors for premature rupture of membranes in pregnant women: a systematic review and meta-analysis	Multinational (21 studies)	Systematic review & meta-analysis	18,174	Low BMI, IPI <2 years, abortion, previous preterm PROM, CS, GDM, HTN, infection	Low BMI OR 2.18; IPI <2y OR 2.99; previous preterm OR 5.72; prior PROM OR 3.95
2	Jena et al. (2022)	Incidence of PPRM and its association with inter pregnancy interval	Urban South Ethiopia	Prospective cohort	2,578	IPI & demografi	IPI <18 mo ARR = 2.59 (95% CI 1.27–5.29)
3	Argaw et al. (2021)	Preterm Premature Ruptures of Membrane and Associated Factors	Ethiopia	Cross-sectional / analytic	412	UTI, abortion, malnutrition, ANC	Infection, no ANC, abortion significant
4	Tadesse et al. (2024)	Determinants of premature membrane rupture	Northeast Ethiopia	Unmatched case-control	353	UTI, anemia, parity, ANC, obstetric history	UTI, prior PROM, anemia, lack of

5	Suriyadi & Hendra (2024)	Systematic Review of Risk Factors for PROM	Multinational	Systematic review	-	Cervical length, CRP, oligohydramnios, contractions	ANC significant Cervical length <20 mm, high CRP → shorter latency
6	Kong et al. (2023)	Predicting chorioamnionitis using inflammatory indexes	Multi-center	Observational / predictive	-	CRP, WBC, biomarkers	CRP + WBC best predictors
7	Intan Purnamawati (2024)	Risk factor for PROM: clinical study	Indonesia (Bima)	Cross-sectional	136	Bacterial colonization, maternal factors	Infection strongly associated with PROM
8	Lathifa & Rahayuningsih (2025)	Factors associated with PROM	Indonesia	Retrospective / case-control	200	UTI, anemia, lack ANC, low BMI, prior CS	Low SES, infection, malnutrition significant

The findings from the ten reviewed studies indicate that premature rupture of membranes (PROM) is influenced by a combination of maternal characteristics, obstetric history, infections, and nutritional status. Overall, the pattern reveals that these determinants do not act independently; instead, they interact and collectively contribute to the risk of PROM.

The systematic review and meta-analysis by Lin et al. (2024) offers the most comprehensive view by synthesizing evidence from more than twenty studies. They highlight that low maternal BMI, short interpregnancy intervals, prior preterm birth, and previous episodes of PROM consistently increase the risk. This is aligned with the cohort findings of Jena (2022), who report that intervals shorter than 18 months significantly elevate the likelihood of PPRM. These converging results underscore the importance of nutritional adequacy and reproductive spacing in maintaining membrane integrity.

Infection-related factors also emerge as dominant contributors. Studies by Argaw et al. (2021), Tadesse et al. (2024), and Suriyadi & Hendra (2024), consistently identify urinary tract infections, bacterial colonization, and various inflammatory conditions as predictors of PROM. Similar patterns appear in the work of Kong et al. (2023), who demonstrate that biomarkers such as CRP and WBC effectively predict chorioamnionitis, indirectly confirming the connection between infection and membrane weakening.

Regional studies from Ethiopia, Uganda, and Indonesia further reveal that socioeconomic conditions, low educational attainment, limited antenatal care, and maternal age under 20 years significantly correlate with PROM. The clinical study from Purnamawati (2024) shows that young maternal age, low education level, and primigravidity heighten vulnerability to PROM, reflecting broader issues of health access and reproductive literacy.

Anatomical and biochemical factors are also highlighted. Suriyadi & Hendra (2024) show that a cervical length below 20 mm and elevated CRP levels are associated with shorter latency periods in PPRM, suggesting that cervical structure and inflammatory status may influence membrane resistance.

Taken together, the ten studies demonstrate that PROM is a multifactorial condition shaped by interacting biological, clinical, and social determinants. These findings emphasize the need for a comprehensive preventive approach, integrating early infection screening, improved antenatal care, nutritional support, and reproductive health education to reduce the risk of PROM.

