PREVALENCE OF LOW BIRTH WEIGHT & ITS CHANGE DUE TO HEAPING PROBLEM IN COLLECTED DATA ON BIRTH WEIGHT

Dharmendra Kumar Dubey[1], Dilip C. Nath, [2]

[1]Research Scholar, Department of Statistics, Gauhati University, Assam,
[2]Professor, Department of Statistics, Gauhati University, Assam,
INDIA.

[1]dubey.dhar@gmail.com, [2]dillipc.nath@gmail.com

ABSTRACT

Exact reporting of the Low Birth Weight (LBW) is important for monitoring the health of a population. LBW is often underestimated in developing countries due to heaping of the data at 2500 grams. The main objective of reaserch was: to study the prevalence of LBW with adjustment of weight heaping and its association with various covariates in India. In this study, data was taken from the third round of National Family Health Survey (NFHS-3), conducted during 2005-2006. Ratio Method was used to give revised estimate of low birth weight and 95% confidence interval calculated for adjusted low birth weight. Data was analyzed for socio-demographic determinants of states and country (India) level. It was concluded that unadjusted prevalence of LBW in India was reported 21.5% and adjusted prevalence of low birth weight in India was obtained 27.1%.

Keywords: Birth Weight, Heaping, Adjusted LBW, Socio-demographic

INTRODUCTION

Low birth weight (LBW) is one of the most important health indicators in every society. It reveals mother and their new-born infant's health condition. Prevalence of LBW represents the scenario of infant's health risk in the country. In general, lower the weight, the higher a baby's risk of mortality. Low birth weight is internationally recognized indicator for the predictor of an individual baby's survival. Therefore, exact reporting of the prevalence of low birth weight is important for monitoring the health of a population. LBW is often underestimated in developing countries due to heaping of the data at 2500 grams.

Birth weight is an important variable both for policy and research, but accurate birth weight data from the developing countries is lacking [3]. The validity and reliability of maternally reported pregnancy and delivery information may differ with the nature of the factor of interest, but is affected little by time from birth or case-control status [4]. Incidence of low birth weight is 15.5 per cent of all births, or more than 20 million infants worldwide, are born with low birth weight. The level of low birth weight in developing countries (16.5 per cent) is more than double the level in developed regions (7 per cent). More than 95 per cent of low birth weight babies are born in developing countries [5].

In this Study, we reviewed some of the relevant studies which have reported the prevalence of low birth weight with adjustment of birth weight heaping on cross sectional surveys data on globally and some selected countries level. So, that following the above literature, we materialize that to analyze the cross-sectional survey data at India level to demonstrate the prevalence of low birth weight & its change due to heaping problem in collected data on birth weight.

Leena and Luna International, Chikusei, Japan.
(株) リナアンドルナインターナショナル, 筑西市,日本
ISSN: 2186-8492, ISSN: 2186-8484 Print
www.ajssh. leena-luna.co.jp

RESEARCH QUESTIONS

Keeping in view of the reviewing literature key questions arise in mind for the study are:

i. What is the prevalence of low birth weight?
ii. What is the association of low birth weight with covariates?
iii. What is the effect of heaping in prevalence of low birth weight?

OBJECTIVE

The main objective was: to study the prevalence of LBW with adjustment of weight heaping and its association with various covariates in India.

MATERIALS AND METHODS

In the present study, data used from the third round of National Family Health Survey (NFHS-3), conducted during 2005-2006. The NFHS-3 survey was established to generate representative data at the national and state levels on population and health indicators, with special emphasis on maternal and child health outcomes. NFHS-3 survey covered all 29 states in India, which comprise more than 99 percent of India's population. In India, very few studies available for prevalence of the low birth weight with adjustment of heaped data. Low birth weight is defined as less than 2,500 grams (up to and including 2,499 grams) [5]. Heaping of birth weight data was evident in the DHS data where mothers show a tendency to round birth weight information to the nearest digit, for example 2,500 g instead of 2,485 grams [9, 2]. The ratio method technique was followed and it was proposed by Channon et.al, 2011[1].

