

*Review Article***Low Birth Weight – Causes, Consequences and Interventions to Achieve Reduction**

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About a third of Indian neonates weigh less than 2.5 kg at birth. There has not been any substantial decline in the incidence of low birth weight (LBW) over the last four decades. Majority of Indian LBW infants are mature, being born after 37 weeks of gestation. Pre-term birth rates in India are about 12-14%.

LBW rates are higher among lower income groups, among infants born to short statured parents, in primi-para and those with four or more children. LBW associated with these factors cannot be reduced rapidly. LBW rates are higher in women with anaemia, systemic disorders prior to pregnancy, pregnancy induced hypertension with or without gestational diabetes. It is estimated that early detection and effective treatment of these health problems through improvement in coverage, content and quality of antenatal care can bring about 5% reduction in low birth weight.

Inadequate dietary intake and high physical activity resulting in low pre-pregnancy weight and poor weight gain during pregnancy are associated with LBW. Identification of under-nourished women and providing food supplements to them can bring about reduction in low birth weight rate in this 'at risk' group, but food supplements to all pregnant women do not bring about substantial increase in the birth weight or reduction in the low birth weight.

Given this scenario, the country will not be able to achieve the WHA/SDG target of 30% reduction in low birth weight by the year 2025. Despite high low birth weight rates, infant mortality rates in India are not very high, because the mature Indian LBW infants survive when they are provided with essential newborn care. Therefore, India will be able to achieve the IMR targets for 2030, even though LBW targets are not met.

Keywords: Low Birth-Weight; Infant Mortality; Maternal Under-Nutrition; Anaemia, Pregnancy Induced Hypertension

Introduction

Globally, low birth-weight (LBW) is defined as birth-weight less than 2500 g. This cut-off was based on the global findings that infants with birth-weight below 2500 g have several fold higher morbidity and mortality as compared to those born with birth weight of 2500 g or above. At birth, infants weigh less than 2.5 kg if they were born before 37 weeks, or if the foetus *in utero* grew at a lower pace than normal or infant was born prior to 37 weeks and also grew slowly *in utero*. The morbidity and mortality rates are highest in the pre-term and growth retarded group; pre-term

births have higher morbidity and mortality rates than mature small for gestational age infants. Both preterm and growth retarded infants require intensive care.

India (and South Asia) have the highest LBW rates (Figs. 1, 2, 3 and 4) in the world (WHO 2004). The high LBW rate is not related to household food insecurity (SOFI 2013) or severe maternal under-nutrition. Data from India has shown that the majority of Indian LBW are mature and survive, if they are given essential newborn care (Ghosh 1968). Studies taken up in sixties (Ghosh 1968) had shown that only those who were pre-term or had birth-weight less

