RESEARCH ARTICLE

PREVALENCE OF LOW BIRTH WEIGHT IN HOWRAH

*Arpita Mandal (Nandi)

Associate Professor in Anthropology, Narasinha Dutt College, Howrah, India

ARTICLE INFO	ABSTRACT
    *Corresponding author	**Background:** Developing countries, specially in India has been constantly facing the problem of Low Birth Weight (LBW) since long. Low birth weight in the Asian countries prevail predominantly because of undernutrition in women prior to and during pregnancy. The second most important factor is also the age of the mother. Even today in many sectors of the Indian society, girls are neglected and deprived of proper nutrition and they are married off at an early age resulting in early motherhood. About 50% of the women in India still suffer from =severe anaemia and we have the highest number of maternal deaths too (Muthayya *et al.,* 2006). **Objective:** This study has been undertaken in the district of Howrah to find out the prevalence of Low Birth Weight in Howrah, to determine the factors and distribution of Low Birth Weight. Data were collected from Howrah District Hospital. **Methods:** ANOVA was performed to determine the spatial variation of birth weight. The co-variates that influence Low Birth Weight are: 1. Social variables 2. Economic variables 3. Biological variables. Multiple Regression Logistic models were carried out to determine the influence of the direct and indirect factors. **Results:** Nearly 24.7% of the new borns have Low Birth Weight. Females were more in number as compared to males low birth weights. Mother's education, access to information, exposure to TV and newspaper, nuclear family, intake of iron supplements and socio-economic conditions play a significant role in determining birth weight.

INTRODUCTION

The World Summit for Children held in New York on September, 1990 pledged to reduce the rate of Low Birth weight (LBW) to less than 10 per cent of 1990 levels by 2000. Since then, there have been initiatives and programmes undertaken by several International bodies, including WHO and UNICEF, to reduce the prevalence of Low Birth Weight. In South Asia, the magnitude of the problem is much more as compared to the developed countries (Gopalan, 1994). South Asia has the highest prevalence of LBW and the disparity in comparison to developed and some developing regions (Africa) is obvious (Sachdev, 2001). In India, data from several studies (Bhargava *et al.,* 1987; Sachdev, 1997; Satpathy *et al.,* 1990) conclude that prevalence of LBW is 32.8% and again of which only 33% of the LBW births were preterm. Regional variations range from 2.7% in Madhya Pradesh to as high as 40% in Orissa (Satpathy *et al.,* 1990). The estimated prevalence of LBW in West Bengal is 18.4% (Gopalan *et al.,* 1949a). Literature review show that the causes behind LBW in the developed and the developing countries are much different (Sachdev, 2001).

Risk factors of LBW in the West and developed countries mostly include Adolescent motherhood, consumption of alcohol and smoking habits (Sethi *et al.,* 1991). Whereas, developing countries specially in South Asia, face LBW because of factors like, premature birth, intrauterine growth retardation, maternal malnutrition, multiple births, inadequate rest and continued hard work during pregnancy. Smoking habits and exposure to passive smoking also occupy an important position as risk factors (UNICEF, 1996). LBW babies can be categorized into any of the following :

1. Baby may be Small for Gestational Age (SGA)
2. Baby may be LBW as a result of Intrauterine Growth Retardation (IUGR)
3. Baby may be born preterm.

South Asian Low birth weights are mostly SGA i.e. full term infants who are small in size (Sachdev, 2001). South Asian Low birth weights are mostly SGA ie full term infants who are small in size (Baghianimoghadam *et al.,* 2015; Demelash *et al.,* 2015; Matin *et al.,* 2008; Sachdev *et al.,* 2001; Yadav *et al.,* 2011). In India, the majority of LBW infants are born because of (IUGR) ie they are born small at term > 37 weeks