In this study, ratio Method was used to give revised estimate of low birth weight in India. Data was analyzed for socio-demographic determinants of India and its state. Birth weight heaping was adjusted by inclusion of apportion of exact birth weight 2500 grams as a low birth weight. Revised estimate of low birth weight was calculated with adjustment of birth weight heaping by ratio method. Ratio method technique was considered as: the percentage apportioned varies is determined by obtaining the total number of babies weighing 2,000–3,000 gram, excluding those weighing exactly 2,500 gram. The percentage of infants weighing 2,000–2,499 gram out of the total weighing 2,000–3,000 gram (excluding those weighing exactly 2,500 gram) is calculated. Assuming that the distribution of birth weights between 2,000 and 3,000 gram is linear, this percentage will be then used to reclassify the same percentage of those infants weighing exactly 2,500 gram into the LBW category [1]. In this study, LBW is defined in three different ways to highlight how the classification of infants weighing 2,500 gram affects the percentage of LBW. The first definition is standard one, which is defined as LBW< 2500 grams. The second definition includes all birth weight reported on exact weight 2500 grams. The last definition apportions a percentage of birth weight recorded as weighing exactly 2500 grams as LBW.

RESULTS

Birth weight heaping adjustment with 95 percent confidence interval

As evident from table-1, shows the percentage of the prevalence of low birth weight in every sub category of variable in relation to data set. In table, prevalence of LBW was given in three different ways. First was the unadjusted LBW considered as <2500grams, second was called ≤ 2500 grams and third was called adjusted LBW with 95% confidence interval for different categories of variable. Percentage of the adjusted LBW was found (27.31%; 95% CI;

26.68-27.94) and unadjusted prevalence of LBW was found (21.53%; 95% CI; 20.95-22.11) in India. If 2500grams birth weight considered as LBW then prevalence of LBW (≤ 2500grams) was found 40% in India. Those birth weight was reported through mother memory recall, the percentage of unadjusted LBW (<2500grams) was found highest (22.50%; 95% CI; 21.86 - 23.14) than health card. Adjusted LBW was also found highest in same category (27.86%; 95% CI; 27.18 - 28.54) than health card. Among all the predictor variables, adjusted low birth weight was found higher than unadjusted low birth weight in India. Details result was given in table1.

Table 1 (Part-I). Estimate of low birth weight with adjustment of heaping for different socio-demographic characteristics and confidence interval of the unadjusted and adjusted low birth weight in India

Place of residence	*<2500*	*95% C.I.*	*≤ 2500*	*Adjusted*	*95% C.I.*	*N*
Urban	19.3	18.5 - 20.2	38.1	24.7	23.8 - 25.6	8623
Rural	23.3	22.5 - 24.1	41.9	29.4	28.5 - 30.3	10626
Wealth Index						
Poor	25.4	24.0 - 26.7	46.0	32.8	31.4 - 34.3	4156
Middle	23.7	22.3 - 25.0	42.6	29.9	28.4 - 31.4	3752
Rich	19.4	18.7 - 20.2	37.2	24.5	23.7 - 25.3	11342
Education						
No education	26.2	24.9 - 27.6	46.1	33.5	32.0 - 34.9	3943
Educated but < secondary	22.0	21.2 - 22.7	40.7	27.8	27.0 - 28.6	11310
Secondary & Above	15.7	14.6 - 16.9	32.8	20.0	18.7 - 21.2	3996
Religion						
Hindu	21.8	21.2 - 22.5	40.8	27.8	27.0 - 28.5	15342
Muslim	20.2	18.6 - 21.7	37.7	25.2	23.6 - 26.9	2622
Others	20.8	18.6 - 23.0	38.2	26.1	23.7 - 28.5	1284
Caste						
Schedule caste	23.7	22.2 - 25.1	43.8	30.6	29.0 - 32.1	3309
Schedule tribe	22.3	19.9 - 24.7	40.0	28.2	25.6 - 30.8	1156
Other backward class	21.3	20.4 - 22.3	39.4	26.7	25.7 - 27.7	7372
Birth order						
1st birth order	22.3	21.4 - 23.2	41.5	28.5	27.5 - 29.5	8556
2nd birth order	19.8	18.8 - 20.8	38.2	25.1	24.0 - 26.2	6381
3rd birth order	21.3	19.7 - 22.9	40.7	27.0	25.2 - 28.8	2402
4th birth order	22.2	19.7 - 24.8	38.5	27.0	24.3 - 29.7	1019
5th & above birth order	26.4	23.5 - 29.3	42.4	32.5	29.4 - 35.6	888