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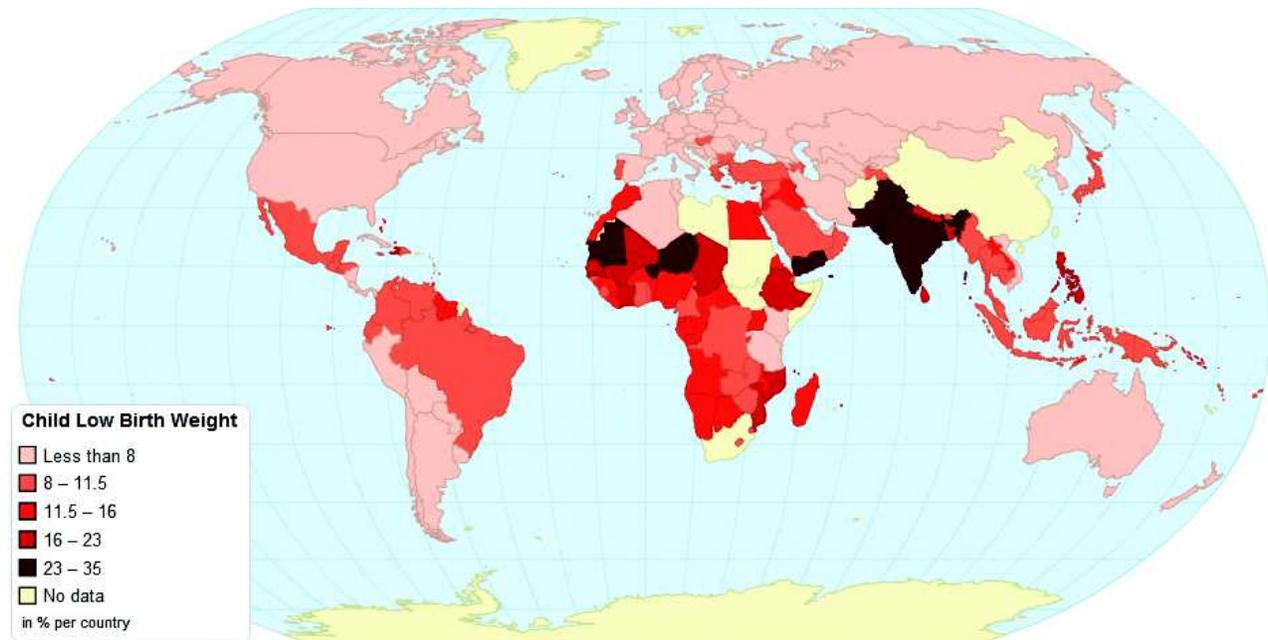


Fig. 1: Global prevalence of low birth weight (UNICEF 2004)

than 2 kg required intensive care; these findings were confirmed by other studies in the seventies. Indian clinicians had been following these norms for admission into intensive care nurseries. India also identified LBW rates according to WHO norms (<2.5 kg) so that international comparisons can be made. Available data from surveys (NNF 2003) and smaller in-depth studies have shown that there has not been any substantial reduction in LBW rates (NFI 2008) over the last three decades. However, during the last four decades there has been substantial reduction in infant mortality (IMR) rates because mature small-for-dates infants survive with essential new born care. Birth weight is a major determinant of growth during childhood and adolescence; mature LBW infants follow a lower growth trajectory as compared to normal infants (Ghosh 1971). LBW is one of the factors responsible for the reported high prevalence of stunting and under weight in Indian children.

Socio-demographic, nutritional, obstetric and systemic problem in pregnant women have been shown to be associated with higher risk of LBW and interventions have been initiated for each of these three broad sectors. There are ongoing programmes addressing socio-demographic factors such as poverty, and food insecurity; there has been some improvement over time in these sectors. Integrated Child

Development Services provides take home food supplements to pregnant mothers to bridge the gap between energy requirement and energy intake. Screening all women for systemic, nutritional (under-nutrition, anaemia) and obstetric factors associated with low birth-weight and, monitoring growth of the foetus in utero have been accepted as essential components of antenatal care. However, there are large differences between states in the coverage under ICDS food supplements and antenatal care. The coverage, content and quality of health and nutrition interventions have been sub-optimal in the states where these interventions are urgently needed. Reported prevalence of LBW is lower in better performing states (in ICDS and health sector) but in the last three decades, there has not been any substantial reduction in low birth weight rates at national level (NNF 2003). This manuscript reviews the global and Indian data on LBW, factors associated higher incidence of LBW, nutrition and health consequences of LBW, ongoing interventions to reduce LBW and explore whether it will be possible to achieve the WHA/SDG target of 30% reduction in low birth weight by 2025.

