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Review article

Addressing the burden of premature birth and its prevention in developing countries: is it time to act now?

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Abstract

India accounts for approximately 3.5 million preterm births annally, representing about 25% of the global burden. Premature birth poses a substantial burden, with an especially profound impact on families and health systems in low-and middle-income countries, where access to adequate healthcare is limited. Premature birth remains a leading cause of neonatal death among children under the age of five years due to organ immaturity, sepsis, and respiratory distress syndrome. Efforts to reduce premature birth include improving access to quality prenatal care, enhancing neonatal care services, and implementing targeted public health interventions. Despite ongoing challenges, considerable progress has been made through concerted efforts by governments, international organizations, healthcare providers, and community stakeholders. Continued investment, monitoring, and innovation are crucial to further prevent preterm births and improve the outcomes. Such efforts aim to alleviate the burden on families and caregivers while strengthening already strained health systems worldwide.

Keywords: Antenatal care, health program, neonatal death, respiratory distress syndrome, prematurity.

The global burden of premature birth is substantial and presents a considerable challenge for public health systems. Any baby born less than 37 weeks of gestational age is considered a preterm baby, which is the most common cause of death in newborns and children under 5 years of age.(1) Premature babies are generally more prone to different types of prematurity-related complications, such as poor control of body temperature leading to hypothermia, increased risk of infection, surfactant deficiency leading to hyaline membrane disease, septicemia, necrotizing enterocolitis (NEC), metabolic abnormalities, neurodevelopmental disabilities, and long-term health issues. These complications contribute to the high rates of early neonatal deaths in resource-limited and low-socioeconomic countries. The burden of premature birth extends beyond immediate health outcomes and encompasses the economic, social, and psychological impacts on families, society, and the healthcare system.(2)

Preterm birth rates tend to be higher in certain regions because of various factors such as poverty, inadequate prenatal care, malnutrition, infections, limited access to the latest medical technology, and poor access to health facilities. Complications from premature birth, including respiratory distress syndrome (RDS), infections, and neurodevelopmental disabilities, can further strain healthcare systems and place additional socioeconomic burdens on families and society. The survival rate of premature babies has increased globally because of recent advances, such as the use of antenatal steroids, the availability of surfactants, and better nursing care provided by trained staff **(Figure 1).**

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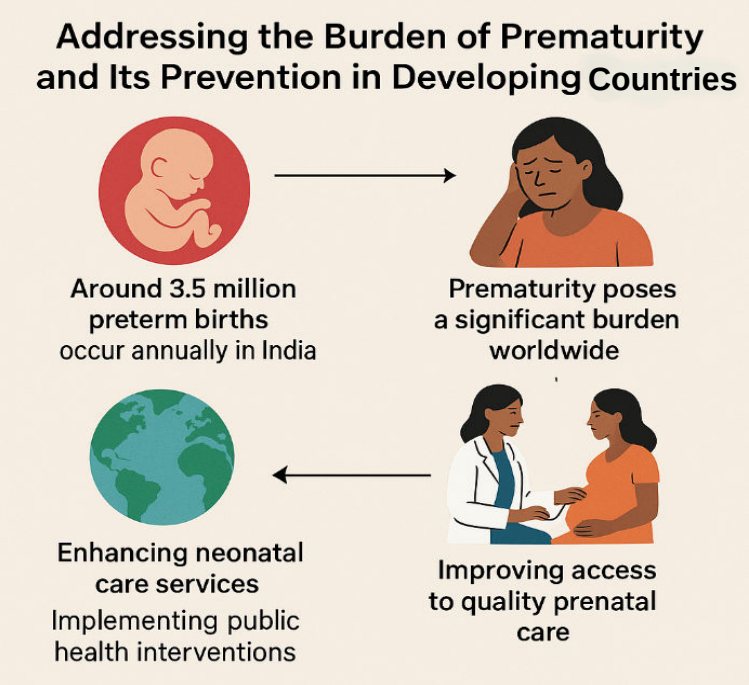

Figure 1. Addressing the burden of prematurity and its prevention in developing countries