of gestation, with only 6.7% born prematurely (Muthayya *et al.,* 2006). These infants are at a high risk of mortality. LBW is a strong predictor for size in later life as these infants seldom catch-up to normal size during childhood (Epstein *et al.,* 2013; Lorne *et al.,* 2008; Rao *et al.,* 2001). Studies in the Indian population (Ahankari *et al.;* Bhaskar *et al.,* 2015; Choudhary *et al.,* 2013; Muthayya *et al.,* 2006; Singh *et al.,* 2011) reveal that the causes for LBW are manifold. Among many, the major ones are: maternal infections, low maternal nutrient intake, higher nutrient losses, increased nutritional requirements during pregnancy. There is thus an urgent need to determine ways and means to prevent LBW from occurring.

Aims and Objectives

It is important to bring out the factors behind occurrence of LBW. LBW babies tend to have a bad start in life, they are vulnerable to low immunity, infection and malnutrition. Thus, bringing out the factors may facilitate better programmes for reformations and further prevent its occurrence. The current study aims at finding the magnitude and the determinants of LBW in the district of Howrah, West Bengal.

The study has the following objectives:

- To study the prevalence of Low Birth Weight babies/children in the studied area.
- To help improve maternal and infant health outcomes by addressing a range of medico-social and behavioral determinants of Low Birth Weight
- The study intends to find out or evaluate the additive effects of community level behavioral interventions which may help in bringing about positive improvements in maternal and infant health outcomes.

Majority of the community based studies on birth weight are in rural areas and there is a paucity of studies from the urban areas. Mothers in rural area enjoy benefits of public health services provided by Government created network of delivery systems. The present study was carried to assess the magnitude of LBW and factors contributing to it. It aims to explore issues related to causes, outcome and interventions in preventing LBW.

MATERIALS AND METHODS

Study area and population: The study was conducted in the District of Howrah. The area of the study was specifically chosen as they were adjacent to the Howrah District Hospital. Community comprised of people residing in the slums of ward nos. 18, 19 of Tikiapara, Howrah and 21 of Narasinha Dutt Road, Howrah. Data of birth records were taken from the Hospital with prior formal permission from the authority. LBW babies' data were derived and their follow-up check up in the hospital out-door were recorded. Socio- demographic information were taken from the parents through a structured questionnaire. Birth weights of 1046 infants were recorded. Data were also extracted from a health – card and self reporting, mostly by the mother. Thus, 1046 infants with complete information on infants with complete information on birth weight and their follow-up growth were included in data analyses. A range of factors influencing fetal growth, were categorized in two groups. First, maternal risk factors

consisting of high risk pregnancy, type of delivery, maternal age, mothers' level of education, parity and mothers' smoking. Secondly, considered were neonate risk factors consisting of sex and gestational age. High risk pregnancy included history of chronic diseases (eg gestational hypertension, diabetes), history of abortion, preeclamsia, multigravity and multiple pregnancies.

Socio-demographic, anthropometric and nutritional variables: A set of theoretically relevant and well established risk factors for LBW was adapted for the analyses. Major factors such as socio-demographic, anthropometric, nutritional status, and health services received during pregnancy were included in the analyses.

Birth –weight: According to the WHO's classification of LBW, birth weight < 2500g was classified as LBW.

Socio-economic status: Household socio-economic status was measured using a validated assessment of household assests. They were then classified as poor, lower middle class and middle class. The caste of the women were classified as – scheduled caste, scheduled tribe, OBC and general caste.

Anthropometric variables: The height and weight of women were measured. Body mass index was calculated using the standard formula- weight(Kg)/Height (m^2). The cut-off points were followed as per WHO. Age of mother, maternal education, place of residence were also recorded.

Statistical Analyses: Associations between socio-economic status, nutritional predictors and LBW were analyzed by bivariate analysis using Pearson's Chi-square tests. Data were analyzed using univariate and multivariate regression methods. SPSS version 7.5 were used.