Leena and Luna International, Chikusei, Japan.
(株) リナアンドルナインターナショナル, 筑西市,日本
ISSN: 2186-8492, ISSN: 2186-8484 Print
www.ajssh. leena-luna.co.jp

Table 1(Part-II). Estimate of low birth weight with adjustment of heaping for different socio-demographic characteristics and confidence interval of the unadjusted and adjusted low birth weight in India

Place of residence	*<2500*	*95% C.I.*	*≤ 2500*	*Adjusted*	*95% C.I.*	*N*
Age of mother						
15-24 age group	24.0	23.0 - 24.9	44.0	30.7	29.7 - 31.7	8424
25-34 age group	19.9	19.1 - 20.7	37.5	25.0	24.2 - 25.9	9842
35-49 age group	16.8	14.5 - 19.2	34.4	21.3	18.6 - 23.9	984
Place of delivery						
Home delivery	24.0	22.4 - 25.7	42.4	30.0	28.2 - 31.8	2535
Institutional delivery	21.2	20.6 - 21.8	39.8	26.9	26.2 - 27.6	16716
Working Status						
Working mother	21.5	20.3 - 22.7	40.4	27.2	25.9 - 28.4	4789
Nonworking mother	21.5	20.8 - 22.2	40.1	27.4	26.6 - 28.0	14431
Reporting methods						
From health card	19.1	17.6 - 20.6	19.2	24.0	22.5 - 25.7	2755
From memory recall	22.5	21.7 - 23.1	21.9	27.9	27.2 - 28.5	16495
Total	*21.5*	*21.0 - 22.1*	*40.2*	*27.3*	*26.7 - 27.9*	*19253*

Figure 1 shows the prevalence of low birth weight in India with three different methodological ways. Here, first bar was shown for actual prevalence of LBW, which has been defined by WHO cut-off point (<2500 grams). Second bar was given for ≤ 2500 grams, When birth weight 2500 grams was consider as LBW then prevalence was obtained 40.20% and third bar was given for adjusted LBW which was calculated by ratio methods.

Figure 1: Prevalence of Low birth weight under three approches.

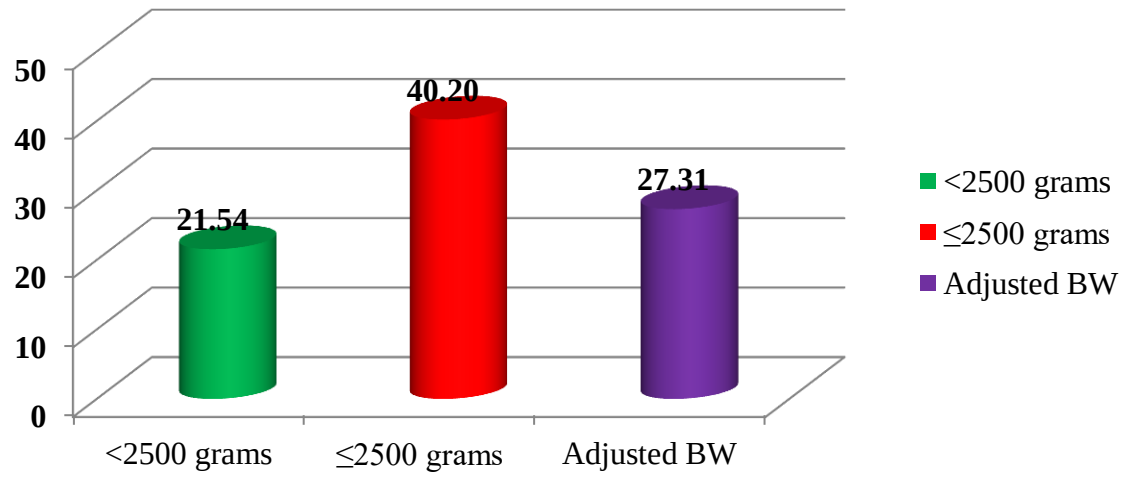

Table 2. Estimate of low birth weight with adjustment of heaping for each states of India and confidence interval of the unadjusted and adjusted low birth weight