Incidence of Low Birth Weight

One of the major problems in estimating LBW rate is

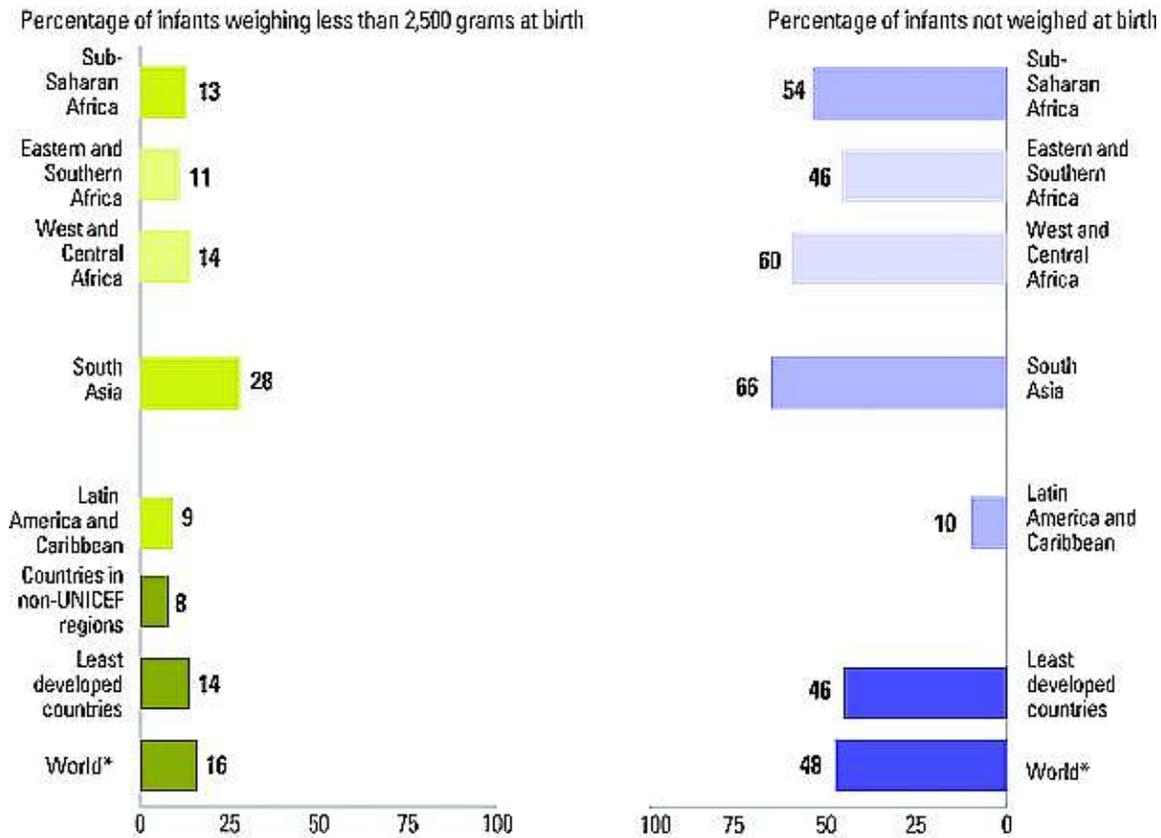


Fig. 2: Global % of children weighed and estimated LBW rate (UNICEF 2004)

the fact that in developing countries, where most of the LBW infants are born, majority of infants are born at home and are not weighed at birth (Fig. 2). Estimated incidence of LBW is around 12% in Africa (50% are not weighed at birth) and 28% in South Asia (66% of infants not weighed at birth). Globally 21 million infants are born with low birth weight (16% of all births). South Asia has the highest LBW rates. South Asia accounts for nearly one fourth global population but nearly one half (11 million) of the 21 million global low birth weight infants are born in South Asia (Fig. 1) (WHO 2004).

Indian Scenario

In India, majority of births especially in rural and tribal areas in poorly performing states take place at home. Therefore, data on birth weight in different states and districts is not available. However, over the last five decades ICMR and other agencies have supported a large number of research studies, both hospital and community based, on low birth weight in India. Based on these studies, it has been estimated that about a

third of Indian infants are LBW neonates. Studies carried out by the National Neonatology Forum (NNF 2003) have shown that 31.3% were LBW infants; 84.5% of live births were full-term, 14.5% were pre-terms and 1.0% were post-term infants. Small for gestational age infants formed 9.65% of all live births, large for gestational age 4.92%, while 85.4% of infants were appropriate for gestational age.