RESULTS

Analysis of Table 1: Table 1 brings about the distribution of the low birth weight babies according to their sex. Most babies in both the sexes were in the range of birth weight of 1kg -1.49 kg. 62.12% of the male babies belong to this category while 68.90% of the female babies were from this category. It is clear from the table that female infants were significantly more in number than their male counterparts.

Table 1. Distribution of Low birth weight babies according to sex of new born

Weight in kg	Low Birth Weight Babies		
	Male (%)	Female (%)	Total
<1.00	7(2.32)	49(11.36)	56(7.65)
1.00-1.49	187(62.12)	297(68.90)	484 (66.12)
1.50-1.99	107(35.54)	85(19.72)	192(26.22)
Total	301	431	732
Mean ± SD	1.57±0.427	1.33±0.464	1.54±0.471

Analysis of Table 2: This table represents basic characteristics of the participants by two groups; 1) women with infants who were normal birth weight (NBW) (≥2500 g) and 2) women with infants who were LBW (<2500 g). Pearson's Chi-square tests identified differences between the maternal socio-economic and nutritional status in both groups. Univariate analysis show that the significant determinants of LBW are; age of mother, level of education of the mother, religion and caste of the mother.

Table 2. Distribution of birth weight of the newborns according to socio-demographic characteristics of the mothers (n=1046)

Socio-demographic variables	Birth weight of the newborns				X^2 / P
	<2500gm(n=732)		>2500gm(n=314)		
	No	%	No	%	
Maternal age (yrs)					
18-22	219	29.9	153	48.7	
22-26	289	39.4	137	43.6	1.703
26-30	187	25.5	15	4.7	p>0.05
>30	37	5.0	9	2.8	
Education of mother					
Illiterate	271	37.0	11	3.5	
Primary school	336	45.9	39	12.4	4.713
Middle school	102	13.9	148	47.1	p>0.05
High school	23	3.1	116	36.9	
Occupation of mother					
House wife	108	14.8	162	51.7	
House maid	339	46.3	43	13.6	7.832
Stitching works	200	27.2	86	27.4	P<0.05
Labour	85	11.7	23	7.3	
Type of family					
Nuclear	375	51.3	200	63.8	33.641
Joint	357	48.7	114	36.3	P=0
Religion					
Hindu	197	26.9	126	40.1	0.210
Muslim	508	69.4	167	53.2	p>0.05
Others	27	3.6	21	6.6	
Ethnicity					
SC	269	36.7	79	25.1	3.732
ST	23	3.1	----	---	p>0.05
OBC	346	47.3	131	41.7	
General	94	12.8	104	33.1	

Table 3. Distribution of birth weight of the newborns according to maternal variables (n=1046)

Biological /Nutritional variables	Birth weight of newborns				X^2 / P
	<2500gm (n=732)		>2500gm (n=314)		
	No	%	No	%	
Maternal body weight (kg)					
<45	383	52.3	29	9.2	1.692
45-55	288	39.3	107	34.0	p>0.05
>55	61	8.3	178	56.6	
Maternal height					
<145	387	52.8	56	17.8	0.472
145-155	285	38.9	111	35.3	p>0.05
155-165	60	8.1	147	46.8	
Parity of mother					
Primipara	271	37.0	166	52.8	3.079
Multipara	461	62.9	148	47.1	p>0.05
Type of delivery					
Normal delivery	358	48.90	119	37.89	
Caesarean section	204	27.86	66	21.01	
Forceps	152	20.76	122	38.85	0.462
Others	18	0.24	7	2.22	p>0.05
Sex of the newborn					
Female	374	51.0	148	47.1	0.070
Male	358	48.9	166	52.8	p>0.05
Day-time rest by mother					
30-60 min	285	38.9	72	22.9	
60-90 min	314	42.8	89	28.3	0.101
90-120 min	117	15.9	97	30.8	p>0.05
>120 min	16	2.1	56	17.8	

Occupation of the mother also had a significant effect on the birth weight of the babies.educated mothers had lesser percentage of LBW babies. Family type whether nuclear or joint had no significant effect on LBW. Analysis of Table 3: Table 3 shows the association and its strength of birth weight with the maternal characteristics. Mothers with short stature, less than normal body weight and inadequate rest were significantly more likely to give birth to LBW babies. Parity at birth and sex of the child had significant role to play. Primipara children were lesser in number as compared to multipara children who had low birth weight. Female children were significantly lower in birth weight as compared to the male children.

