Chapter – VII

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7.1 Introduction

Low Birth Weight, defined as the birth of an infants who weigh less than 2.5kg (<2000 grams). LBW is a major public health concern especially in developing countries. Worldwide more than 15-30 million infants are born annually, of which one fifth births are LBW. Mothers’ nutritional status is the most important determinant of newborn birth weight. In addition to socio-demographic and maternal characteristics, certain amenable maternal factors also affect birth weight. Many risks factors for LBW can be identified, prior to occurrence of pregnancy.

LBW have been a problem concern worldwide. From time to time there have been numerous studies both community and hospital based addressing these concern. Low birth weight is a strong predictor of an infant survival. LBW is internationally recognized indicator for predicting baby's survival. By increase in the baby’s survival, the maternal and child health related demographic indices are improved. However, in a developing country like India, these indices are of major public health problem. The problem gets aggravated as they impose significant burden in terms of economy to the developing world, and consequently researchers and public health professionals are baffled in planning effective intervention strategies. Such challenges are ascribed to the fact that small cross sectional studies are incapable in providing the wider spectrum of the burden of disease inflicted due to increased IMR and problems related to LBW. Hence from time to time studies are needed with greater coverage of the maternal population at national level, and thereby provide the evidence and provide guidance to plan appropriate interventions.

Moreover, in developing countries majority of birth occurs outside health facilities. The estimates of birth weight are prone to biases in the form of being inaccurate in measurement; imprecise in methods of reporting and varying background characteristics that influences the reporting on part of mother. These measurement issues can substantially distort the actual prevalence of LBW and hence the intervention formulated on this empirical information remains ineffective in
practical sense. Therefore accurate reporting of prevalence of LBW is important for monitoring the health of a population.

Another implicated problem for researchers working in the field of population sciences and to some extent even to the public health professionals is the phenomena of heaping. Heaping represents misclassification that arises when measured birth weights are rounded to the nearer grams and grouped into weight classes. The heaping occurs because of the clustering effects on certain digits that by the ‘Health Cards’, that are utilized for the purpose of recalling the birth weight of a child, in community settings.

In addition to the above problems, maternal assessment of birth size at the time of birth can be regarded as the proxy indicator for the infant birth weight, in case we have missing information of birth weight or unrecorded birth weight, even or deliveries in the institutional settings. This is ascribed to the fact that since such assessments are subjective in nature, there is high likelihood to arrive at the actual birth weight, once it gets unrecorded. This situation becomes deleterious in nature on account of the situation that such unrecorded or missing birth weight can in actual sense be LBW.

On account of such concern studies have identified numerous risk factors for LBW at state and regional levels in India. Furthermore, prevalence of LBW gets underestimated due to variation in the pattern of reporting birth weight, through health card or mother memory recall (birth weight or birth size) and prevailing of heaping phenomenon. Hence, there is need to conduct studies in India from time to time for an updated epidemiological understanding behind the occurrence of LBW. Such studies enables in providing better evidence and clues to plan future public health programs.

Research Questions addressed in the present investigation are (i) what is the extent of birth weight reporting and quality of the data? Is there any solution to the problem of non-recording of birth weight in India? (ii) What is the burden of LBW in India? (iii) Whether this burden varies across the states/regions? (iv) Do the women with poor nutritional status (measured in terms of body mass index and anemia) are more likely to produce children with LBW? With these views in mind the objectives that are being attempted to answer by this investigation are as:- (i) assessing the data
quality and compare two methods of data collection on LBW in India; (ii) to demonstrate adjusted estimates of LBW by considering the problem due to heaping (iii) to develop epidemiological model investigating the association between mothers nutritional status and LBW in India; (iv) to develop regional models assessing region specific determinants of LBW in India.

The present investigation entitled “An Epidemiological Study of Low Birth Weight in India: Biostatistical Appraisal” has been organized into seven chapters. The chapter-I; contains a brief introduction of the topic including review of literature, and rationale for undertaking the present work. Chapter-II, elaborates about the data considered under the study, statistical and analytical techniques applied. Chapter-III covers the pattern of reporting system of birth weight in India and its states. The agreement analysis was performed to find the accuracy between birth weight and birth size at the time of data reporting. Chapter-IV substantiate regarding ratio method for calculating the revised estimate of LBW. Chapter-V deals with the association between mother’s nutritional status and LBW in India and its states. Chapter-VI deals with the results are obtained by analyzing the regional determinants of birth weight and LBW in India.

