Factors Associated with Low Birthweight in Low-and-Middle Income Countries in South Asia

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Abstract: Child with Low Birth Weight (LBW) has a higher risk of infant mortality, learning difficulties in childhood due to stunted growth and impaired neurodevelopment, is more likely to develop heart diseases and diabetes in adulthood. This study aimed to evaluate the latest demographic and health surveys (DHSs) across multiple countries in South Asia to determine the factors associated with LBW among these countries. Latest available DHS data across Afghanistan (2015, n = 29,461), Bangladesh (2018, n = 20,127), Nepal (2016, n = 12,862), and Pakistan (2018, n = 15,068) were analysed. Complex survey adjusted generalized linear models were fitted to investigate the association of birth weight with sociodemographic and decision-making factors. Pakistan had the highest proportion of LBW at 18% followed by Afghanistan and Bangladesh at around 14% and Nepal had the lowest (13%). Children born in Pakistan were more likely to have LBW children than Afghanistan (AOR = 2.17, 95% CI = 1.49–3.14). Mothers living in rural areas (AOR = 0.77, 95% CI = 0.61–0.97), with highly educated partners and belonging to richer families were less susceptible to having child with LBW. To reduce 30% LBW in-line with the World Health Organisation’s 2025 goal, policymakers in SA should focus on women in urban areas with low-educated partners belonging to poor households to ease LBW burden.

Keywords: low birth weight; low-and-middle income; South Asia; multivariate binary logistic regression; complex survey

1. Introduction

Child with low birth weight (LBW) have a higher risk of infant mortality, learning difficulties in childhood due to stunted growth and impaired neurodevelopment, and are more likely to develop heart disease and diabetes in adulthood [1–4]. According to the World Health Organisation (WHO) child born under the weight of 2500 gm is considered LBW. Given the complications associated with it, the WHO has set a goal to reduce cases of LBW by 30% by 2025 [3]. The region of South Asia (SA) currently has the highest proportion (28%) of children who were born with LBW worldwide [3]. It is, thus, deserve careful attention if the 2025 goal is to be achieved.

Several research determined a few factors that were found to be associated with LBW including socio-economic status, maternal age, parity, pregnancy interval, non-pregnant weight, maternal height, haemoglobin level, BMI, trimester bleeding, tobacco consumption, alcohol consumption, gestation age, antenatal care (ANC), and maternal nutritional status [5–7]. Furthermore, recent studies demonstrated that women who participates in family decision making was a positive predictor for ANC [8], and women who experienced intimate partner violence (IPV) had a higher risk of giving birth to child with LBW [9].

LBW is one of the major public health concerns, as it is estimated that 20 million children born each year are underweight and is more prevalent in low-middle income countries (LMICs), with 28% of all LBW children born in SA, 13% in sub-Saharan Africa.
Prior studies into LBW in SA were mostly country specific. This study aimed to address the gap in identifying the common socio-economic factors of LBW in the selected multiple countries to aid policymakers in comparing their policies and assess the action plan or interventions that have worked thus far in achieving target set by the WHO.

This study, thus, aimed to evaluate the latest population surveys of multiple LMICs in SA including Afghanistan, Bangladesh, Nepal, and Pakistan to determine the effects of socio-economic factors, decision-making power of women (DPW), and intimate partner violence (IPV) have on LBW among these countries.

Furthermore, insights into DPW and IPV can setting policies to improve women’s quality of life and to enhance United National gender equality target related to Sustainable Development Goal 5 [13] as well as a step toward empowering women.

2. Methods

This study analysed comparable population-based cross-sectional demographic and health surveys (DHS) data across four LMICs in SA conducted between 2015–2021. These surveys collected data on women aged between 15 to 49 years old. The data custodians of DHS ensure the population in surveyed countries are well presented by implementing two-stage stratified sample of households. The first stage involves using probability proportion to size (PPS) to select the most appropriate enumeration areas (EAs) from Census file, the second stage involves using an updated list of households to select the sample of households in each EAs [14].

