Chapter

# Low Birth Weight and Adverse Perinatal Outcomes

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## Abstract

Globally, annually an estimated 15–20% of all births are low birth weight (LBW). Low birth weights are at a greater risk of neonatal and postneonatal mortality and morbidities. Therefore, this chapter is aimed to highlight the prevalence of low birth weight, predictors and adverse perinatal outcomes, and the respective possible prevention modalities. Sociodemographic, obstetric (previous abortion, hypertensive disorder, antenatal visits, and prematurity), and nutritional factors increased the risk of low birth weight. Low birth weight neonates were associated with adverse perinatal and childhood outcomes: low Apgar score, neonatal death, malnutrition, academic, and mental disorders. Improving the care of women who have previous or recent morbidities, hypertensive disorders of pregnancy, and prematurity should be priorities aimed at reducing low birth weight and its adverse perinatal outcomes. Incorporating mental health in the prenatal visit, improving the care for a high-risk pregnant woman, and community-based kangaroo mother care practice were also recommended.

**Keywords:** low birth weight, prematurity, adverse perinatal outcome

## 1. Introduction

Low birth weight (LBW) is defined as a weight of <2500 g (5.5 lb) at birth. Low birth weight includes both appropriately grown preterm neonates (<37 completed weeks of gestation) and term and preterm growth-restricted neonates (less than the 10th centile of weight for gestational age). It is an important marker of maternal and fetal health, predicting mortality, stunting, and adult-onset chronic conditions [1]. Globally an estimated 15–20% of all births are low birth weight, representing more than 20 million births a year [1, 2]. In 2015, an estimated 20.5 million live births were LBW, 91% from low-and-middle-income countries, 48% in Southern Asia, and 24% at sub-Saharan Africa [3].

Low birth weight is associated with short- and long-term complications such as prematurity and its associated morbidities; 1.1 million babies die from complications of prematurity accompanied with LBW. Neonates with LBW have a higher risk of mortality than neonates with normal birth weight [4, 5]. Those who survive tend to remain that predispose newborns to many health disorders: hypoglycemia [6–8], hypothermia [9, 10], neurodevelopmental problems (mental retardation) [11], malnutrition, and have impaired immune function. Low birth weight neonates are not only at high risk of death but also are at increased risk of long-term neurologic disability, impaired language development, reduced cognitive abilities,

and greater risk of medical disorders including cardiovascular disease and diabetes [1, 12, 13]. Moreover, immaturity of multiple organs resulted in respiratory distress, interventricular hemorrhage, sepsis, blindness, and gastrointestinal disorders [14]. Medical conditions, medications prescribed, and mortality rate were significantly higher among preterm and underweight neonates admitted to NICU [15].

Maternal dietary diversity practice was associated with the risk of LBW. Low birth weight was also associated with multiple gestations, previous abortion, socioeconomic status, infections, maternal lifestyle, and complications during pregnancy: hypertensive disorders, fetal infection, and placental pathologic conditions [2, 16, 17]. Different stakeholders are working against reducing low birth weight by 30% by the year 2025 [18]. Despite those activities, low birth weight is increasing in Ethiopia based on 11% in 2011 to 13% in 2016 [10–12] and developing countries. Concerning perinatal outcomes, there is a paucity of study across the globe. Therefore, this chapter aimed to highlight the prevalence, predictors, and adverse perinatal outcomes of low birth weight newborns as well as the possible preventive modalities.