Analysis of Table 4: This table represents the association of Low birth weight with the utilization of Antenatal care by the mothers. It is quite prominent that mothers availing none of the ANC or in inadequate numbers gave birth to Low birth weight babies. It is highly significant.

Analysis of Table 5: In Table 5 Logistic regression for adjusted and unadjusted odds ratio (OR) of low birth weight (LBW) have been represented. If a women's BMI was <18.5, then the odds of having LBW infants was 98 higher (OR = 1.98, 95% 1.31-3.95, P < 0.001) than the women with BMI >18.5.

Women who have a shorter stature (height <145 cm) were 67% more likely to give birth of an infant with LBW (OR = 1.67, 95% CI: 1.10-1.67, *P* < 0.01).

Table 4. Association of Low birth weight with utilization of Antenatal care (ANC) by mothers

Utilization of ANC	LBW(%)	OR	95%CI	X²/p
Nil (0)	409 (55.87)	5.37	2.4-12.46	18.47/ p <0.001
Inadequate (1-2)	311 (42.48)	2.87	1.59-5.64	12.67/ P<0.001
Adequate (≥3)	12 (1.63)	1		

Table 5. Logistic regression for adjusted and unadjusted odds ratio (OR)

Determinants	Unadjusted OR		Adjusted OR	
	OR[a]	CI(95%)	OR[b]	CI(95%)
Sex				
Male	0.83[***]	0.81-0.91	0.78[***]	0.71-0.90
Female	1			
Wealth Status				
Poor	1.41[***]	1.31-1.57	0.97	0.80-1.14
Lower middle class	1.30[***]	1.18-1.41	1.02	0.87-1.21
Middle class	1			
Caste/ Tribe				
SC	1.21[**]	1.11-1.31	1.11	0.91-1.27
ST	0.91	0.78-1.06	0.83	0.61-1.17
OBC	1.06	0.93-1.11	0.91	0.87-1.10
General	1			
Age (year)				
<18	1.47[**]	1.27-1.68	1.17	0.70-2.02
18-35	1			
>35	0.88[*]	0.68-0.97	0.97	0.68-1.37
Education				
Illiterate	2.01[***]	1.77-2.07	1.86[***]	1.48-2.36
Primary	1.82[***]	1.60-2.20	1.57[***]	1.27-2.07
Secondary	1.36[***]	1.25-1.57	1.20	0.98-1.47
Higher secondary	1			
Stature				
Height(<145cm)	1.58[***]	1.39-1.57	1.37[**]	1.10-1.67
Height (≥145cm)	1			
BMI				
<18.5	1.98[***]	1.37-2.38	1.97[***]	1.31-3.95
18.5-24.9	1.67[***]		1.42	
>25.0	1			

In the unadjusted model, maternal age <20 years, having moderate to severe anemia, shorter inter-pregnancy interval (<18 months), 'poor' and 'middle-class' socio-economic status, "scheduled caste" and living in urban area were significant risk factors for giving birth to an infant with LBW. However, in the adjusted model, influences of these factors were greatly attenuated and statistically insignificant.