From a midwifery and obstetric practice perspective, these findings highlight the critical role of antenatal surveillance. Midwives and obstetricians must systematically assess risk factors such as maternal anemia, history of prior PROM or abortion, genitourinary infections, maternal hypertension, parity, and nutritional status. For example, a recent Indonesian study found that maternal anemia was significantly associated with increased PROM risk (Lin et al. 2024). Another study identified maternal infection history, parity, gestational age, and chronic diseases as significant correlates of PROM (Lathifa & Rahayuningsih 2025)

By integrating these risk assessments into routine antenatal visits, health providers can stratify pregnant women into risk categories, enabling targeted interventions such as iron supplementation, infection screening and treatment, health education, and closer monitoring as delivery approaches. This not only supports safer pregnancy outcomes but also contributes to reducing maternal and neonatal morbidity associated with PROM including preterm birth, neonatal infection, and birth complications. For instance, newborns born after PROM pregnancies show elevated leukocyte counts, indicating possible infection risk (Wu et al., 2017)

From a public health and policy perspective, such evidence should prompt health authorities to strengthen prenatal health programs. Governmental or health-system responses may include: (1) promoting universal antenatal care coverage, especially in rural or underserved areas; (2) implementing routine screening for urinary/genital tract infections and anemia in pregnancy; (3) providing nutritional support and education to pregnant women; (4) integrating reproductive health education into community outreach; (5) establishing guidelines for early detection and management of PROM risk factors; and (6) improving data collection and monitoring to identify high-risk populations and evaluate intervention effectiveness.

Moreover, health policymakers should ensure maternal health services are accessible, affordable, and culturally acceptable. Through health education campaigns, community-based interventions (via midwife visits, community health centers, maternal classes), and strengthening of referral systems, the burden of PROM and its downstream impacts on maternal and neonatal health can be mitigated.

In the broader scope of obstetrics and midwifery science, understanding PROM as a condition influenced by an interplay of biological vulnerabilities (e.g., anemia, maternal hypertension), obstetric history (prior PROM, parity), infection status, and socio-demographic factors advances holistic maternal care. It encourages a shift away from viewing PROM solely as a random obstetric complication, toward seeing it as a preventable outcome through comprehensive prenatal care, risk stratification, and early intervention.

#### 4. Comparison

A review of eight recent studies shows that the findings of this research are in line with the latest developments (state-of-the-art) regarding factors that influence premature rupture of membranes (PROM).

Large-scale evidence, particularly the meta-analysis by Lin et al. (2024), emphasizes that nutritional status, short interpregnancy intervals, prior PROM, and a history of preterm birth are consistent determinants across diverse populations. The present review reinforces these conclusions, particularly highlighting low BMI, inadequate antenatal care, and adverse obstetric histories as recurrent risk factors in multiple settings.

Recent advancements in PROM research have also focused on the predictive use of biological and inflammatory markers (Kong et al. 2023). report that CRP, procalcitonin, and white blood cell counts exhibit strong predictive value for infection-related complications in PPRM. The studies included in this review similarly underscore the role of genital and urinary infections and microbial colonization in weakening fetal membranes.

However, this review also identifies gaps in recent state-of-the-art studies. While many contemporary investigations concentrate heavily on biological mechanisms and biomarker development, evidence from countries such as Ethiopia, Uganda, and Indonesia highlights the persistent influence of socioeconomic conditions, educational attainment, and antenatal care access factors that advanced biomedical research often overlooks. Thus, the contribution of this review lies in demonstrating that effective PROM prevention requires an integrated approach encompassing biological, clinical, and socio-environmental domains.

Overall, this review not only supports but also extends current state-of-the-art findings by incorporating evidence from low- and middle-income regions, providing a more comprehensive understanding of PROM risk determinants.

#### 5. Conclusions

This literature review aims to provide a thorough overview of the multifaceted variables that significantly influence the occurrence of Premature Rupture of Membranes (PROM). By conducting a detailed analysis of eight recent and highly relevant scientific investigations, this study successfully offers an up-to-date synthesis of data concerning the multifactorial etiology of this obstetric condition. Specifically, the primary focus of this review is to identify and

critically compare the major determinants of PROM based on the latest scientific evidence available. The resulting analysis underscores the clinical complexity of PROM, which is fundamentally triggered by the intricate interaction of several risk factors. Ultimately, this review serves as a crucial foundation for understanding the evolving risk profile of PROM within contemporary clinical practice.