7.2 Summary

The chapter –III, dealt with the measurement issues of birth weight through cross-sectional survey data in India. The result revealed that only one-third births in India were reported at birth either through health card or mother memory recall. This finding suggests that the picture of reporting of birth weight in India is dismal. Hence there is a need to have a formal procedure or recording of birth weight. These findings corroborate with the study by Channon et al., which suggested that health systems in poor countries should initiate efforts to systematically monitor the recording of birth weight data ensuring for both quality and comparability at the international levels (Channon et al., 2011). Further, reporting of birth weight was detected lowest among residents of rural category, uneducated mothers, poorer economic status, in schedule tribes category, muslims religions and higher birth order category. Of these identified factors, the amenable one is the birth order. Hence women with higher birth order should be educated with the correct ways of reporting birth weight. This finding has also another side too. Is there uniformity in reporting across various birth orders. Or in another words are mothers going for higher birth order more likely not to report birth
weight. Has this some stigma related problem too in some of religious community. Such implication arising due to higher birth order needs to be explored further in the forthcoming studies. Significant difference was identified between reporting of birth weight in deliveries occurring at home, or in institution. These findings are also in congruence with existing literature (Agarwal et al., 2011). Further, data reveals that substantial heaping on reported birth weight at exact weight 2500 grams and the cut-off point for low birth weight defined <2500 grams. One-fifth of birth weight reported at exact weight 2500 grams, it might be of less than 2500 grams; thus, not including them biases estimates of the prevalence of LBW might show improvement. The problems of heaping have been addressed by few studies (Boema et al., 1996; Channon et al., 2011; Ann et al., 2005). Such studies conducted on large data set will provide methodological gain and thereby increment our knowledge in arriving at the true estimate of LBW.

The second objective in Chapter-III was regarding calculating agreement between LBW based on actual reported weight and LBW approximated using reported birth size based on recall method. The reliability of birth size in terms of actual birth weight was in agreement at moderate level. The estimated sensitivity was proportionately lower than specificity, PPV and NPV. The results revealed that only 53% of babies reported by their mothers as small were actually LBW baby, while nine in every ten normal babies were correctly classified as normal. The optimal balance between the sensitivity and specificity of test relies on capture of true prevalence that occurs in the phenomenon under investigation. In case of very low reporting of LBW, obviously would have let out record of true diseased state (true positive cases-LBW). Hence sensitivity is likely to be lower. On the other hand higher PPV suggests that the subjective assessment of birth size on part of mother has potential to predict actual positive cases (PPV-True LBW cases). Hence the mother’s perception of the birth size needs to be strengthened that can correctly classify LBW and normal weight babies. These findings are also in congruence with existing literature (MM Islam, 2014).

Third objective under Chapter-III emphasized upon key determinants of birth weight reporting. Results suggested that non-reporting of birth weight was higher than reporting of birth weight in India. All predictor variables were having significant effect with birth weight reporting. There have been many studies corroborating these
findings (Bharti et al., 2011; Kadam et al., 2015; Rakesh et al., 2013). This indicates that the selected background characteristics may be regarded as potential predictors for the reporting of birth weight. Such findings need to be replicated in more studies. When such studies will be conducted with more periodicity, it will enable in prioritizing the amenable factors that may attenuate the prevalence of LBW in developing country like India.

The multivariable results identified key determinants for reporting of birth weight as mother’s residing in urban areas; educated up-to less than secondary level and secondary; middle level economically placed mother’s and richer ones; of other backward class. Moreover, Muslim category mother’s possessed significantly less chance for reporting birth weight. Significantly, decreasing trend of reporting birth weight was noticed with increasing birth order (P for trend <0.05). In addition to aforementioned potential predictors, mothers in the middle reproductive age group were more likely to report birth weight. One another vital finding observed was twenty times more likelihood reporting birth weight among mothers whose delivery took place in hospital. These findings are also in congruence with existing literatures (Kaushal SK et al., 2012).

Chapter-IV also provides methodological improvement in our understanding regarding prevalence of LBW, by taking into account the problem of heaping. In absolute sense the adjusted LBW was found 6% higher than unadjusted LBW in India. Across all subcategories of predictor variables, adjusted LBW was found higher than the unadjusted LBW. The percent prevalence was found highest in Haryana for both estimation procedures, unadjusted and adjusted. Adjusted LBW was found 11% higher than unadjusted LBW in Haryana. For the state of Mizoram, the minimum prevalence of LBW was detected in both the estimation procedures (unadjusted and adjusted LBW). These results point to the fact that future studies must consider the economic cost and implications associated with the absolute difference of 6% between the unadjusted and adjusted prevalence of LBW. In absolute sense 6% may not be very attractive to policy planners, but there will always be challenges methodologically to address such difference in actual field settings across different regions of India. These findings are also in congruence with existing literatures (Deshpande et al., 2011; Kandhasamy & singh et al., 2015).
In cases where the birth weights were reported through mother memory recall, prevalence of unadjusted and adjusted LBW was found highest than health card. Birth weights reported through health card displayed less heaping than recall methods. Unadjusted and adjusted LBW was found highest among the sub-category of predictor variables; mother residing in rural area; belonging to poorer economic status; uneducated; Hindus; of schedule caste; younger age group; experiencing higher birth order and among those mother’s whose delivery took place at home.