DISCUSSION

Most Low birth weight babies in this study were females, about 68.9% as revealed in Table 1.Table 2 results indicate that mothers aged below 20 years had significantly greater chance of having LBW babies as compared to the mothers of age group above 20 years. It corresponds according to the findings of (Ahmed *et al.,* 1994; Eisner *et al.,* 1979; Mavalankar *et al.,* 1994; Rao *et al.,* 2001; Ronnenberg, 2004). Univariate analysis show that the significant determinants of LBW are; age of the mother, level of education of the mother, religion and caste of the mother. Occupation of the mother also had an important impact on the birth weight of the babies. Mothers doing more physical labour during pregnancy gave birth to more number of LBW babies.

In this study, 46.3% of LBW babies had mothers who worked as maids and 27.2% LBW babies were born to mothers occupied in stitching and tailoring works. Usage of sanitary latrines also had an important impact on the birth of LBW babies. This may be due to the reason of infestation of hookworm in persons practicing open air defecation. In his study (Dowding, 1981), show that socio-economic class of the mother influence the birth weight. This study also confirm that the proportion of births with low birth weight is higher among children born to younger women, and also families with lower wealth quintiles (Makhija and Murthy, 1990). Maternal education was also found to be a risk factor in this study. In this study 37% of the low birth babies were born to illiterate mothers while another 45.9% of the low birth weight babies were born of mothers who had priviledge to avail only primary level education. Stature of the mother also play an important role here. Mothers having height less than 152 cm in this study were found to be at more risk of giving birth to low birth weight babies. 52.8% of the low birth weight babies were born of mothers of short stature. This result matches well with the study of Ferraz *et al,* 1990 while contradicts the study (Horon *et al.,* 1983). The results of this study reveal that to obtain a maximum effect on birth weight, iron supplements should be started in early pregnancy. Iron deficiency anaemia has been shown to be associated with low birth weight and preterm delivery. Table 4 reveals that 55.87% Low birth weight babies were born to mothers who did not avail the Ante-natal care (ANC) and another 42.48% were born to mothers who inadequately availed the ANC facilities. These results are in accordance to the studies of (Preziosi *et al.,* 1997; Rasmussen *et al.,* 1993).A study from Shanghai reveal that the effect of maternal anaemia on preterm delivery was the most detectable during the 1st trimester (Zhou *et al.,* 1998). This study also show that, IUGR comprises of two thirds of the LBW births. It thus becomes one of the leading causes of LBW. The studies of (Hosain *et al.,* 2006; Kramer, 1987) also reveal the same facts. Stature of the mother also play an important role here. Mothers having height less than 145cm in this study were found to be at more risk of giving birth to low birth weight babies (52.8% from Table 3). This matches some of the studies (Ferraz *et al.,* 1990) while contradicts with results of some (Horon *et al.,* 1983). Parity also play a significant role in low birth weight. There were significant difference in multiparity birth of children as compared to primiparity children. As high as 62.9% of LBW children in this study were multiparity born. Female babies were higher in percentage of LBW (51.0%).Occupation of the mother, her nutritional intake and duration of day-time rest showed statistically significant differences. These results are in agreement with the studies conducted by (Conde-Agudel *et al.,* 2006; Muthayya, 2009; Osrin *et al.,* 2005). 55.87% Low birth weight babies were born to mothers who did not avail the Ante-natal care (ANC) and another 42.48% were born to mothers who inadequately availed the ANC facilities. These results are in accordance to the studies of (Preziosi *et al.,* 1997; Rao *et al.,* 2001; Rasmussen and Stoltzfus, 2003). A study from Shanghai reveal that the effect of maternal anaemia on preterm delivery was the most detectable during the 1st trimester (Zhou *et al.,* 1998). This study clearly support the facts earlier stated. Mother's stature, health conditions and nutrition during pregnancy do play important role in determining birth weight of her baby (Alexander *et al.,* 2008; Choudhary *et al.,* 2013; Jha *et al.,* 2009; Lalita and Mesquita, 2012; Lawn *et al.,* 2005; Manzur and Tripathi, 2012) have similar findings.