This review is based on a comprehensive literature search of original research articles, review papers, and authoritative reports focusing on premature birth, its causes, consequences, and prevention strategies. A combination of relevant keywords, including "antenatal care," "neonatal death," "health programs," "prematurity," "RDS," and "low birth weight," was used to retrieve the literature. The databases searched included PubMed, Scopus, Web of Science, and Google Scholar. Only peer-reviewed articles published in English between 2010 and 2024 were considered to ensure the insights were contemporaneous and evidence-based. Government and international health agency reports (e.g., the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF)) were also included to provide contextual and statistical relevance, especially for India and other low- and middle-income countries. Studies were screened based on their titles and abstracts by two independent reviewers, and then the full texts were reviewed for relevance and quality. Articles not available in full text, not related to the primary focus of the review, or found to be duplicates were excluded. Disagreements in selection were resolved by consensus or, when necessary, consultation with a third reviewer. The selected literature was critically analyzed and compiled to present a structured narrative on the current understanding of premature birth, its burden, associated risk factors, and strategies for reduction through antenatal interventions and public health programs.

Burden of premature birth in developing countries

Preterm birth rates vary widely across countries, with higher rates often seen in developing and low- to middle-income countries. Efforts have been made to address premature birth in developing countries, including improving access to antenatal and prenatal care, promoting maternal health initiatives, enhancing safe deliveries, referring early neonatal care to well-equipped facilities, and implementing public health strategies to lower the rates of preterm births and their associated mortality. In India and many other developing countries, the incidence of premature births is notably higher compared to that of developed nations. A systematic review published in The Lancet in October 2023 revealed that approximately 13.4 million babies were born premature in 2020, as compared to the 13.8 million in 2008, although the rate has decline slightly, it remains largely unchanged. Out of these total preterm births, 55.0% were born in Asia and sub-Saharan African countries. Between 2010

and 2020, around 15% of babies were born prematurely worldwide. In 2019, approximately 900,000 deaths occurred in children less than 5 years of age due to prematurity and its related problems worldwide. Globally, the premature birth rate varied from 4.0% to 16.0% in 2020, and timely interventions could prevent about 75% of these deaths.[3] The neonatal mortality rate in India has come down from 29.5 to 24.9 deaths per 1000 live births, as per the National Family Health Survey (NFHS-5) data. According to the WHO, approximately 15 million premature babies are delivered annually worldwide.[1, 4] Furthermore, around 5%–10% of pregnancies are complicated by preterm labor, which also imposes greater health risks on pregnant women and adds a substantial burden to maternal mortality.[5] Extremely preterm babies are more prone to developing RDS, intraventricular hemorrhage, NEC, septicemia, hypothermia, and hospital-acquired infections, which contribute to a major proportion of early neonatal deaths.[6]

Economic aspects of premature birth

The burden of premature birth in India is a substantial public health challenge. The high prevalence thereof highlights the magnitude of the issue in the country. Preterm birth is the most common cause of neonatal mortality in India, which contributes to the higher mortality rate among preterm infants compared to that of full-term babies. Preterm babies who survive infancy may face additional long-term health challenges such as cerebral palsy, developmental delay, poor cognition, auditory and visual problems, and other chronic health conditions.[7] These long-term effects can put a considerable burden on families, healthcare systems, and society as a whole, requiring ongoing medical care, therapeutic interventions, and supportive services.[8] Preterm babies generally require a longer stay in the neonatal intensive care unit (NICU), which imposes mental stress and financial burdens on the parents. The average cost of NICU care for preterm infants is substantially higher than that for term infants because of the complications and prolonged stays.[9]

The economic burden of premature birth in India is substantial, encompassing medical expenses associated with neonatal intensive care, special education and rehabilitation services for children with developmental disabilities, and lost productivity for families caring for the preterm infants. These costs can exacerbate existing socioeconomic disparities and strain healthcare resources.[8, 9] Preterm birth can also have social implications, including emotional distress for the families, stigma associated with disabilities, and challenges in accessing appropriate care and support services. Furthermore, addressing the social and psychological needs of families affected by premature birth is essential for promoting holistic well-being and inclusion within society. Overall, the burden of premature birth in India is multifaceted, affecting the health and well-being of individuals as well as imposing social burdens and breakdowns for the parents and families.[10] Efforts to address the issue of premature birth require a comprehensive approach that encompasses prenatal care, neonatal health services, community support, and public health interventions aimed at reducing risk factors associated with preterm birth.