The most recent DHS survey for Afghanistan (2015) consists of 29,461 women, Bangladesh (2018) with 20,127 women, Nepal (2016) with 12,862 women, and Pakistan (2018) with 15,068 women were used were 98%, 99%, 98% and 96%, respectively [15–17]. For the current study, samples where information on child’s weight were available for mother were extracted and the sample size was 2671, 2200, 2564, and 1575 for Afghanistan, Bangladesh, Nepal and Pakistan, respectively. This study focused on latest single birth child for each mother, as few surveyed birth weights were based on mother’s memory and the current demographic information of households are more likely to be comparable with most recent childbirth.

2.1. Outcome Variable

The outcome variable for this study was low birthweight—a dichotomous measure with children with birthweight < 2500 gm is considered as ‘LBW’, otherwise noted as ‘normal’ weight.

2.2. Covariates

Literature review on LBW in LMICs in SA identified seven covariates as predictors for LBW and was included in this study. These are place of residence (urban/rural), maternal age at birth of child (<20, 20–24, 25–29, and ≥30), respondent’s education level (no education, primary, secondary, and higher), partner’s education level (no education, primary, secondary, and higher), respondent’s employment status (yes/no), wealth index (poorest, poorer, middle, richer, and richest) derived from principal component analysis on data
such as household assets owned [18], and respondent’s exposure to media; a dichotomous measure—derived from frequency of watching television, reading the newspaper, and magazine and listening to the radio. For the current analysis, a mother is considered exposed to media if they engaged to any of the media ‘at least once a week’.

Two targeted covariates of this study are DPW and justification to IPV. DPW—a binary variable—depends on respondents’ contribution on three major household decisions such as ‘respondent’s health care’, ‘large household purchases’, and ‘visits to family/relatives’. Respondents were considered to contribute to household decisions if they made these decisions alone or co-decided with partners [8]. Otherwise, if the decision was made by their husband/partner or someone else, they were considered to not have decision-making power. Respondent’s justification to IPV is also a dichotomous variable computed from respondent’s opinion on physical abuse from husband. It is considered ‘yes’ if respondent responded that physically hearting wives was justified if wives did not tell husbands of her whereabouts, neglected children, refused intimacy, and burnt food [9].

2.3. Statistical Analysis

This study explored the primary unweighted bivariate association between LBW and the covariates through Chi-square ($\chi^2$) test. This study assumed data is missing at random and therefore listwise deletion method was used to exclude them from the study, as done in similar studies published previously [19,20]. Survey outcomes of the four countries was merged into one dataset to assess the inter-country differences. To assess the strength and direction of cohort associations the complex-survey generalized linear models (GLMs) adjusted for strata, cluster, and weight variables was fitted on the merged dataset. Adjusted odds ratio (AOR) along with 95% confidence interval was obtained to gain insights on the effect size and strength of association. R package ‘survey’ (version 4.1-1) was used to input survey design elements and apply modeling. All analyses were conducted on R (version 4.1.2).

3. Results

Among the four countries assessed, Pakistan had the highest proportion of LBW at 18.7% and Nepal had the lowest at 11.3%. Both Afghanistan and Bangladesh were similar at around 14%. Pakistan had the highest proportion of LBW in all sociodemographic factors except for mothers with no education/preschool and higher education level. Bangladesh had highest proportion of LBW where mother had no education/preschool, and Afghanistan had highest proportion of LBW where mother had higher education level. Nepal had lowest proportion of LBW in all sociodemographic factors except for material age <20 and richer wealth index, where Afghanistan had lower proportion of LBW.