Conclusion

It appears that there are several maternal nutritional variables which seem to function in association with Low Birth Weight and IUGR among women in Howrah. Among many of the etiological factors, socio-economic status seem to be an important factor. The second important factor seem to be maternal weight gain. The prevalence of LBW revealed from this study is the result of undernutrition of the mother before and during pregnancy. Low birth weight or intra uterine growth retardation (IUGR) coexist in this study area. Mother's education has a significant impact on birth weight of infants. It can be thus concluded from the study that, improved food intake, food supplementation, mother's education and the environment of the pregnant women and her family play a significant role in determining birth weight of infants. Low birth weight in Howrah still poses a problem and factors like height, socio-economic upliftment, improved basic amenities, good ante- natal care (ANC), provision of IFA tablets, reducing anaemia, providing sanitary latrine need to be attended to with immediate effect. Above all, mothers have to be motivated to access adequate consumption of food, rest and taking care of themselves. Poverty could affect maternal health status at the time of conception through lower physiologic reserves. Other potential causes could be variation in the quality and quantity of medical care, diet, housing conditions, lower social support, unemployment, increased exposure to toxic agents or differences in risk of infections.

The present study concludes the following:

- Major factors responsible for LBW in newborns are
  - Age of mother at time of delivery
  - Poor nutritional health of mother
  - Availing inadequate antenatal care
  - High parity
- Low birth weight in infants can be reduced by attending towards maternal health, looking after their nutrition, counseling them for delayed child bearing age especially above 20 years.
- Mothers have to be made aware of the importance of availing antenatal care and how to carry on healthy pregnancy.
- Harmful behaviors such as smoking and consumption of alcohol also bring about risks to Low birth weight.

REFERENCES

Ahankari A, Bapat S, Myles P, Fogarty A, Tata L, Factors associated with preterm delivery and low birth weight: a study from rural Maharashtra, India, F1000Research, 6: 72.

Ahmed FU, Das AM, Mostafa MG, Association of maternal biological factors with birth weight in Bangladesh, JOPSOM, 1994, 13: 52-57.

Alexander GR, Wingate MS, Bader D, Kogan MD, The increasing racial disparity in infant mortality rates: Composition and contributors to recent US trends.(et-9), *American Journal of Obstetrics and Gynaecology,* 2008, 198: 51.

Baghianimoghadam MH, Baghianimoghadam B, Ardian N, Alizaden E, Risk factors of low birth weight and effect of them on growth pattern of children up to sixth months of life: A cross-sectional study. 2015, 4:40.

Bhargava SK, Ramji S, Srivastava U, Sachdev HPS, Kapani V, Datta V, Satyanarayan L, Growth and sexual maturation of low birth weight children: A 14 year follow up., Indian Pediatrics, 1995, 32: 963-970.

Bhargava SK, Sachdev HPS, Ramji S, Iyer PU, Low birth weight: Etiology and prevention in India, *Annals of Tropical Paediatrics,* 1987,7:59-65.

Bhaskar RK, Deo KK, Neupane U, Bhaskar SC, Yadav BK, Pokharel HP, Pokharel PK, A case control study on risk factors associated with low birth weight babies in Eastern Nepal,2015, *International Journal of Pediatrics,* 1-7.

Choudhary AK, Choudhary A. Tiwari, SC, Dwivedi R, Factors associated with low birth weight among newborns in an Urban Slum community in Bhopal, 2013, 57(1): 20-23.

Conde-Agudel A, Rosas-Bermudez A, Kafury-Goeta AC, Birth spacing and risk of adverse perinatal outcomes: A neeta analysis., JAMA, 2006, 295:1809-1823. (PubMed).

Dasgupta A, Basu R, Determinants of low birth weight in a Block of Hooghly, West Bengal: A multivariate analysis, *Int. J.Biol.Med. Res,* 2011, (4):838-842.

Demelash H, Motbainor A, Nigatu d, Gashaw K, Melese A, Risk factors for low birth weight in Bale zone hospitals, South-East Ethiopia : a case–control study, 2015, 15: 264.