Result of the study under Chapter-IV were further crystallized that the reported birth weight at exact weight 2500grams affected the prevalence of LBW. At the time of birth weight reporting, respondent prefer to report and recorder prefer to record rounded figure of birth weight. The key point highlighted under the present chapter is that what is/are implications of birth weight 2500grams being labeled as LBW? Related literature also suggested that a weighting procedure that combines reported birth weights with mothers’ assessment of the child’s size at birth, and categorization of one-quarter of the infants reported to have a birth weight of exactly 2500 grams as having LBW (Blanc A., et al., 2005). Similarly, a study suggested that an inherent problem in using birth weight data from most population-based retrospective surveys, including the NFHS, is the heaping of the weights as people tend to round digits, irrespective of the unit of measurement (Boerma JT. et al., 1996). For measurement error a study suggested that Cross-sectional estimates of birth weight data are subject to recall bias and measurement errors (Blanc A. et al., 2005). A study suggested by Channon et al., 2011, was found that a substantial differences in the distribution of birth weights by method of reporting. Problems identified here sometimes weight recorded, 2498 grams, 2499 grams, but it was reported as a rounded digit as (2500 grams). Whenever, birth weight was recorded in actual LBW but it was reported in normal birth weight because of preference of round digit number. That is why prevalence of LBW affected either weight was recorded from health card or mother memory recall. Prevalence of LBW was found under unadjusted was 21.5% and adjusted was 27.31% in India. These findings are in line with the existing literature documenting that infants with missing birth weight data have different characteristics from those with recorded birth weight, estimates of low birth weight depending solely on available birth weight records will produce a biased prevalence (MM Islam, 2014). We may conclude that adjusted LBW may be consider
Chapter-V; developed the epidemiological models investigating the association between mother's nutritional status and LBW in India. The prevalence of the LBW was found to be 21.5%, which means one in every five infants born is of LBW. Contingency coefficients was found statistically significant (p<0.05) for all predictors variable except religion. In Haryana, prevalence of LBW was found highest and lowest in Mizoram. The varying prevalence across regions suggests that many local and contextual variables may also influence the recorded prevalence. Such regional and contextual actors must also be considered in the future studies.

Mothers’ nutrition, measured by their body mass index (BMI) had the greatest odds on birth weight. Underweight mothers were more likely to have a LBW than normal BMI. Anemic mothers were more likely to have LBW than non anemic. Literature suggested that a factor associated with underweight, obesity or overweight are very similar, information and health education programs for women are needed to help them to understand the components of a healthy diet and to ensure adequate access to health services, as suggested by existing studies (Patil Ramesh S, 2012).

Mother’s who never underwent for antenatal checkup were more likely to have LBW than those with 3 or more visits by model (III, IV). Moreover, those who never visited for ANC checkup were more likely to have LBW than those who used to go regularly for ANC checkup. The average Birth weight was low for malnourished pregnant women. Hence so health policies should aimed at early detection and effective management of under nutrition mother’s to reduce the burden of LBW. The study suggests the need for paying more focused attention on better maternal nutrition and education on birth spacing, early pregnancy, family planning and nutrition, as suggested by Megha et al., 2014. Hence this study provides further importance of maternal related characteristics like nutrition, education, anemic status, regular ANC checkups, on reducing the burden of LBW. Additionally, fifth and above birth order of baby were more likely to have a LBW than first order of the baby. Hence mother’s
coming for ANC with probable higher birth order must be acquainted for the related consequences, and be educated for means of effective contraceptive methods to stop further pregnancy.

The critical relevance of mother’s nutritional status was emphasized by the fact that all the EAG including Assam state, were part of the present analysis. The two significant finding for Uttar Pradesh, were overweight (less likely) and fourth birth (less likely). In Madhya Pradesh, only single predicted variable being overweight (less likely) was significant finding. In Bihar, two significant predictor variables for LBW were underweight (more likely); birth order fifth and above (two times more likely). In Jharkhand, only third birth order was significantly predicted LBW (less likely). In case of Orissa, anemic and underweight mothers were more likely to deliver LBW infants. In Rajasthan, anemic mother were more likely to have LBW than non anemic. In Assam, underweight mothers were approx three times more likely to have LBW as compared to mother’s having normal BMI level. In Nepal, the study suggested that increasing BMI and the gestational weight gain to be strongly associated with the birth weight of the newborns among the ethnic community (S.upadhyay et.al, 2011).

