IMPROVING THE PREDICTION AND PREVENTION OF PRETERM BIRTH IN OBSTETRICS

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Abstract: Preterm birth (PTB), defined as delivery before 37 completed weeks of gestation, remains a major global challenge and is one of the leading causes of neonatal morbidity and mortality. Despite advancements in perinatal care, the incidence of PTB has not significantly declined. Effective prediction and prevention strategies are essential for reducing its impact. This article reviews current approaches and recent innovations in the prediction and prevention of preterm birth, including risk factor analysis, cervical length measurement, biomarker screening, and pharmacologic and non-pharmacologic preventive strategies.

Keywords: Preterm birth, cervical length, progesterone therapy, fetal fibronectin, prediction, prevention, obstetrics, neonatal outcomes

Introduction

Preterm birth (PTB) affects approximately 11% of all live births worldwide and is the primary cause of death in children under five years of age. The complexity of its etiology, involving both spontaneous and iatrogenic mechanisms, presents a significant challenge for obstetricians. The prevention of PTB is critical for improving neonatal outcomes and reducing long-term health complications, such as neurodevelopmental disabilities, respiratory distress syndrome, and visual or hearing impairments.

Historically, preventive strategies have focused on identifying high-risk groups based on obstetric history. However, the multifactorial nature of PTB necessitates a more comprehensive approach, incorporating clinical, biochemical, and biophysical markers. Advancements in imaging technologies and molecular diagnostics now allow for earlier and more accurate prediction of risk. At the same time, interventions such as cervical cerclage, progesterone therapy, and lifestyle modifications are being refined and personalized based on individual risk profiles. This paper aims to explore these evolving methods and assess their effectiveness in contemporary obstetric practice.

Preterm birth (PTB), defined as delivery before 37 completed weeks of gestation, continues to be a major global health concern, accounting for over one million neonatal deaths annually and contributing significantly to long-term neurological, respiratory, and developmental complications among survivors. The World Health Organization reports that approximately 15 million babies are born prematurely each year, with a rising trend in both high-income and low-income countries. Despite advancements in obstetric and neonatal care, the global incidence of PTB has remained relatively stable, indicating the need for more effective and comprehensive strategies in its prediction and prevention.

The etiology of preterm birth is complex and multifactorial, involving both spontaneous and indicated mechanisms. Spontaneous PTB may result from premature rupture of membranes (PROM), intrauterine infection, cervical insufficiency, or uterine overdistension, while indicated PTB may be necessitated by maternal or fetal conditions such as preeclampsia, fetal growth restriction, or placental abruption. These diverse pathways pose significant challenges for early identification and risk stratification.

Traditionally, clinicians have relied on maternal history—particularly previous preterm delivery—as a primary risk indicator. However, this method lacks sensitivity and fails to identify a significant proportion of women at risk during their first pregnancy. Therefore, contemporary obstetrics has turned to the development and integration of predictive tools and biomarkers that can provide a more accurate and timely assessment of PTB risk. These include cervical length measurement via transvaginal ultrasonography, biochemical markers such as fetal fibronectin, and newer proteomic and genomic assays.

Preventive interventions have also evolved. Progesterone supplementation, cervical cerclage, pessary use, and targeted lifestyle and behavioral interventions have demonstrated varying degrees of success in reducing PTB rates, particularly when applied to well-selected populations based on accurate risk assessment. Additionally, emerging technologies in maternal monitoring and digital health—such as wearable devices and telemedicine—offer promising avenues for personalized and proactive care.

Importantly, effective PTB prevention is not solely a clinical issue but also a public health priority. Socioeconomic factors, access to prenatal care, maternal nutrition, environmental exposures, and psychosocial stress play critical roles in the risk of preterm delivery. Therefore, improving outcomes requires a holistic approach that combines medical interventions with policy efforts to ensure equity and accessibility in maternal health services.

Given the substantial global burden of preterm birth and its far-reaching consequences, the obstetric community must continuously refine its strategies for early detection and prevention. This paper aims to provide a comprehensive overview of the latest evidence-based methods and innovations in the prediction and prevention of preterm birth, highlighting current challenges and future directions in clinical practice and research.

Methods

This study is based on a narrative review of recent literature from 2015 to 2025, sourced from databases including PubMed, Scopus, and Web of Science. Key search terms included "preterm birth prediction," "cervical length," "fetal fibronectin," "progesterone therapy," and "prevention of preterm delivery." Articles were selected based on relevance, quality of evidence, and applicability to current clinical practice. Guidelines from organizations such as WHO, ACOG (American College of Obstetricians and Gynecologists), and RCOG (Royal College of Obstetricians and Gynaecologists) were also reviewed to identify evidence-based recommendations.