## 2. Epidemiology of low birth weight

Globally an estimated 15–20% of all births are low birth weight, representing more than 20 million births a year [1]. LBW was lowered in developed countries [19]. The prevalence of LBW varies in in the world, which was higher in African countries [20, 21] and which was 15.9% in 10 developing countries based on the demographic and health surveillance data [20]: 13.45 in Burkina Faso, 10.2% Ghana, 12.15 in Malawi, 15.7% in Senegal, and 10% in Uganda, respectively [22]. The incidence of LBW in Ethiopia hospital was 16.6% in Hawassa and 17% in Ethiopia based on the recent meta-analysis [23]. The findings of Zambia [24] and Tanzania [25] showed 10.6% of prevalence of LBW. The highest prevalence that occurred in developing countries might be due to the high prevalence of home delivery, preterm delivery, and hypertension during pregnancy, antepartum hemorrhage, and study area difference, which increased the referral of complicated cases and increased risk of LBW. Studies revealed that the prevalence of LBW varies across the countries: 7.3% in Nigeria [26], 40.0% in India, and 5–12% in Iran [27].

## 3. Predictors of low birth weight

The most common diagnoses associated with indicated low birth weight and preterm birth are hypertensive disorders, hemorrhage, and acute or chronic fetal compromise (fetal distress or intrauterine growth restriction). A recent study in Hawassa University Comprehensive Specialized Hospital, Southern Ethiopia, showed that previous abortion, hypertensive disorder of pregnancy, frequency of ANC visit, and gestational age at birth were the commonest predictors of LBW [28]. Sociodemographic (**Figure 1**),

### 3.1 Sociodemographic factors

Maternal age was a significant predictor of LBW. A study in developing countries [20], maternal age of 35–49 years old increased the odds of LBW. In addition, maternal age <20 years [23, 26, 29], absence of social support [27, 30] and rural

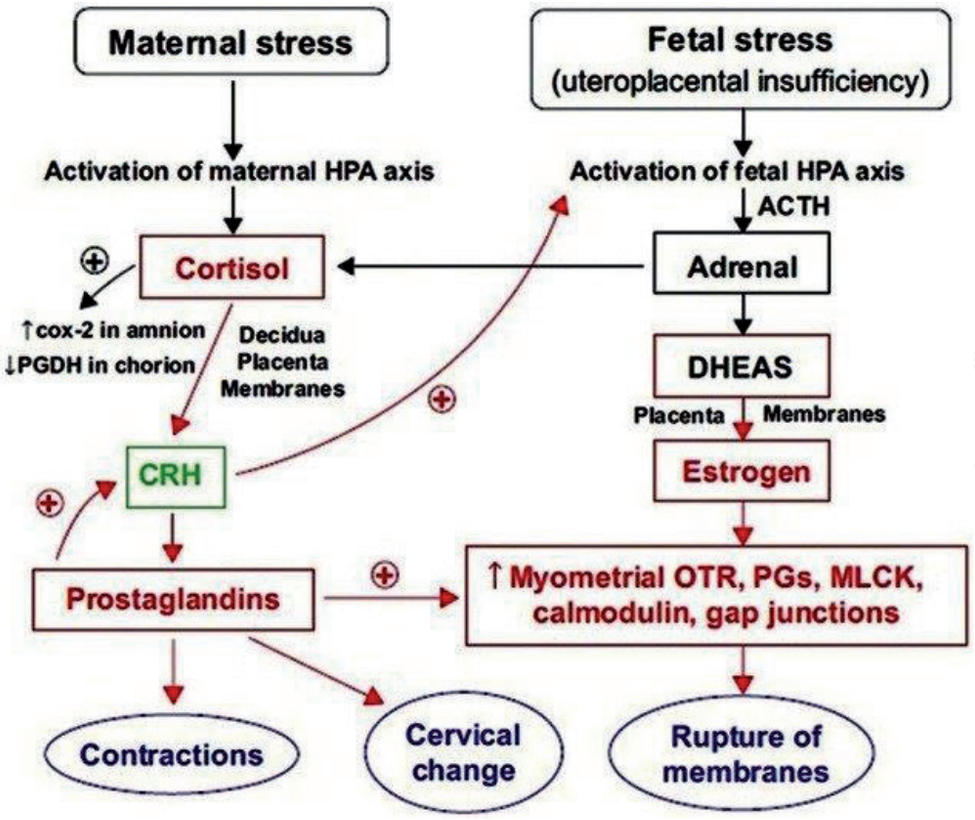


**Figure 1.**
*Pathophysiology of preterm birth and low birth weight due to stress.*

residence [31, 32], and absence of formal education [20, 27, 33, 34] were another factor associated with LBW.