Factors contributing to premature birth

Several factors contribute to the high incidence of premature birth, including inadequate prenatal care, maternal malnutrition, infections, lack of access to skilled birth attendants, socioeconomic disparities, and the limited availability of neonatal intensive care units (NICUs) equipped to manage preterm infants. Maternal factors commonly associated with preterm labor include chronic medical conditions, systemic illnesses, underlying cardiac disease, gestational diabetes, eclampsia, placental anomalies, fetoplacental insufficiency, and poor nutritional status.[11] Obstetric factors during pregnancy such as intrauterine infections, antepartum hemorrhage, abruptio placentae, uterine malformations, fetal hypoxia, and abnormal umbilical artery Doppler findings (e.g., absent or reversed end-diastolic flow) also play a significant role and immunological factors such as Rh isoimmunization may increase the risk of preterm birth.[11,12] In addition, the fetal factors responsible for preterm delivery include various genetic defects, syndromes, multiple gestations, complex congenital heart disease, neural tube defects, inborn errors of metabolism, and various structural defects. Maternal and fetal intrauterine nutritional deprivation leading to intrauterine growth retardation is also a confounding factor.[13]

The other important etiological factors responsible for premature birth are smoking, alcohol consumption, and substance abuse during pregnancy, which can impede the fetal blood flow and intrauterine growth of the fetus. The other contributing factors include

various infections, such as vaginal infections, urinary tract infections, chorioamnionitis, and intrauterine infections, as well as systemic bacterial, viral, and sexually transmitted infections. Societal cultures, parental education, parental decision-making, and psychiatric illness during pregnancy may increase the chances of extreme preterm labor.[14] Furthermore, poor access to quality reproductive health services and antenatal check-ups, the non-administration of iron, calcium, and folic acid, and poor compliance with routine antenatal check-ups can increase the chances of premature birth, miscarriage, and subsequent preterm births. Collaboration among healthcare professionals is crucial for comprehensive care and optimal outcomes.

Care for preterm babies in the NICU

The outcome of preterm babies can be improved by giving them early surfactant therapy and gentle ventilation, through proper sepsis management, and by preventing the presence of NEC in the NICU. Providing access to specialized, well-equipped tertiary care centers and proper, timely management of critical conditions, such as NEC and neonatal sepsis, is of utmost importance. Ensuring proper nutrition for preterm infants, including human milk feeding (either from the mother or a donor) and nutritional supplementation, when necessary, is critical for supporting their growth and development. Addressing and treating premature-related problems, such as RDS, NEC, sepsis, hypothermia, hypoglycemia, intraventricular hemorrhage, and bronchopulmonary dysplasia, in a timely manner should be the primary focus to mitigate neonatal death and morbidity.[14]

Addressing respiratory issues earlier requires a well-equipped and trained team approach. For respiratory issues, interventions may include respiratory support, such as Neopuffs, incubators, early surfactant use, nasal continuous positive airway pressure, and gentle ventilation.[15] Furthermore, promoting in-house kangaroo mother care (KMC) has been shown to improve survival rates, regulate body temperature, and facilitate breastfeeding in preterm infants.[16] These babies are more susceptible to lung injury, pulmonary hemorrhage, ventilator-associated pneumonia, and its sequelae, such as bronchopulmonary disease. The aim of addressing respiratory issues earlier is to prevent free radical injury, hypoxia, target saturation, and gentle ventilation, and maintain intact brain functions without disability.[17]

Preventive measures against RDS involve the use of antenatal corticosteroids, a labor room T-piece resuscitator devices, gentle ventilation, selective non-invasive rather than invasive ventilation, and the administration of exogenous surfactant after birth. In the case of retinopathy of prematurity (ROP), close monitoring by an ophthalmologist is essential. Treatment options to prevent blindness range from observation for milder cases to laser therapy or anti-vascular endothelial growth factor injections for more severe cases. Thus, timely screening and intervention are crucial to prevent vision impairment or blindness later in life. There should be a routine screening of eyes for ROP in preterm babies before discharge, as per the WHO guidelines.[18]