State	*<2500*	*95% C.I.*	*≤ 2500*	*Adjusted*	*95% C.I.*	*N*
Jammu & Kashmir	19.1	9.8 - 28.5	35.3	23.3	13.3 – 33.3	68
Himachal Pradesh	24.6	16.5 - 32.6	40.9	30.3	21.7 - 38.9	110
Punjab	27.7	23.6 - 31.9	51.6	37.5	33.0 – 42.0	451
Uttaranchal	25.0	16.5 - 33.5	43.4	31.8	22.7 – 41.0	100
Haryana	32.8	27.6 - 38.0	52.3	42.1	36.6 - 47.6	308
Delhi	26.6	21.3 - 31.9	46.2	35.2	29.5 – 41.0	267
Rajasthan	27.5	24.3 - 30.7	45.0	33.4	30.0 - 36.8	735
Uttar Pradesh	25.2	22.5 - 27.9	45.8	32.8	29.9 - 35.8	973
Bihar	27.6	24.4 - 30.9	51.9	37.0	33.6 - 40.6	728
Sikkim	7.7	Indeterminate*	23.1	10.8	Indeterminate*	13
Arunachal Pradesh	15.8	Indeterminate*	22.2	18.4	1.0 - 35.9	19
Nagaland	10.0	Indeterminate*	20.0	12.5	Indeterminate*	10
Manipur	13.0	4.0 - 21.9	26.4	16.9	6.9 - 26.8	54
Mizoram	7.0	Indeterminate*	14.3	8.4	0.0 - 16.7	43
Tripura	26.8	16.5 - 37.0	43.7	31.9	21.0 - 42.7	71
Meghalaya	18.3	8.5 - 28.1	25.0	20.2	10.0 - 30.4	60
Assam	19.4	14.8 - 23.9	37.4	24.7	19.7 - 29.7	289
West Bengal	22.9	20.9 - 24.8	41.7	29.2	27.0 - 31.3	1784
Jharkhand	19.0	14.7 - 23.3	38.2	24.8	20.0 - 29.6	316
Orissa	20.6	17.7 - 23.6	38.9	26.2	23.0 - 29.4	718
Chhattisgarh	17.4	12.9 - 21.9	36.9	22.3	17.3 - 27.2	270
Madhya Pradesh	23.3	20.5 - 26.2	47.9	31.8	28.6 - 34.9	857
Gujarat	21.9	19.8 - 24.1	40.4	27.9	25.5 - 30.3	1386
Maharashtra	22.2	20.7 - 23.6	42.5	28.8	27.2 - 30.4	3096
Andhra Pradesh	19.4	17.6 - 21.1	39.2	24.9	23.0 - 26.9	1968
Karnataka	18.7	16.9 - 20.6	36.4	23.7	21.7 - 25.7	1695
Goa	23.4	11.3 - 35.5	42.6	30.4	17.2 - 43.5	47
Kerala	16.0	13.8 - 18.4	25.0	18.2	15.8 - 20.6	988
Tamil Nadu	17.2	15.5 – 19.0	32.0	20.5	18.7 - 22.4	1829
Total	*21.5*	*21.0 – 22.1*	*40.2*	*27.3*	*26.7 - 27.9*	*19253*

*Indeterminate means data is not follow normal distribution sample size (n ≤ 30), so that lower limit of the confidence interval is calculating negative points, which is indeterminate.