There has not been much change in the incidence of LBW (one third of the neonates weight below 2.5kg) between 1960s in Safdarjung hospital Delhi (Ghosh 1968, NFI 2008) and in the study on LBW conducted by National Neonatology forum 1995 to 2002 (Figs 5 and 6). National Family Health Survey 1-4 recorded information on birth-weight but this was for less than 1/4th of the mothers as only those who delivered in the hospital can report birth-weight. Reported rates of LBW were 25.2, 22.9 and 20.9% in National Family Health Survey (NFHS) 1, NFHS 2 and NFHS 3. Majority of those who provided data on birth-weight belonged to urban, higher income group living in better performing states. Therefore,

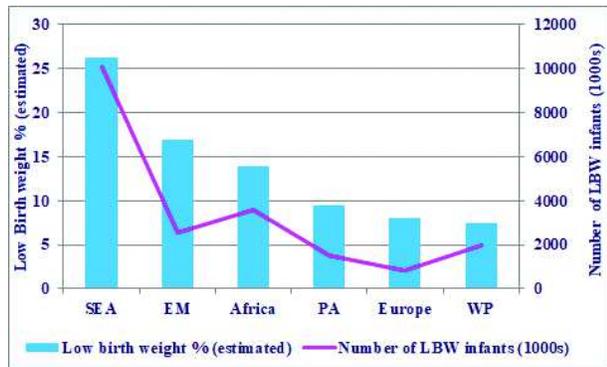


Fig. 3: Prevalence of LBW in WHO regions (UNICEF 2004). SEA South East Asia, EM Eastern Mediterranean, PA Pan American, WP Western Pacific

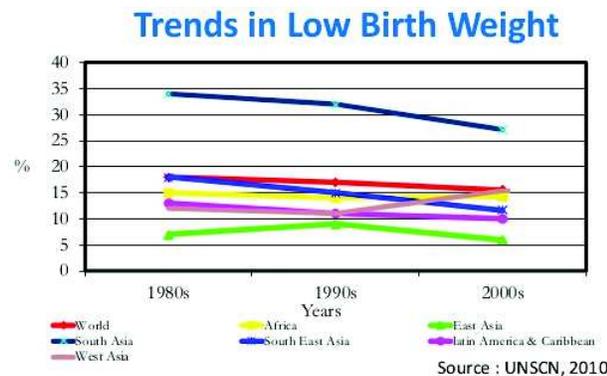


Fig. 4: Time Low birth weight in different region (UN SCN 2010)

the data may not be representative of the LBW rates in the country. Data from NFHS 1, 2 and 3 on inter-state differences in LBW reported in the Princeton study (Princeton 2010) showed that incidence of LBW was lower in Tamil Nadu, Andhra Pradesh and Kerala with better access to antenatal care, as compared to UP, MP and Rajasthan. Between NFHS 1-3, Andhra Pradesh and Bihar did not show any decline in incidence of LBW, while Madhya Pradesh, Rajasthan and Uttar Pradesh showed a marked decline. Tamil Nadu has shown no change but in Kerala there has been an increase in incidence of LBW in NFHS3. It is difficult to draw any conclusion from these data because birth weight data was not available in majority of births. Currently over 80% of deliveries in all states occur in hospitals, therefore it is expected that the next NFHS will provide better estimates of LBW in different states of the country.