### 3.2 Obstetrical factors

Prematurity was the single most predictive of LBW in the world. It is evidenced by different studies [26, 29, 34–37], and gestational age below 37 weeks significantly increased the risk of LWB. Those women who deliver before 37 completed weeks are more at risk to give low-weight births. This is in accordance with different studies [36], and a systematic review and meta-analysis done in Ethiopia [23] reported that preterm birth was significantly associated with the increased odds of LBW. When the neonates were delivered before reaching the recommended due date of delivery or 37–42 weeks, they are likely to be small and to have decreased skeletal muscle mass and subcutaneous fat tissue. Moreover, hypertension, preeclampsia and eclampsia [29, 35], lack of antenatal care follow-up [20, 27, 30, 36, 38–41], pregnancy interval <24 months [23, 39], depression during pregnancy [42], and maternal near miss [37, 43–45] were also other common predictors of LBW. A recent study done in Ethiopia also found that mothers who have a previous abortion, frequency of ANC visit, gestational age at birth, and hypertensive disorders of pregnancy were significant predictors of low weight at birth.

Moreover, hypertensive disorder of pregnancy, a leading cause of maternal near miss and perinatal mortality, has a significant effect on the increasing trend of LBW in Africa. There was a higher risk of delivering a low-weight infant among mothers with hypertension during pregnancy as compared with their counterparts [28]. The association is increased if the delivery occurs before reaching

37 weeks of gestation [46]. Other studies have similar findings [36]. This can be due the reason that hypertension results in uteroplacental insufficiency. Similarly, the studies also reported that mothers who had fewer ANV visit than the WHO recommendations (<4 ANC visit) were more likely to give a low-weight newborn than those who adhered to the recommended ANC visits, who have more than four times [28]. This is also supported by other evidences [36, 40, 47]. This is similar with studies done by Gizaw et al. [27], Mahmud et al. [20], Outlay et al. [40], and Kamala et al. [48].

In addition, findings also showed that those women who have at least one previous abortion were at greatest risk of giving LBW neonates as evidenced by a study done in Ethiopia [28], Denmark, and the USA [49, 50] and a meta-analysis in Canada [17]. The report also in-line with the study by Bossley [51] showed that women who had an abortion in the first or second trimester had a 35% increased risk of a LBW baby and a 36% raised risk of a preterm baby in later pregnancies and Ethiopia [52] found that previous adverse pregnancy outcomes were associated with recent outcome. This can be explained by physical damage to the cervix caused by types of abortion, reduced tensile strength of the cervical plug, preterm birth subsequently causing LBW, and stress/depression for the previous occurrence of the event. Thus, stress-depression is significantly associated with previous abortion [53, 54] and lowers dietary diversity of women, reduces fetal nutrients vital for development, and leads to an increased risk of LBW. In addition, untreated antenatal depression was also another significant predictor of; a meta-analysis revealed that women who have antenatal depression [55] and maternal anemia [56, 57] were more likely to have LBW.