Results obtained from unweighted bivariate analysis presented in Table 1 show there were slightly higher proportion of LBW children in rural areas than urban areas for all countries except for Afghanistan; however, only strong evidence of difference was found for Pakistan ($p = 0.011$). While the proportion of children with LBW decreases as mother’s age at childbirth increases for Nepal, it is a V-curve for Pakistan and Bangladesh and is inverted-U shape for Afghanistan. Younger mothers (<20-year-old) in Pakistan had much higher proportion of LBW than the other countries, and Afghanistan had the lowest LBW rate (13.9%) compared with Nepal (15.2%) and Bangladesh (15.5%). For mother’s education, while LBW of children in Bangladesh and Nepal decreased as mother’s education level increased, in Pakistan LWB rate was lower among mothers with higher education compared with other education levels. All four countries show the same trend for partner’s education level; LBW decreases when partner’s education level increases that is proportional of children with LBW decreased when partner’s had secondary or higher level.
| Determinants | Afghanistan | Bangladesh | Nepal | Pakistan |
|--------------|-------------|------------|-------|----------|
|              | All (n)     | LBW (n/%)  | All (n) | LBW (n/%)  | All (n) | LBW (n/%)  | All (n) | LBW (n/%)  |
| **Total**    | 2671        | 389 (14.6) | 2200   | 317 (14.4) | 2564    | 289 (11.3) | 1575    | 294 (18.7) |
| Residence    |             |            |        |            |         |            |         |            |
| Urban        | 1052        | 154 (14.6) | 970    | 132 (13.6) | 1701    | 180 (10.6) | 973     | 162 (16.6) |
| Rural        | 1619        | 235 (14.5) | 1250   | 185 (14.8) | 863     | 109 (12.6) | 602     | 132 (21.9) |
| **p-value**  | 0.974       | 0.462      | 0.138  | 0.011      |         |            |         |            |
| Maternal age at birth |           |            |        |            |         |            |         |            |
| <20          | 316         | 41 (13.0)  | 624    | 97 (15.5)  | 578     | 88 (15.2)  | 76      | 25 (32.9)  |
| 20–24        | 842         | 130 (15.4) | 756    | 105 (13.9) | 1038    | 112 (10.8) | 371     | 79 (21.3)  |
| 25–29        | 666         | 103 (15.5) | 529    | 65 (12.3)  | 603     | 65 (10.8)  | 549     | 87 (15.8)  |
| >=30         | 847         | 115 (13.6) | 311    | 50 (16.1)  | 345     | 24 (7.0)   | 579     | 103 (17.8) |
| **p-value**  | 0.521       | 0.328      | 0.001  | 0.002      |         |            |         |            |
| Mother’s Education |          |            |        |            |         |            |         |            |
| No Education/preschool | 1854       | 285 (15.4) | 57     | 14 (24.6)  | 536     | 74 (13.8)  | 256     | 57 (22.3)  |
| Primary      | 316         | 37 (11.7)  | 344    | 60 (17.4)  | 435     | 50 (11.5)  | 184     | 41 (22.3)  |
| Secondary    | 379         | 52 (13.7)  | 1126   | 168 (14.9) | 1045    | 116 (11.1) | 504     | 121 (24.0) |
| Higher       | 122         | 15 (12.3)  | 693    | 75 (10.8)  | 548     | 49 (08.9)  | 631     | 75 (11.9)  |
| **p-value**  | 0.288       | 0.002      | 0.901  | <0.001     |         |            |         |            |
| Partner’s Education |           |            |        |            |         |            |         |            |
| No Education, preschool | 970        | 156 (16.1) | 158    | 26 (16.5)  | 219     | 35 (16.0)  | 162     | 38 (23.5)  |
| Primary      | 461         | 74 (16.1)  | 534    | 90(16.9)   | 437     | 62 (14.2)  | 150     | 37 (24.7)  |
| Secondary    | 847         | 115 (13.6) | 790    | 127 (16.1) | 1285    | 136 (10.6) | 600     | 121 (20.2) |
| Higher       | 393         | 44 (11.2)  | 738    | 74 (10.0)  | 623     | 56 (09.0)  | 663     | 98 (14.8)  |
| **p-value**  | 0.076       | < 0.001    | 0.006  | 0.004      |         |            |         |            |
| Employment Status |           |            |        |            |         |            |         |            |
| Not Working  | 2418        | 359 (14.8) | 1505   | 214 (14.2) | 1245    | 139 (11.2) | 1363    | 249 (18.3) |
| Working      | 253         | 30 (11.9)  | 715    | 103 (14.4) | 1319    | 150 (11.4) | 212     | 45 (21.2)  |
| **p-value**  | 0.235       | 0.958      | 0.917  | 0.351      |         |            |         |            |
| Wealth Index |             |            |        |            |         |            |         |            |
| Poorest      | 299         | 77 (25.8)  | 240    | 47 (19.6)  | 462     | 56 (12.1)  | 77      | 25 (32.5)  |
| Poorer       | 405         | 73 (18.0)  | 307    | 39 (12.7)  | 484     | 54 (11.2)  | 184     | 38 (20.7)  |
| Middle       | 469         | 63 (13.4)  | 399    | 71 (17.8)  | 534     | 74 (13.9)  | 266     | 61 (22.9)  |
| Richer       | 685         | 82 (12.0)  | 520    | 74 (14.2)  | 572     | 69 (12.1)  | 367     | 72 (19.6)  |
| Richest      | 813         | 94 (11.6)  | 754    | 86 (11.4)  | 482     | 36 (07.5)  | 681     | 98 (14.4)  |
| **p-value**  | <0.001      | 0.004      | 0.048  | <0.001     |         |            |         |            |
| Exposed to Media |           |            |        |            |         |            |         |            |
| No           | 861         | 159 (18.5) | 690    | 109 (15.8) | 949     | 123 (13.0) | 405     | 99 (24.4)  |
| Yes          | 1810        | 230 (12.7) | 1530   | 208 (13.6) | 1615    | 166 (10.3) | 1170    | 195 (16.7) |
| **p-value**  | <0.001      | 0.190      | 0.045  | 0.001      |         |            |         |            |
Table 1. Cont.