While not all preterm births can be prevented, implementing various government policies at different levels can lower the preterm birth rates and improve the neurocognitive and behavioral outcomes of preterm babies without disability. A multi-stimulation module strategy, with comprehensive care and a multidisciplinary team, is required to address various aspects of premature birth, such as respiratory support, nutrition, infection prevention, and neurodevelopmental monitoring.[19] Prevention of mortality often includes strategies such as the early and timely detection of complications and the management thereof, following the neonatal resuscitation program protocol for preterm babies, delayed cord clamping, skin-to-skin contact, and access to advanced medical interventions. To prevent cerebral palsy and neurodevelopmental delay, the early identification of risk factors, timely interventions, such as occupational and physiotherapy, and long-term follow-up are crucial. Moreover, nutritional support for the mother and enrolling families in various government health programs can help reduce the rate of premature birth. In addition, ensuring a supportive environment for the baby and family can aid in optimizing the outcomes.

Prevention of premature birth

Preventing premature birth in India requires a comprehensive approach that primarily focuses on improving antenatal care. Various strategies, such as encouraging pregnant women to seek antenatal care early and attend regular check-ups, can help detect and manage the risk factors for preterm birth. Routine antenatal fetal monitoring, growth assessment, Doppler studies, and screening help identify high-risk

pregnancies earlier. Furthermore, providing access to balanced nutrition and supplements, particularly for women from economically disadvantaged backgrounds, can reduce the risk of preterm birth. Treating and focusing on maternal health issues such as diabetes, hypertension, proper nutrition, obstetrical condition management, and proper antenatal follow-ups can prevent complications that may lead to preterm birth.[20] Moreover, awareness, education, and counseling are the most important components of the preventive strategy for prematurity. Offering educational programs and counseling sessions to all eligible couples, addressing antenatal care, providing routine check-ups, proper follow-ups, complicated pregnancy, healthy lifestyle choices, and the early recognition of warning signs of preterm labor can facilitate timely, correct, and informed decisions. Implementing initiatives to reduce smoking, substance abuse, and alcohol consumption during pregnancy can lower the risk of preterm birth associated with these risk factors. Screening for intrauterine infections, hepatitis, human immunodeficiency virus, and sexually transmitted diseases can also help reduce the risk of complications and lower the incidence of preterm birth.[20] Providing support services and stress management interventions for pregnant women and family members may potentially reduce the risk of preterm birth. Counseling should be provided by auxiliary nurse midwives, Anganwadi workers, primary care physicians, and obstetricians. Iron, folic acid, and calcium supplementation must be emphasized to correct anemia and provide nutritional rehabilitation to prevent early and recurrent miscarriages. Ensuring access to quality reproductive health services, including family planning, contraception, and safe abortion services, can help prevent unintended pregnancies and subsequent preterm births.[21]

Ensuring universal access to quality antenatal care, the early identification of high-risk pregnancies, and proper follow-up can lower the mortality rate associated with preterm birth. Our focus and target should be to ensure early pregnancy registration, early risk identification, immediate screening for infections and chronic conditions, and nutritional support for pregnant women. Implementing these quality improvement initiatives in healthcare facilities, including standardized protocols for prenatal care, labor and delivery management, and neonatal care, can improve the outcomes for mothers and babies.[22]

Preventing cerebral palsy in preterm babies

Overall, preterm babies require individualized care addressing their specific medical needs, which include nutritional support, infection prevention, temperature regulation, and developmental monitoring, in addition to addressing respiratory and ophthalmic issues such as ROP.[23] The maximum cognitive and neurological development of a baby primarily occurs in the third trimester; however, because of premature birth, most of these preterm babies spend this time in a NICU environment. Brain injury during this critical period increases the risk of cerebral palsy in later life. Various studies have shown that premature birth itself can lead to nutritional deprivation and poor skeletal and brain growth, resulting in developmental delay and quadriplegic cerebral palsy in later years.[24] Furthermore, any insult to the developing brain, such as intraventricular hemorrhage, meningitis, jaundice, or periventricular leukomalacia, increases the chances of preterm babies developing cerebral palsy because of their immature brains and vascular fragility.[25]