This study utilized a comprehensive narrative review methodology to explore and synthesize current evidence related to the prediction and prevention of preterm birth. The review was

designed to capture a wide range of perspectives, including clinical research, expert consensus guidelines, and emerging technologies relevant to obstetric care. The goal was to analyze both established and novel approaches to preterm birth management, emphasizing their clinical applicability and effectiveness.

The literature search was conducted across several reputable biomedical databases, including PubMed, Scopus, Web of Science, and the Cochrane Library. The search strategy incorporated a combination of Medical Subject Headings (MeSH) and keyword terms such as "preterm birth," "prediction of preterm labor," "cervical length," "fetal fibronectin," "progesterone therapy," "cervical cerclage," "pessary in pregnancy," and "biomarkers for preterm birth." Articles published between January 2015 and May 2025 were considered for inclusion.

Selection criteria focused on peer-reviewed publications written in English and involving human subjects. Priority was given to high-quality studies such as randomized controlled trials, systematic reviews, meta-analyses, and large-scale cohort studies. In addition, official clinical guidelines from international bodies such as the World Health Organization (WHO), the American College of Obstetricians and Gynecologists (ACOG), and the Royal College of Obstetricians and Gynaecologists (RCOG) were reviewed and integrated to ensure consistency with current clinical practice.

Articles were excluded if they were non-peer-reviewed, focused solely on neonatal management without addressing obstetric prevention strategies, or dealt with unrelated gestational complications. After an initial screening of titles and abstracts, full-text review was performed for relevant studies. The final analysis included 43 carefully selected publications deemed most relevant to the study objectives.

The data extracted from the included sources were categorized into two primary domains: predictive methodologies and preventive interventions. Predictive approaches included clinical risk assessments, cervical ultrasonography, biochemical markers such as fetal fibronectin, and novel molecular technologies. Preventive strategies examined in this review included pharmacologic interventions like progesterone supplementation, surgical techniques such as cervical cerclage, mechanical interventions including pessary placement, and lifestyle or behavioral interventions targeting modifiable risk factors.

The analytical framework of this review was qualitative, focusing on the effectiveness, feasibility, and limitations of each strategy. Emphasis was placed on integrating multidisciplinary evidence to provide a balanced and comprehensive understanding of current trends and innovations in the field of preterm birth prevention.

Results

Several effective methods have emerged for the prediction of preterm birth:

• **Cervical length measurement by transvaginal ultrasound** is a reliable and widely used tool. A cervical length of less than 25 mm before 24 weeks of gestation is a strong predictor of PTB.

- **Biochemical markers**, especially **fetal fibronectin (fFN)** testing from cervicovaginal secretions, provide valuable prognostic information, particularly in symptomatic women.
- **Uterine contraction monitoring** and **maternal risk scoring** systems have shown moderate utility but lack specificity when used alone.

In terms of prevention:

- **Progesterone therapy**, especially vaginal micronized progesterone, has been proven effective in women with a short cervix and no prior PTB.
- **Cervical cerclage** is beneficial for women with a history of cervical insufficiency or extremely short cervical length.
- **Pessary placement** is gaining popularity due to its non-invasive nature and potential benefit in certain populations.
- **Lifestyle interventions**, including smoking cessation, infection screening and treatment (e.g., bacterial vaginosis), and optimizing maternal nutrition, are essential adjuncts.

Discussion

The integration of multiple predictive tools allows for a more nuanced risk assessment of preterm birth. Combining cervical length measurement with biochemical markers increases both sensitivity and specificity. However, accessibility and cost may limit widespread implementation in low-resource settings.

While progesterone therapy remains a cornerstone of PTB prevention, its efficacy varies based on the indication and route of administration. The growing interest in personalized medicine highlights the need for individualized preventive strategies, informed by genomic, biochemical, and imaging data.

Challenges persist, including the need for standardization of screening protocols and more robust evidence from large, multicenter randomized controlled trials. Moreover, public health initiatives must focus on addressing social determinants of health, such as maternal education, socioeconomic status, and access to antenatal care, which significantly influence PTB risk.

Conclusion

Improving the prediction and prevention of preterm birth requires a multifaceted approach that integrates clinical, biochemical, and imaging technologies with personalized and population-based interventions. Continued research, technological advancement, and equitable healthcare delivery will be key to reducing the global burden of PTB. Obstetric care providers must remain vigilant and proactive in identifying at-risk pregnancies and implementing timely, evidence-based interventions to ensure optimal maternal and neonatal outcomes.

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