Fig. 5: Time trends in LBW in Safdarjang Hospital (NFI 2008)

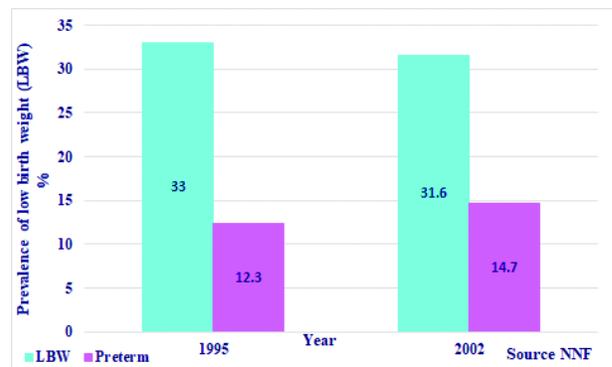


Fig. 6: Prevalence of LBW in India (NNF 2003)

Factors Associated with Low Birth Weight: Global

Despite intensive research over the last five decades, there is very limited data on factors responsible for pre-term labour and intra-uterine growth retardation. There is, however, a large data base providing information about “risk factors” which if present in an individual woman indicates an increased chance of her delivering a low birth weight infant (Committee on prevention of low birth weight 1985). Some of the major risk factors associated with higher incidence of low birth weight are:

Demographic Factors: low socio-economic status, low level of education, child bearing at extremes of reproductive age span

Medical Risk Factors Prior to Pregnancy: chronic medical diseases, bad obstetric history, maternal anaemia

Maternal Under-nutrition: low pre-pregnancy

weight and low weight gain in pregnancy are associated with increased risk of low birth weight

Complications During Pregnancy: maternal infections especially urinary tract infection, pregnancy induced hypertension and gestational diabetes are some of the major risk factors for low birth-weight.

Poor Access to Antenatal Care: results in inability to detect and treat complications during pregnancy and leads to increased risk of low birth-weight.

Factors Associated with Low Birth Weight in India

- An analysis of data from NFHS 1, NFHS 2 and NFHS 3) has shown that low fertility, illiteracy, anemia, lack of antenatal care and pregnancy complications have contributed to LBW (Princeton 2010).
- A third of women in reproductive age in India are under-nourished, with a body mass index (BMI) of less than 18.5kg/m². It is well known that an under-nourished mother gives birth to an under-nourished baby, perpetuating an intergenerational cycle of nutrition (UNICEF 2018).
- Bharati *et al.* (2011) analysed the covariates which influence LBW from NFHS3 and concluded that mother's education, access to TV, nuclear family and intake of iron tablets were the most important determinants of birth weight in India.
- Data from NFHS -3 (Kader *et al.* 2014) showed that mother's low education level, BMI <18.5, short stature (height <145 centimetres) and lack of antenatal visits (<4 visits) were significant predictors of LBW.
- In a cohort study from Assam, Nair *et al.* (Nair, 2016), had reported that in Assam maternal anemia was associated with low birth weight, higher perinatal death and increased risks of post-partum hemorrhage.
- Review of maternal nutritional status associated with LBW (Muthayya, 2009) showed that low maternal weight gain and micro-nutrient deficiencies during pregnancy have serious

implications on the developing fetus.

- A study from Rajasthan (Asopa, 2016) reported an association of asymptomatic bacteriuria with pre-term deliveries, low birth weight deliveries and pre-term premature rupture of membranes.

In India, women's education, socio economic factors, under-nutrition and anaemia in pregnancy have a significant role in increasing the risk of LBW. During pregnancy lack of antenatal care, inadequate nutrition, anaemia and infections affect the growth of the fetus and result in LBW (Ramachandran, 2008).