Dowding VM, A new assessment of the effect of birth order and socio-economic class on birth weight., *Br.Med. J.,* 1981, 282:683-686.

Eisner V, Brazie JV, Pratt MW, Hexter AC, The risk of low birth weight, AJPH,, 1979,69:887-93.

Epstein MB, Bates MN, Arora NK, Balakrishnan K. Household fuels, low birth weight, and neonatal death in India: the separate impacts of biomass, kerosene, and coal. *International Journal of Hygiene and Environmental Health,* 2013;216:1–10.

Ferraz EM, Gray Rh, Cunha TM, Determinants of preterm deliveries and intrauterine growth retardation in North-East Brazil, *International Journal of Epidemiology*,1990, 19: 101-108.

Gopalan C, Low birth weight, In: Nutrition research in South – East Asia: The Emerging Agenda of the Future. WHO, Regional office of South East Asia, New Delhi, 19949a), 13-31.

Gopalan C, Low birth weights: Significance and implications. In : Nutrition in children : Developing Country Concens, eds.Sachdev HPS, Choudhury P., New Delhi, National Update on Nutrition.1994,

Horon IL, Strobino DM, MacDonald HM, Birth weight among infants born to adolescent and young adult woman., *Am. J. Obs. Gynae.,* 1983, 146:440-449.

Hosain GM, Chatterjee N, Begum A, Saha SC. Factors associated with low birthweight in rural Bangladesh. *J Trop Pediatr,* 2006;52:87–91.

Hosain GM, Stillbirth in a rural area of Bangladesh, Paper presented in the 11th Congress of the Federation of the Asia and Oceania Perinatal Societies, 2000, Manila, Phillipines.

Jha SK, Mishra CP, Hussain MA. Determinants of low birth weight: Findings from a community based study in a rural area of Varanasi. *Indian J Community Health,* 2009;21:18-022.

Kramer MS, Effects of energy and protein intakes on pregnancy outcome: An overview of the research evidence from controlled clinical trials. *Am. J. Clin. Nutri.,* 1993, 58:627-635.

Kramer MS,Determinants of low birth weight: Methodological and meta analysis, Bull WHO,19987,65(5): 663-737.

Lalita F, Mesquita AM. Household air pollution due to biomass smoke exposure and chronic obstructive pulmonary disease. *International Journal of Biomedical And Advance Research,* 2012;10(74):65–7.

Lawn JE, Cousens S, Zupan J, Lancet Neonatal Survival Steering Team. 4 million neonatal deaths:When? Where? Why? *Lancet,* 2005,365:891-900.

Lorne T. Determinants and prevention of low birth weight: a synopsis of the evidence, vol. 127. 2008. 127–170.

MacDermott J, Steketee R, Wirima J, Perinatal mortality in rural Malawi, Bull WHO,1996, 79:165-171.

Makhija K, Murthy GV, Sociobiological factors influencing low birth weight at a rural project hospital, *J Ind Med Assoc,* 1990, 88:215-217.

Manzur K, Tripathi N. Determinants of low birth weight in rural Bangladesh. International Journal of Reproduction, Contraception, *Obstetrics and Gynecology*, 2012;2(2):1–5.

Matin A, Azimul SK, Matiur AKM, Shamianaz S, Shabnam JH, Islam T. Maternal socioeconomic and nutritional determinants of low birth weight in urban area of Bangladesh, *J Dhaka Med Col,* 2008, 17(2): 83-87.

Mavalankar DV, Gray RH, Trivedi CR, Parikh VC, Risk factors for small for gestational age births in Ahmedabad, *Indian Journal of Tropical Pediatrics,* 1994, 40:285-290.

Mavalankar DV, Gray RH, Trivedi CR. Risk factors for preterm and term low birth weight in Ahmedabad, India. *Int J Epidemiol,* 1992; 21 : 263-72.