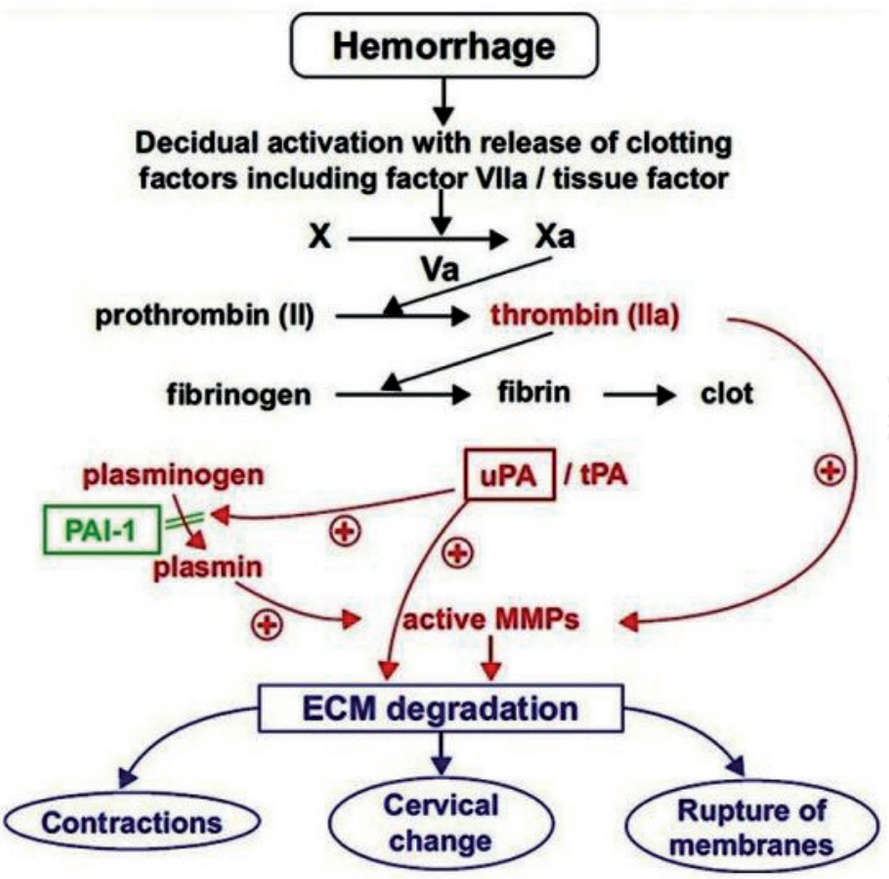


**Figure 2.**
*Association of hemorrhage and preterm labor/LBW.*

### 3.3 Nutritional factors

A study in Tanzania showed that pregnant women with malnutrition were another factor that increased the risk of LBW [35]. Studies done in developing countries [20, 39], meta-analysis done in Ethiopia [22, 23], and another study [29, 31] showed that BMI <18.5 kg/m increased the odd of LBW. Another study done in Ethiopia also showed that lacking nutrition counseling during pregnancy, lacking iron/folic acid supplementation during pregnancy [34, 36, 58–60], not taking snacks during pregnancy, maternal undernutrition, maternal anemia, and inadequate minimum dietary diversity score of women were independently associated with LBW.

An evidence-based medicine showed that the benefits of iron supplements in improving birth weight illustrate the need for increased efforts to improving coverage of antenatal programs and promoting food fortification. Underlying social factors, such as poverty and women's status, are also important, especially in South Asia [61]. Strategies that combine nutrition-based interventions, such as improving food intakes and micronutrient status, especially iron status, with approaches that improve women's status and reproductive health are needed to reduce LBW (**Figure 2**).

## 4. Adverse perinatal outcomes of low birth weight

Important birth outcomes related to LBW include both fetal and neonatal death, postneonatal death, short-term morbidities such as respiratory distress syndrome and necrotizing enter colitis, and long-term morbidities such as blindness, deafness, hydrocephaly, mental retardation, and cerebral palsy.

A recent study revealed that 68% of the LBW neonates and 48% of the NBW neonates had adverse perinatal outcomes [28]. LBW newborns significantly increased the greater risk of low Apgar score (42%), early neonatal death (19.3%) and NICU admission (22.6%) [28], and increased chronic kidney disease (CKD) [62]. Similarly, LBW newborns are associated with an increased risk of a low Apgar score and early neonatal death as evidenced with a study in Brazil [63] and Tanzania [25]; Bangladesh [63] showed that the probability of early neonatal mortality was increased among LBW newborns. The possible reason for this can be explained due to that low weight increases the risk of intrauterine growth restriction and early neonatal death. It is also explained due to the high burden of preterm birth and its complications. Hence, several organ systems of the human fetus usually immature before the end of 37 weeks of gestational age lead to difficult to maintain extrauterine environment.