Low Birth-weight and Infant Mortality in India

Available data from India suggest that it will not be possible for India to achieve 30% reduction in LBW by 2025. A major reason for the concern about high LBW rates is its impact on child survival. Studies carried out by Ghosh (1971) showed that majority of LBW babies in India are term IUGR; their survival rates are much better than the pre-term babies with similar birth weight. With warmth, breast feeding and prevention of infection most term IUGR babies survive (Ghosh, 1971). These findings were confirmed by many others from different parts of the country. Therefore, it was recommended that only pre-term babies and those weighing below 2 kg require admission into intensive care in nurseries. India has been following these guidelines and had been providing essential new born care to LBW in primary and secondary care settings. This has saved millions of lives within existing health care constraints. Despite high LBW rates (30%) and high under-nutrition rates (>40%) in pre-school children, neonatal, infant and under-five mortality rates in India are relatively low; this has been called as the South Asian Enigma (UNICEF 1996). Both in 1990 and in 2015, IMR and U5 MR in India are comparable to other developing countries (Ramachandran, 2016). India narrowly missed achieving the MDG for under five mortality reduction. It is, therefore, likely that though India could not achieve the reduction envisaged in low birth weight, it could achieve the reduction envisaged in IMR and under-five mortality rates by 2025.

Long Term Health Consequences of Low Birth Weight

Birth weight is a major determinant of growth during

infancy, childhood and adolescence. The small Indian neonate growing along the trajectory determined by birth weight gets classified as under-nourished. LBW is one of the major reasons for high under-nutrition rates in Indian children. FAO recognized that the high under-nutrition rates in India (and South Asia) is unrelated to national food security (SOFI 2013). Data from the New Delhi Birth cohort (Bhargava *et al.*, 2004) has shown that children who cross the BMI trajectory are more prone to become over weight adults, develop hypertension and diabetes in their thirties. LBW and under-nutrition in childhood have been recognized as risk factors for adult obesity and non-communicable diseases. Prevention of undue weight gain in LBW infants should therefore receive due attention.

WHO Recommendations on Interventions for Reducing Incidence of Low Birth Weight

Comprehensive implementation plan on maternal, infant and young child nutrition with targets to be achieved by 2025 was endorsed by the World Health Assembly in 2012. The target for low birth weight reduction was 30%. WHO had developed a Low Birth-weight Policy Brief (2012), which has been disseminated to all the member countries. This policy brief focused on need to increase investment and implement evidence based cost-effective interventions, which can effectively reduce low birth rates.

No single approach will solve the low birth weight problem. Several types of programs range from specific medical interventions to large scale public health measures and educational efforts. Some major interventions include

Interventions at Country/Regional Level

- Food distribution systems to food insecure pregnant women
- Antenatal, intrapartum and postnatal care free of cost to all to overcome economic barriers to seeking care
- Universal access to iodised salt
- Improvement in facility based peri-natal care in regions with low coverage
- Improved environmental sanitation and access to safe drinking water

- Prevention of tobacco use

Interventions at Community Level

- If prevalence of anaemia in pregnancy is over 20% universal daily IFA supplementation to women and adolescent girls
- Prevention of malaria in malaria endemic areas. Universal institutional delivery and referral linkages for management of those with complications
- Collection of simplified perinatal data system with electronic feedback systems

Pregnancy Related Interventions

- Adequate and appropriate antenatal, natal and neonatal care for all
- IFA and calcium and vitamin D supplementation for all pregnant women
- Intrauterine growth monitoring and appropriate intervention

Antenatal care interventions in selected at risk women

- Treatment of bacterial vaginosis and asymptomatic bacteriuria with antibiotics
- Progesterone therapy or uterine cervical cerclage in women with previous pre-term birth
- For those at risk of pre-eclampsia anti-platelet agents begun before 16 weeks
- energetic treatment and effective interventions for severe pre-eclampsia
- For women in pre-term labour or where pre-term delivery is considered antenatal corticosteroids for accelerating fetal lung maturity.