Table 2 results were given for unadjusted (< 2500grams) and adjusted LBW with 95% confidence interval for each state. The percentage of unadjusted LBW (<2500grams) was found higher (32.79%; 95% CI; 27.55 - 38.04) in Haryana than others state and adjusted

Leena and Luna International, Chikusei, Japan.
(株) リナアンドルナインターナショナル, 筑西市,日本
ISSN: 2186-8492, ISSN: 2186-8484 Print
www.ajssh. leena-luna.co.jp

LBW was also higher (42.10%; 95% CI; 36.59 - 47.62) in Haryana than others state. Prevalence of adjusted LBW was found 11% higher than defined LBW (<2500grams) in Haryana state. The lowest percentage of prevalence of LBW was found in Jammu & Kashmir than others states. Unadjusted LBW was (19.12%; 95% CI; 9.77 - 28.46) and adjusted LBW was (23.29%; 95% CI; 13.25 – 33.34) in Jammu & Kashmir. For every individual state, results were given specifically in the table2.

In figure 2 the line diagram, the prevalence of low birth weight was shown with three different lines for every state of India. First line of the diagram considered the shape of Platykurtic; it was shown for actual prevalence of low birth weight (<2500 grams) for each state. Second line considered the shape of Mesokurtic; it was shown for adjusted low birth weight. Third line of the diagram considered the shape of Leptokurtic; it was shown for birth weight considered as (≤ 2500 grams).

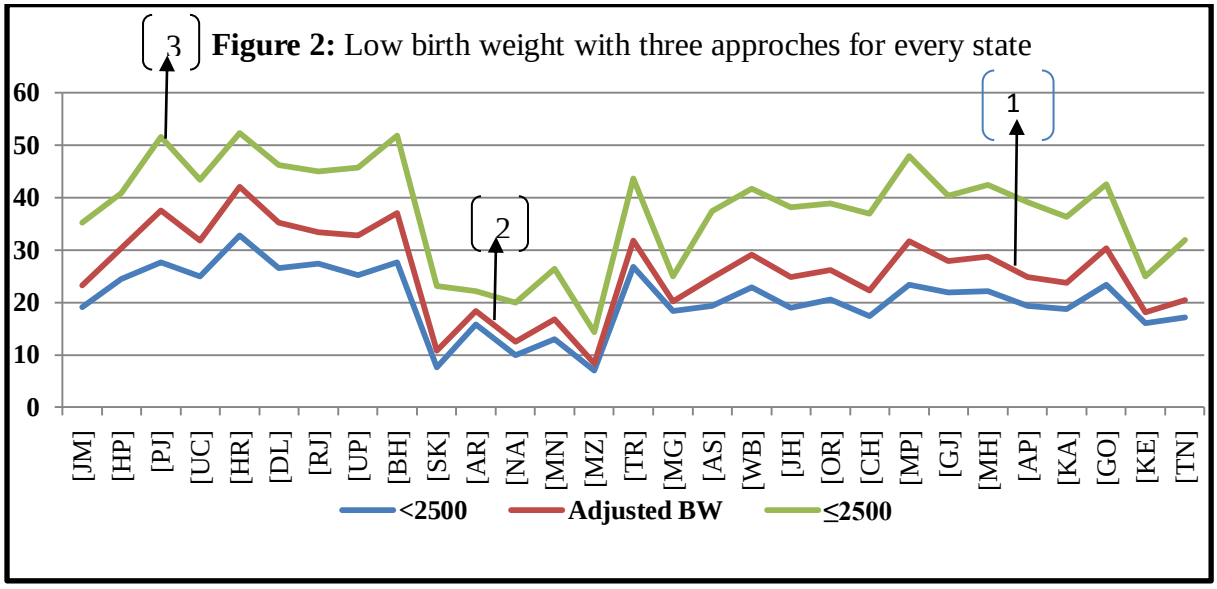

Figure 2: Low birth weight with three approches for every state

DISCUSSION AND CONCLUSIONS

The aimed of the study was the prevalence of LBW with adjustment of weight heaping and its association with various covariates in India. When 2500grams birth weight was considered as LBW then ≤ 2500grams was found 40% in India. Estimate of adjusted LBW has increased 6% in prevalence of LBW than defined LBW (<2500grams) [5]. According to various categories of variable, adjusted LBW was increased than unadjusted low birth weight in India. Weighting procedure combines the 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 low birth weight [9].