Accordingly, LBW infants experienced a higher fold of mortality rate and hospitalization than appropriate birth weight infants in the postneonatal period. LBW infants also experienced 33% more days with diarrhea and 32% more days with vomiting [64]. Moreover, studies revealed that LBW affects adulthood social relationships and lower educational qualifications, decreased rate of employment, and increased rate of receipt of social benefits in adulthood [65, 66], disability [67], and common chronic health conditions [68]. A systematic review and meta-analysis supported that adults born with LBW were less likely to have ever experienced a romantic partnership, to have had sexual intercourse to have become parents (OR) [66]. This might be due to the lack of sexual or partner relationships that might increase the risk of decreased well-being and poorer physical and mental health and subsequent psychiatric disorders. Thus, children born with LBW had an increased risk of neurocognitive impairment [69].

## 5. Prevention of low birth weight and associated adverse outcomes

### 5.1 Prevention of preterm birth or prematurity

Prematurity is the single leading cause of neonatal mortality, resulting from 35% of the world's deaths annually (3.1 million) and risk of lifelong impairment among survivor [70, 71], and cause of child death in all high- and middle-income countries [71] when accompanied with LBW. For this, prevention of preterm birth is the major area of intervention. As a result, the March of Dimes plans to reduce prematurity to 8.1% in 2020 and 5.5% in 2030 in the USA [72]. To achieve this goal, the following roadmap interventions in the area and in the globe should be followed in appropriate manner:

- Elimination of nonmedically indicated early elective deliveries
- Access to progesterone shots for women with a previous preterm birth
- Smoking cessation
- Birth spacing and expanding group prenatal care
- Low-dose aspirin to prevent preeclampsia
- Vaginal progesterone and cerclage for short cervix
- Reduce multiple births conceived through assisted reproductive technology

#### *5.1.1 Elimination of nonmedically indicated elective deliveries*

Inductions and cesarean sections (CS) scheduled before 39 weeks gestation without medical reason increase the risk of early-term and late-preterm birth and their health consequences [72]. The rate of cesarean section is increasing globally.

#### *5.1.2 Use of progesterone to prevent recurrent preterm birth*

The weekly progesterone injections for at-risk women starting at 16–21 weeks gestation is a proven recommendation to reduce very early as well as later preterm birth effectively in women with a prior preterm birth [72]. Different clinical trials supported that early initiation of intramuscular 17-alpha hydroxyprogesterone caproate is recommended to prevent preterm birth [73]. Women starting with early initiation (at a mean $17^{6/7}$ ± 2.5 weeks) of 17-alpha hydroxyprogesterone caproate trended toward lower rates of preterm birth <37 weeks than those with late-start 17-alpha hydroxyprogesterone caproate (17P), which reduce a woman's risk of recurrent preterm birth by 33% [74]. Later initiation of 17-alpha hydroxyprogesterone caproate was significantly associated with increased odds of preterm birth <37 weeks. In addition to this, women with early 17-alpha hydroxyprogesterone caproate initiation also had lower rates of major neonatal morbidity than those with later 17-alpha hydroxyprogesterone caproate initiation [73]. The effectiveness of 17-hydroxyprogesterone caproate is reduced as the gestational age increased; nonresponders increased as evidenced by a study done by Manuck and his collaborator's [75]. Consideration of the factors that increased nonresponse for the hormone should be considered during initiation, mainly placental abruption or significant

vaginal bleeding, gonorrhea and/or chlamydia in the current pregnancy carriage of a male fetus. For thus, a clinical prediction score is needed before prescribing the hormone [75].