The in-depth scrutiny of the eight included studies revealed that PROM incidence is shaped by several closely interconnected factors, forming a complex risk chain. The most prominent biological factors identified consistently involve infections of the reproductive and urinary tracts, which are known to directly contribute to the weakening of the membrane integrity. Furthermore, suboptimal nutritional status in the mother was also found to play a vital role in influencing the structural resilience of the amniotic sac. A history of problematic previous pregnancies, such as recurrent miscarriages or preterm births, alongside inadequate spacing between pregnancies, were also established as consistent factors that heighten a mother's susceptibility to PROM. These findings strongly confirm that the integrity of the fetal membranes relies heavily on the mother's internal health and obstetric history.

Moving beyond biological factors, the evidence indicates that socioeconomic determinants and the quality of Antenatal Care (ANC) services play a substantial and crucial role in modulating the overall risk of PROM. The accessibility and standard of ANC received by the mother throughout her gestation have a direct impact, as poor or inconsistent care can conceal or exacerbate pre-existing risk factors. Social dimensions, including the mother's educational attainment, socioeconomic status, and community support network, were also shown to influence health behaviors, such as adherence to medical advice and proper nutritional intake. The influence of these variables highlights that effective PROM prevention necessitates strategies that extend beyond purely medical interventions. Consequently, these elements significantly contribute to either escalating or diminishing a patient's probability of experiencing PROM.

Overall, the findings presented within this review successfully validate its initial objective, which was to identify and synthesize the principal determinants of PROM using updated scientific insights. The clear and discernible interrelationship among infection, maternal nutrition, membrane integrity, and the standard of antenatal care suggests that PROM is not the consequence of a singular causative agent. Instead, the condition emerges from the simultaneous accumulation of various interacting risks within the maternal environment. This comprehensive understanding solidifies the argument that prevention must be holistic and multi-pronged. The insights garnered unequivocally underscore the necessity for developing preventative strategies that target the medical, behavioral, and healthcare system components concurrently.

The implications derived from this systematic review strongly emphasize the clinical utility of a multidimensional approach in the concerted effort to reduce PROM incidence worldwide. A more lucid and detailed understanding of this risk factor spectrum can effectively guide healthcare providers in designing and implementing preventive strategies that are significantly more targeted and impactful. Additionally, this synthesis provides a substantial contribution to the broader field of obstetrics by integrating empirical evidence from diverse geographical settings. The inclusion of these data, particularly from low- and middle-income regions, offers a more inclusive and global view of PROM determinants. This contribution significantly extends the current state-of-the-art findings and supports the development of universally relevant clinical guidelines.

While this review offers a robust synthesis of the literature, it is crucial to acknowledge certain inherent limitations encountered during the process. A primary challenge was the inconsistency in the operational definitions of PROM across the analyzed studies, which inherently complicates direct comparative analysis. Furthermore, the methodological variations observed, combined with the limited availability of clinical biomarker data in certain regions, partially constrict the full generalizability of the findings. Considering these constraints, future research endeavors should prioritize stricter standardization of the PROM definition to enhance data comparability. Subsequent research efforts must also incorporate more advanced diagnostic assessments and include more demographically diverse populations to augment both the generalizability and scientific robustness of the conclusions.

#### **Author Contributions:**

In this study, the authors shared responsibilities according to their expertise. Aticeh and Endah developed the core research concept and overall study framework. The

methodological design was primarily arranged by Aticeh, while the software-related processes were also handled by Aticeh. The verification and refinement of data and procedures were conducted collaboratively by Aticeh, Endah, and Debbiyantina. Formal data analysis and comprehensive investigation activities were undertaken by Aticeh. The acquisition of research resources and the management of data curation were also coordinated by Aticeh. The initial drafting of the manuscript was prepared by Aticeh, whereas the critical review, language polishing, and editorial refinement were performed by Endah. Visual presentation aspects were developed by Debbiyantina. Oversight of the research progress and guidance throughout the project were provided by Rosita, who also supervised administrative tasks related to the project. The funding required to support this work was secured by Endah.

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### **Data Availability Statement:**

The authors affirm their willingness to provide the research data used in this study. All datasets that support the findings of this work are available from the corresponding author upon reasonable request. Due to considerations related to participant privacy and ethical obligations, the data cannot be deposited in a public repository; however, the authors will share relevant materials with qualified researchers who meet the necessary ethical requirements.

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### **Conflicts of Interest:**

The authors declare that they have no conflicts of interest that could influence the presentation or interpretation of the findings reported in this study. Since this work was self-funded, the funders had no involvement in the study design; in the processes of data collection, analysis, or interpretation; in the preparation of the manuscript; or in the decision to submit the results for publication.

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