| Determinants                        | Afghanistan | Bangladesh | Nepal | Pakistan |
|-------------------------------------|-------------|------------|-------|----------|
|                                     | All (n)     | LBW (n/%)  | All (n) | LBW (n/%)  | All (n) | LBW (n/%)  | All (n) | LBW (n/%)  |
| Decision-making Power of Women      |             |            |        |           |         |           |         |           |
| No                                  | 774         | 106 (13.7) | 265    | 38 (14.3) | 720     | 98 (13.6) | 392     | 87 (22.2) |
| Yes                                 | 1897        | 283 (14.9) | 1995   | 279 (14.0)| 1844    | 191 (10.4)| 1183    | 202 (17.1)|
| p-value                             | 0.452       | 1.000      | 0.023  | 0.046     |
| Intimate Partner Violence           |             |            |        |           |         |           |         |           |
| No                                  | 531         | 88 (16.6)  | 1892   | 266 (14.1)| 1867    | 215 (11.5)| 1183    | 195 (16.5)|
| Yes                                 | 2140        | 301 (14.1) | 328    | 51 (15.5) | 697     | 74 (10.6) | 392     | 99 (25.3) |
| p-value                             | 0.162       | 0.531      | 0.569  | <0.001    |

Mother’s employment status did not show any primary association with LBW of children in the bivariate analysis. Children with LBW were typically more common among mothers residing in lower wealth indices households and wealth index was found to have an association for all for countries. Mothers who were not exposed to media had a higher percentage of children with LBW and showed significant association between LBW and exposure to media for Afghanistan (p < 0.001), Nepal (p = 0.045) and Pakistan (p = 0.001). The proportion of LBW was lower for mothers who contributed to household decisions, and the difference was significant for Nepal (p = 0.023) and Pakistan (p = 0.046). Women in Afghanistan and Nepal who felt intimate partner violence (IPV) is justified had slightly lower proportion of LBW than those who believed IPV is not justified although the differences are not significant (p > 0.05), whereas in Pakistan it is the reversed and the difference is significant (p < 0.001).