When considering the findings of this study we need to keep in mind the problems associated with birth weight and the fact that information on mothers’ BMI, ANC visits and anemia status was collected at survey date. We focused on the relationship among the eleven predictor variables and the likelihood of LBW. Of special, consideration was the link between mothers’ nutritional status and LBW. Controlling the effect of other proximate determinants in the model-IV, body mass index (BMI), antenatal care, ANC-checkup, education of mother, birth order, age of mother and other factors were found a significant impact on the likelihood of LBW. In EAG states including Assam state were also showed that mothers’ nutritional status had more consistent relationship with LBW than any other sub-categories of covariate included in the analysis. The effect of mothers’ nutritional status on newborn baby birth weight highlights the interaction between the predictor variables. BMI was the most discriminating factor in birth weight outcomes in those social contexts where use of antenatal services was almost universal. Among the other proximate determinants included in the analysis, some factors were relevant for birth weight in many states compared to other factors. The evidence from studies in India and overseas
corroborates the finding that maternal nutritional status substantially impact birth weight. An exhaustive review of the literatures concluded that improving mothers’ nutritional status and increasing coverage of antenatal visits are reduce the prevalence of LBW (Arodi Dalal et al., 2014; Muthayya et al., 2009; P.Kalk et al., 2009; Agarwal et al., 2012; KK Sahu et al., 2015). The results of the study also suggested that prevalence of LBW was observed high among those women who were underweight in comparison to women with normal BMI. Prevalence of the LBW was found low under not anemic than anemic. This can be done by selectively targeting interventions to improve nutrition (BMI), anemia, ANC visits, education and birth order.

Chapter-VI; the objective under the present chapter were to portray region specific profile of respondent by different background characteristic; reporting the prevalence of birth weight and LBW across different regions by background characteristic and quantify the association of various background characteristic with phenomenon of reporting birth weight and LBW.

The profiling under chapter VI suggested that predominantly across all the regions the mothers were from rural areas; belonging to the middle age group; practicing Hinduism; their infants with first birth order; were anemic but having normal body mass index and house wife. The region specific distribution of percent prevalence for reporting of birth weight revealed that across all region proportionately higher mothers were from urban areas; educated up to secondary and above level; in the middle age group, except east; economically better; belonging to general caste category; delivering in institutional settings; experiencing lower birth order; non-anemic but non-working; and overweight.

Moreover, the region specific distribution of percent prevalence for LBW revealed that across all region proportionately higher respondent were from rural areas; with low level of educational attainment in the younger age group; economically deprived; delivering at home; experiencing higher birth order except (central and northeast); anemic; and underweight.

The multivariable logistic regression model suggested significant association for reporting of birth weight with background characteristic to higher extent (higher odds) with education (secondary and above); economically better (richer).
Furthermore, the higher the birth order lower the odds for reporting of birth weight for region of north, central and east. Contrary to above findings majority of the background characteristic did not predicted significant odds for low birth weight. The insignificant finding for the majority of background characteristics is suggestive of the potential confounding by type of residence (rural/urban). The profile of birth weight and LBW respectively portrayed urban and rural profile. This has much public health implications. For example it is quite likely that rural women do not report birth weight, as their delivery may have occurred at home. At the same time being malnourished they develop anemia and thus more prone for the LBW infants. This signified that development o epidemiological models are not same for both areas. Future studies must take account of this fact and develop regional specific epidemiological models by further enrichment in the list of selected variables as considered in the present study.

7.3 Conclusions

The present study provides evidence for methodological improvement in terms of diagnostic parameters for reporting of birth weight (both by recall method and health card (by taking gold standard as actual reported birth weight); adjustment for phenomenon of heaping; developing epidemiological models for identification of key parameters of background characteristics and also mother’s nutritional status on prevalence of LBW. The absolute enhancement of 6% in the prevalence of LBW; strikingly different profile of mother’s responding for birth weight and LBW; homogeneity in terms of key socio economic parameters across different regions of India for reporting of birth weight and LBW, provides clue for deeper understanding of epidemiology of LBW. More studies are needed to develop regional specific epidemiological models that can further provide evidence in local settings. There would have been other covariate that had been left out in the present study. More studies in time to come should widen the scope of contextual framework in regional settings, for amelioration in our understanding for the LBW. India is the second largest populous country in the world and largest democracy in the world. In our country, any planned change has to be pursued with people's acceptance, and hence concentrating to development of regional models may go a long way in reducing the associated burden. The true causality of LBW in terms of pathways through which different variables may contribute their own relative importance could not be
addressed under the present study. Such further methodological advancements can be made through application of robust statistical techniques such as, latent class analysis and latent trait analysis for regional settings and structural equation modeling at national level. The contributors to the present research works anticipate utilization of these findings, in actual field settings.
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