A meta-analysis of clinical trial showed that regarding the safety or efficacy of vaginal progesterone versus injections, daily vaginal progesterone (either 100–200 mg suppository daily or 90 mg gel daily) started at about 16 weeks' gestation is reasonable, if not weekly 17-OHPC injection for prevention of SPTB in women with singleton gestations and prior SPTB despite low level of quality [76]. The rate of women who reported recurrence of preterm birth adverse drug reactions and rate of neonatal intensive care unit admission was significantly lower in the vaginal progesterone group than the 17-OHPC neonatal outcomes. In addition, cervical Pessary is another prevention of spontaneous preterm birth in women with singleton pregnancies and short cervical length based on a recent clinical trial [77].

*5.1.3 Low-dose aspirin and birth spacing*

Preeclampsia can only be cured by delivering the infant, regardless of the gestational age in case of severe preeclampsia and eclampsia. The US Preventive Services Task Force and Prematurity Campaign recommends that all at-risk women should take a daily low-dose aspirin [72]. The initiation of daily low-dose (60–80 mg) aspirin beginning in the late first trimester for women with a medical history of early-onset preeclampsia and preterm delivery at <34.0/7 weeks of gestation or preeclampsia in more than one prior pregnancy was recommended by the American College of Obstetrics and Gynecology. In addition, appropriate inter-birth interval according to the WHO recommendations at least 24 months is better to reduce preterm birth. A meta-analysis [78] supported that short birth interval was associated with preterm birth.

### 5.2 Improving kangaroo mother care (KMC) utilization

Kangaroo mother care (KMC) is the placement of the newborn baby into skin-to-skin contact with the mother's chest and abdomen coupled with frequent and preferably exclusive breastfeeding. Thus, the premature baby or LBW newborn is kept warm in the maternal pouch and close to the breasts for unlimited feeding. KMC has emerged as a nonconventional low-cost method for newborn care that provides warmth and touch and confers significant survival benefit. An updated Cochrane review has reported that KMC benefits breastfeeding outcomes and cardiorespiratory stability in infants without negative effects [79]. Thus, findings of the clinical trial done in India support that wider implementation of KMC has a significant improvement in vital physiological parameters of LBW newborn; individual abnormalities (hypothermia, bradycardia, tachycardia, and low $SpO_2$) were corrected during the KMC sessions [80] and 51% reduction of early neonatal mortality and series morbidities associated with preterm birth based on the meta-analysis findings [81]. The utilization of KMC service is lower in LMICs among preterm newborn; only 14% of LBW newborn and <25% of preterm babies receive KMC in Ethiopia. For this, to improve the service provision of training of health-care facilities, community-based education on KMC should be focused, and community-based KMC should be improved [82]. Hence, provision of training of hospital-provided KMC services increases to 36% of preterm babies in Ethiopia [83]. In addition, a KMC indicator has been included in the HMIS. It is expected that there will be a national-level data about the preterm babies who are initiated in KMC [84].

Kangaroo mother care adapted from a meta-analysis done in LMICs (put on cover page) [81].

## 6. Conclusions

Sociodemographic, obstetrical factors (previous abortion, hypertensive disorder, antenatal visits and prematurity), and nutritional factors increased the risk of low birth weight. Low birth weight neonates were associated with adverse perinatal and childhood outcome: low Apgar score, neonatal death, malnutrition, academic, and mental disorders. Improving the care of women who have previous or recent morbidities, hypertensive disorders of pregnancy, and prematurity should be priorities aimed at reducing low birth weight and its adverse perinatal outcomes. Incorporating mental health in the prenatal visit, improving the care for a high-risk pregnant woman, and community-based kangaroo mother care practice were also recommended.

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## Abbreviations

| | |
|---|---|
| ANC | ante natal care |
| ARR | adjusted relative risk |
| LBW | low birth weight |
| NBW | normal birth weight |
| WHO | World Health Organization |

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