Ongoing Interventions for Reducing Incidence of LBW in India

Some of the major intervention programmes to improve pregnancy outcome and birth weight which had been taken up at the national level include

National Health Mission

It was formed by merging of the National Rural Health Missions which was focused on improving access to healthcare to the vulnerable segments of rural population and National Urban Health Mission which emphasized on improving access to health care for urban poor. It envisaged that

- all pregnant women will be screened for under-nutrition and anaemia and provided appropriate interventions so that LBW associated with these problems can be reduced;
- advise at-risk individuals to have delivery in institutions, which can provide optimal intra-partum and neonatal care and improve neo-natal survival even among low birth weight neonates;
- have the anganwadi worker check the birth weight of babies as soon as possible after delivery, in all home deliveries and refer those neonates with birth weight less than 2.0 kg to hospitals where there is a pediatrician available, so that these high-risk neonates get adequate care and there is reduction in neonatal mortality.

National Iron Plus Initiative

Contains the programme guidelines for control of anaemia. Under the National Iron Plus Initiative, iron and folic acid tablets are distributed to all pregnant women and lactating mothers. In addition, wherever feasible, testing for anemia and providing appropriate treatment depending upon the severity of anaemia is envisaged.

Janani Suraksha Yojana (JSY)

It is a safe motherhood intervention under the National Health Mission (NHM). It promotes institutional delivery among poor pregnant women so that there is reduction in maternal and neonatal mortality. The scheme is under implementation in all states and Union Territories (UTs), with a special focus on Low Performing States (LPS).

The National Maternity Benefit Scheme

It provides for financial assistance of Rs. 500/- per birth up to two live births to the pregnant women (>19 years of age) belonging to the below poverty line (BPL) households.

Pradhan Mantri Matritva Vandana Yojana (PMMVY)

It was introduced in 2010 and is implemented by the Ministry of Women and Child Development. It is a conditional cash transfer scheme for pregnant and lactating women providing a partial wage compensation to women for wage-loss during child birth and child care. In 2013, the scheme was brought under the National Food Security Act, 2013. Currently, the scheme provides cash maternity benefit of Rs. 6000 to women in 53 selected districts.

Janani Shishu Suraksha Karyakram

This programme was initiated in 2010. Under this scheme pregnant women are entitled to free and cashless delivery, free drugs and consumables, free diagnostics, free diet during stay in the health institutions, free provision of blood, exemption from user charges, free transport from home to health institutions, free transport facilities in case of referral and drop back from institutions to home after 48 hour stay.

It is obvious that during the past decade, numerous initiatives aimed at improving access to ante-natal, intra-partum and neo-natal care have been taken. Some of them such as Janani Suraksha Yojana addressed a long-felt need of the population; once the economic barrier to accessing intra-partum care had been removed there was a steep increase in institutional deliveries. Others such as National Iron Plus Initiative have faced several bottle necks in implementation and are yet to be scaled up. It is expected that over the next few years all these programmes will help in bringing about some reduction in the LBW rates but it is unlikely that the SDG target for reduction in LBW rate by 30% will be achieved. However, these programmes when scaled up and implemented effectively will help India in achieving the SDG targets set for IMR and U5 MR reduction by 2030.

Summary and Conclusion

India had, and continues to have, LBW rates higher than even Sub-Saharan Africa. The high LBW rates are not due to household food insecurity. Low parental statures, pre-pregnancy under-nutrition, poor weight gain in pregnancy are some of the major nutritional

problems associated with LBW in India. Identification of under-nourished women and providing food supplements to them can bring about reduction in low birth weight rate in this at-risk group, but food supplements to all pregnant women does not bring about substantial increase in birth weight. Anaemia, pregnancy induced hypertension (PIH), repeated infections especially urinary tract infections, gestational diabetes with PIH are some of the obstetric problems associated with LBW. Effective antenatal

care can result in some reduction in LBW rates. However, it is unlikely that the country can reduce LBW rate by 30% by the year 2025. The mature small Indian neonate survives if provided essential neonatal care and the country has witnessed sustained reduction in IMR and U5 MR in the last two decades. Even though India may not be able to achieve 30% reduction in low birth weight the country can strive and achieve the IMR U5 MR targets set for 2025.

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