Furthermore, the NICU environment, care of babies, treatment of acute illnesses, and preterm bundle care are a few of the components that can prevent insult to the developing brain, thereby resulting in a lower incidence of cerebral palsy in later life. Preventing cerebral palsy in preterm babies involves a multifaceted approach and by comprehensively addressing these factors, healthcare providers can work toward reducing the risk of cerebral palsy in preterm babies and promoting improved long-term outcomes.[26]

Key strategies include proper comprehensive prenatal care to address problems such as identification of high-risk pregnancies; treatment for anemia; controlling maternal infections, gestational diabetes, eclampsia, and multiple gestations; and preventing intrauterine growth retardation. Antenatal corticosteroids can accelerate the maturation of fetal lungs, thereby reducing the chances of developing RDS and reducing the risk of perinatal mortality and cerebral palsy. Ensuring high-quality neonatal care with a focus on preventing brain injury, minimizing complications, such as intraventricular hemorrhage, and optimizing their overall health and development.[26, 27]

In addition, the implementation of KMC is beneficial for improving neurodevelopmental outcomes, early attainment of feeding, a shorter duration of hospital stays, and decreasing the incidence of cerebral palsy in preterm infants.[16] Furthermore,

the prompt identification and management of neurodevelopmental issues, including early referral to developmental specialists, physical therapists, and occupational therapists, can help mitigate the impact of risk factors on neurological development. Moreover, providing appropriate nutrition, including breast milk or fortified formulas, supports optimal growth and brain development. In addition, curtailing abnormal postures and providing proper neurodevelopmental follow-up helps the early identification of developmental delays. The main strategies that address developmental delays and prevent disabilities in preterm infants include providing developmental support care, promoting a healing environment in the NICU, early intervention programs, proper pain management, good sleep patterns, and family-centered nutritional care.[28] Regular monitoring of developmental milestones and ongoing follow-up with healthcare providers may identify any emerging concerns or delays in development. Promoting family-targeted approaches that involve parents in decision-making, encouraging bonding and attachment, and providing emotional support can improve the outcomes for preterm infants and their families.[29] By implementing these strategies and investing in improving antenatal care services, India can make significant strides in decreasing premature birth rates and improving maternal health and child well-being.[27, 29] Addressing the issue of premature birth in India and other developing countries requires a multifaceted target approach, such as improving universal accessibility and affordability of quality prenatal care, promoting maternal health and nutrition, strengthening healthcare infrastructure, enhancing neonatal care services, and implementing public health interventions that can improve the outcomes of preterm births.

Steps taken by various government agencies and their role in overcoming premature birth

Government agencies, the WHO, and UNICEF play critical roles in preventing premature deliveries through various initiatives and interventions. There are some key areas where interventions can make a considerable impact on lowering birth and death rates among preterm babies. Proper policy development and implementation are pivotal for the successful lowering of mortality among preterm babies. Government agencies, such as the WHO and UNICEF, collaborate to provide education and training for healthcare professionals on the best practices for preventing premature births, identifying risk factors, and managing preterm labor and delivery.[30] Furthermore, government agencies formulate and implement policies and guidelines aimed at improving maternal and child health, which include strategies for reducing the incidence of premature births. These policies often include recommendations for prenatal care, maternal nutrition, and universal access to healthcare services in rural and small towns. Governments, with support from the WHO and UNICEF, invest in strengthening healthcare infrastructure, including maternal and neonatal healthcare facilities, to ensure that preterm infants have a smooth course in the NICU. Novel research in various fields has been promoted worldwide by various agencies, such as the Indian Council of Medical Research and the WHO, to address the issues and barriers to the implementation of these policies. Various interventions have been undertaken to lower the mortality rate among newborn babies.[4, 31]