Table 2 shows the outcome of the survey adjusted binary logistic regression models. Five covariates showed strong evidence of association (p < 0.05) with LBW Children from Pakistan had 2.17 times higher odds of being LBW compared to those from Afghanistan (AOR = 2.17, 95% CI = 1.49–3.14). Children were less likely to be born with LBW when mothers live in rural area (AOR = 0.77, 95% CI = 0.61–0.97), have partner with higher education level (AOR = 0.63, 95% CI = 0.42–0.94), and belong to poorer (AOR = 0.71, 95% CI = 0.52–0.97) or richer (AOR = 0.70, 95% CI = 0.50–0.97) wealth quantile compared to poorest households.

Table 2. Results of the logistic regression model fitted to LBW with sociodemographic factors, adjusting for survey weights.

| Variable                          | AOR (95% CI) | p-Value |
|-----------------------------------|--------------|---------|
| Country (Ref: Afghanistan)        |              |         |
| Bangladesh                        | 1.27 (0.91 to 1.78) | 0.159   |
| Nepal                             | 0.73 (0.50 to 1.05) | 0.092   |
| Pakistan                          | 2.17 (1.49 to 3.14) | <0.001  |
| Residence (Ref: Urban)            |              |         |
| Rural                             | 0.77 (0.61 to 0.97) | 0.027   |
| Maternal age at birth (Ref: <20)  |              |         |
| 20–24                             | 0.91 (0.73 to 1.13) | 0.386   |
| 25–29                             | 0.86 (0.64 to 1.16) | 0.314   |
| >=30                              | 0.76 (0.56 to 1.03) | 0.076   |
Table 2. Cont.

| Variable                                      | AOR (95% CI)               | p-Value |
|-----------------------------------------------|----------------------------|---------|
| Mother’s Education (Ref: No Education/preschool) |                            |         |
| Primary                                       | 0.78 (0.58 to 1.05)        | 0.098   |
| Secondary                                     | 0.81 (0.53 to 1.25)        | 0.334   |
| Higher                                        | 0.63 (0.38 to 1.05)        | 0.079   |
| Partner’s Education (Ref: No Education, preschool) |                        |         |
| Primary                                       | 0.90 (0.66 to 1.23)        | 0.524   |
| Secondary                                     | 0.94 (0.69 to 1.29)        | 0.707   |
| Higher                                        | 0.63 (0.42 to 0.94)        | 0.024   |
| Employment Status (Ref: Not Working)          |                            |         |
| Working                                       | 1.07 (0.87 to 1.32)        | 0.519   |
| Wealth Index (Ref: Poorest)                   |                            |         |
| Poorer                                        | 0.71 (0.52 to 0.97)        | 0.032   |
| Middle                                        | 0.88 (0.66 to 1.20)        | 0.425   |
| Richer                                        | 0.70 (0.50 to 0.97)        | 0.032   |
| Richest                                       | 0.78 (0.52 to 1.19)        | 0.500   |
| Exposed to Media (Ref: No)                     |                            |         |
| Yes                                           | 0.87 (0.72 to 1.05)        | 0.143   |
| Decision-Making Power of Women (Ref: No)      |                            |         |
| Yes                                           | 0.82 (0.66 to 1.03)        | 0.090   |
| Intimate Partner Violence (Ref: No)           |                            |         |
| Yes                                           | 1.08 (0.88 to 1.32)        | 0.467   |