Muthayya S, Kurpad AV, Duggan C, Bosch RJ,, Dwarkanath p, mhaskar A, Maternal vitamin B12 status is a determinant of intrauterine growth retardation in South Indians, *Eur J Clin Nutr,* 2006, 60:791-801.

Muthayya S, Maternal nutrition and low birth weight-what is really important? *Indian Journal of Medical Research,* 2009, 130:600-608.

Ohhssson A, Shah P, Edmonton: Institute of Health Economics (IHE), Determinants and prevention of low birth weight: A synopsis of the Evidence., 2008.

Osrin D, vaidya A, Shrestha Y, Bania RB, Manandhar DS, Adhikari RK, Effects of antenatal multiple micronutrient supplementationon birthweight and gestational duration in Nepal: Double blind, randomized controlled trial, lancet, 2005, 365: 955-962.

Preziosi P, Prual A, Galan P, Daouda H, Hercberg S, Effect of iron iron supplementation on the iron status of pregnant women: Consequences for the newborn, *Am J Clin Nutr,* 1997,66: 1178-1182.

Rao S, Yajnik CS, Kanade A, Fall CH, Margetts BM, Jackson AA, Intake of micronutrient –rich foods in rural Indian mothers is associated with the size of their babies at birth: *Pune Maternal Nutrition Study, J Nutr,* 2001,58:627-635.

Rasmussen KM, Stoltzfus RJ, New evidence that iron supplementation during pregnancy improves birth weight: new scientific questions, *Am J Clin Nutr,* 2003,78:673-674.

Ronnenberg AG, Preconception hemoglobin and ferritin concentrations are associated with pregnancy outcome in a prospective cohort of Chinese women, *J Nutr,* 2004, 134: 2586-2591.

Sachdev HPS, Low birth weight in South Asia, In Malnutrition in South Asia: A regional profile., Regional Office for South Asia (ROSA), UNICEF. 1997.

Sachdev HPS, Low Birth Weight in South Asia, Int J Diab Dev Countries, 2001, 21: 13-30.

Sachdev HPS,,Nutritional status of children and women in India: recent trends, NFI Bull, 1997(a),18 (3): 1-5.

Satpathy R, Das DB, Bhuyan BK, Pant KC, Santhanam S, Secular trend in birth weight in an industrial hospital in India, Ann Trop Pediatr, 1990, 10: 21-25.

Sethi GR, Sachdev HPS, Puri RK, Women's health and fetal outcome, *Indian Pediatr,* 1991,28:1379-1393.

Singh S, Shrestha S, Marahatta S ,Incidence and risk factors of low birth weight babies born in Dhulikhel Hospital. 2011.

UNICEF, Malnutrition in South Asia: A regional profile. Regional Office for South Asia (ROSA). 1997.

UNICEF, Regional Office for South Asia. Atlas of South Asian Women and Children. Kathmandu, United Nations Children's Fund. 1996.

Valero De Bernabe J, Soriano T, Albaladejo R, Juarrang m, Calle ME, Martinez D, Risk factors for low birth weight : A review, *Eur J Obstet Gynecol Reprod Biol*, 2004, 116:3-15.

World Health Organisation, Low birth weight: A tabulation of available information, WHO/MCH/92.2,WHO ,Geneva and UNICEF, 1992, New York.

World Health Organisation, Maternal anthropometry and pregnancy outcomes: A WHO collaborative study. BULL WHO, 1995, 73(suppl):1-98.

Yadav DK, Chaudhary U, Shrestha N, 2011. Risk factors associated with low birth weight., *J Nepal Health Res Council,* 2011,9(15): 159-164.

Zhou LM, Yang WW, Hua JZ, Deng CQ, Tao X, Stotzfus RJ, Relation of hemoglobin measured at different times in pregnancy to preterm birth and low birth weight in Sanghai, China, *Am J Epidemiol,* 1998, 148:998-1006.

****