The percentage of prevalence of unadjusted LBW (<2500grams) was found highest in Haryana than others state and adjusted LBW was also found highest in Haryana. The prevalence of adjusted LBW was increased 11% than defined LBW (<2500grams) in Haryana. The lowest percentage of prevalence of LBW was found in Jammu & Kashmir for both unadjusted & adjusted LBW. An inherent problem in using birth weight 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. Although heaping of birth weight is found common in developing countries [8].

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 [1]. Heaping represents misclassification that arises when measured birth weights are rounded to the nearer grams and then grouped into weight classes. Possible biases from misclassification should be carefully evaluated [2].

Those birth weight was reported through mother memory recall, the percentage of prevalence of unadjusted LBW (<2500grams) was found highest than health card and adjusted LBW was also found highest. Cross-sectional estimates of birth weight data are subject to recall bias and measurement errors [8, 9].

It was expected that weights reported from a health card shows less heaping than those recalled from mother memory recall. The percentage of the prevalence of unadjusted and adjusted LBW was higher in following the categories of the predictor variables like rural, poor, uneducated, Hindu, schedule caste, early age group, higher birth order and home delivery. Channon et al., 2011 [1] was found that there were substantial differences in the distribution of birth weights by method of reporting.

Haryana state shows higher prevalence of low birth weight (unadjusted & adjusted) and Mizoram shows lowest prevalence of adjusted LBW. Birth weight reported through mother memory recall was recorded highest prevalence of LBW in comparison to health card.

These study summaries that if birth weight reported in digit preference like round figure then prevalence of low birth weight affected. At the time of reporting birth weight, respondent prefer to report round figure of birth weight. In this study question was identified that birth weight 2500grams should consider as a low birth weight or not? Digit preference was influenced the actual prevalence of LBW. Sometimes birth weight recorded, 2498g, 2499g, but it was reported as a round figure (2500grams). According to ratio method prevalence of low birth weight was found 27.1% and unadjusted LBW was found 21.5% in India.

Leena and Luna International, Chikusei, Japan.
(株) リナアンドルナインターナショナル, 筑西市,日本
ISSN: 2186-8492, ISSN: 2186-8484 Print
www.ajssh. leena-luna.co.jp

REFERENCE

[1] Andrew, A. R. C., Sabu, S. P., & John, W. M. (2011). Measuring birth weight in developing countries: Does the method of reporting in retrospective surveys matter? *Maternal and Child Health Journal*, *15*, 12-18.

[2] Blanc, A., & Wardlaw, T. (2005). Monitoring low birth weight: An evaluation of international estimates and an updated estimation procedure. *Bulletin of the World Health Organization, 83* (3), 178-185.

[3] Boerma, J. T., Weinstein, K. I., Rutstein, S. O., & Sommerfelt, A. E. (1996). Data on birth weight in developing countries: Can surveys help? *Bulletin of the World Health Organization, 74* (2), 209-216.

[4] Eggleston, E., Tsui, A. O., & Fortney, J. (2000). Assessing survey measures of infant birth weight and birth size in Ecuador. *Journal of Biosocial Science, 32*, 373-382.

[5] Olson, et al. (1997). Medical record validation of maternally reported birth characteristics and pregnancy-related events: A report from the children's cancer group. *American Journal of Epidemiology, 145* (1).

[6] Quigley, M. A., Hockley, C., & Davidson, L. L. (2007). Agreement between hospital records and maternal recall of mode of delivery: Evidence from12391 deliveries in the UK Millennium Cohort Study. *BJOG: An International Journal of Obstetrics and Gynecology, 114*, 195-200.

[7] Rekha, et al. (2014). Evaluation of adjustment methods used to determine prevalence of low birth-weight babies at a rural hospital in Andhra Pradesh, India. Retrieved from http://www.ijph.in.

[8] Umbach, D. M. (2000). Unit conversion as a source of misclassification in US birth weight data. *American Journal of Public Health, 90* (1), 127-129.

[9] UNICEF. (2004). *United Nations Children's Fund and World Health Organization, low birth weight: Country, regional and global estimates*. New York: UNICEF.