4. Discussion

This study investigated the factors associated with LBW among children in Afghanistan, Bangladesh, Nepal, and Pakistan using comparable population-based cross-sectional DHS conducted between 2015–2021. The study results showed that the proportion of LBW was lower than previously reported national level studies in the region, with LBW proportions in Afghanistan, Bangladesh, Nepal and Pakistan was 16%, 20%, 15.4% and 25%, respectively and now they are 14.6%, 14.3%, 11.3% and 18.7%, respectively [10,21–23]. Among the studied countries, Pakistan needs a greater effort to reduce its higher prevalence of LBW among newborns. This could be because currently Pakistan is behind the other countries in providing adequate medical care for expecting mothers and newborn children [24], and majority of Pakistanis do not spend enough on nutritious diet resulting in malnutrition that could lead to mothers having LBW children [25]. Cultural stigma could be an important factor, not available in the current study data, for Pakistan as well. Ahmed, Khoja and Tirmizi [26] reported that strict religious norms hinder mothers’ access to antenatal care. Furthermore, male dominance in a factor in societies such as Bangladesh and Pakistan, which may have played a role in care for mothers and seeking appropriate medical services [27–29].

Although the results obtained from unadjusted bivariate analysis showed a higher proportion of LBW children in rural compared urban areas, especially in Pakistan, the survey weight adjusted model revealed that mothers from urban areas have higher odds of having LBW children compared to their rural counterparts, which is consistent with findings from previous studies in this region [6,7,12]. However, this finding contradicts with some studies where opposite results were reported [30] or no significant difference.
was found between rural and urban [23,31]. This issue clearly needs further research taking into account the change environmental health in urban setting.

It was found that as fathers’ education level increased the proportion of children’s LBW decreased. Children with well-educated parents are less likely to be LBW and is consistent with previous studies in this region [1,10,21–23], this could attributed to educated fathers are more likely to understand the value of maternal health services and nutrition of mother/child. Educated fathers are more aware of maternal health issues and more likely to seek medical expert’s advice during their wife’s pregnancy and time of child delivery which decreases the likelihood of having LBW children.

Mothers belonging to the poorest quantile generally had the highest proportion of LBW children with exceptions in Nepal, and the model results showed strong evidence that higher wealth groups were less likely to have children with LBW. In accordant with previous studies in the same region [22,23,31] this study also found that the likelihood of having LBW child decreased as wealth index increased. Having more money enable mothers to have access to appropriate nutrition, full antenatal care and, able to deliver babies at hospitals by health professionals [31,32].

The strengths of this study are the use of comparable population-based cross-sectional DHSs across multiple countries LMICs in SA providing a snapshot of the whole region as well as comparing country-wise differences. Some interesting avenues for future research were revealed; particularly, the urban rural unexpected finding that rural areas were performing better with lower likelihood of LBW among children. This calls for further studies across different regional areas. Furthermore, education of mother’s, which is typically an indicator for health outcomes in newborns, did not show any strong evidence of association with LBW among children. This could be due to confounding effect and an impact of change in distribution when multiple survey data were merged. The study had some limitations. First, this study used cross-sectional study therefore cannot make causal inferences. Second, this study could not include all LMICs in SA due to lack of available DHS data. Third, as surveys in all four countries were not conducted in the same year there could be minor inconsistencies. Fourth, some confounders such as maternal comorbidity and parity of mothers were not adjusted in the current study models as they were not available in the DHS data sets. Future studies with an extensive data set can explore this. Lastly, the study only included the latest single birth from each household, and some of surveyed birth weights were based on mothers’ memory and can induce some memory bias.

5. Conclusions

LBW is a global health issue which is more prevalent in LMICs in SA. To meet the WHO’s target countries in this region can accelerate their relevant public health programs and social policies by leveraging and learn of each other, such as District Investment Case program implemented by Nepal [33] and Inclusive Growth framework implemented by Bangladesh [34]. By evaluating the common factors associated with LBW in the selected LMICs in SA, policymakers are encouraged to focus their attention to the vulnerable group of women living in urban areas with low-educated partners belonging to poorest wealth quantile to decrease the rate of LBW among children in SA.

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