In addition, community outreach and awareness programs are run by government agencies, the WHO, and UNICEF to promote better healthy lifestyle choices and recognize the early signs and management of preterm labor. Strengthening ground-level research and rural data collection by the WHO and UNICEF regarding the underlying causes of preterm birth would help in identifying high-risk populations and evaluating the effectiveness of interventions aimed at preventing premature deliveries. The government agencies, the WHO, and UNICEF advocate for increased funding and resources to address maternal and child health issues, including the prevention of premature birth. They also work to mobilize political support and partnerships to prioritize preterm birth prevention within the national and global health agendas **(Figure 2, Table 1).**

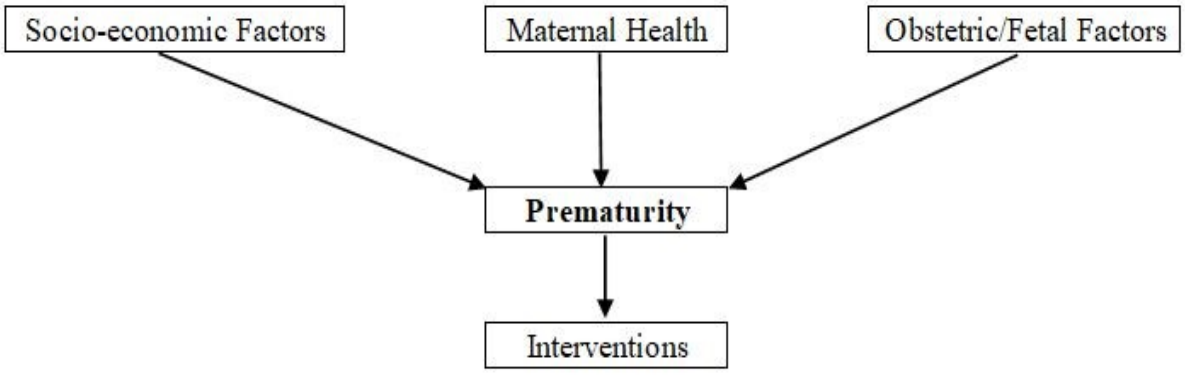

Figure 2. Pathway leading to prematurity and point of intervention

Table 1. Interventions to reduce prematurity and their impact.

Level of care	Key interventions	Impact
Preconception and antenatal	Nutritional supplementation (iron, folic acid, calcium), infection screening, antenatal corticosteroids, family planning.	Reduces maternal complications, improves fetal maturity.
Intrapartum	Skilled birth attendants, safe delivery practices, delayed cord clamping.	Reduces perinatal mortality, improves transition to neonatal life.
Immediate newborn care	KMC, early surfactant therapy, gentle ventilation, neonatal resuscitation program.	Improves survival, reduces hypothermia and RDS.
NICU/advanced care	CPAP, exogenous surfactant, sepsis management, human milk feeding, ROP screening.	Reduces neonatal mortality and long- term disability.
Community and policy	Public health awareness, government programs (ICMR, UNICEF, WHO support), maternal health schemes.	Strengthens health systems, reduces disparities.

CPAP, continuous positive airway pressure; ICMR, Indian council of medical research; KMC, kangaroo mother care; NICU, neonatal intensive care unit; RDS, respiratory distress syndrome; ROP, retinopathy of prematurity; UNICEF, United Nations Children's Fund, WHO, World Health Organisation.

Conclusion

Premature birth is a serious threat worldwide and a burden on society, families, and the health care system. There is an urgent need to enhance, implement, and closely monitor maternal and child health programs led by government and international agencies in developing countries. By navigating and implementing comprehensive care at various levels, such as primary health centers, rural hospitals, and medical colleges, we can work together toward a healthy future and improved child survival.

By collaborating with government agencies and international organizations such as the WHO and UNICEF, developing countries can implement comprehensive strategies to prevent premature deliveries, improve maternal and child health outcomes, and reduce the burden of preterm births on families, society, and healthcare systems.

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Not applicable

Conflicts of interest statement
The authors declared no conflicts of interest.

Data sharing statement
The present review is based on the references cited. All data generated or analyzed during the present study are included in this published article and the citations herein. Further details, opinions, and interpretation are available from the corresponding author on reasonable request.

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