Differentials and Determinants of Low Birth Weight in India; Evidence from National Family Health Survey (NFHS-5)

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ABSTRACT

Background: Low birth weight (LBW), defined as a birth weight below 2,500 grams, remains a major public health challenge due to its strong association with neonatal mortality, impaired childhood growth, and long-term developmental complications. Objectives of the study are to determine the prevalence of low birth weight and to examine determinants of low birth weight in India.

Methods: Study used nationally representative data from the National Family Health Survey (NFHS-5, 2019–21). A total of 149,279 women aged 15–49 years who had their most recent birth in a health facility were included. Descriptive statistics and chi-square tests assessed variations in LBW prevalence across socio-demographic and maternal characteristics. Logistic regression analysis conducted to estimate associations among selected determinants and LBW.

Results: LBW prevalence among facility-based deliveries in India was found to be 17%. Higher risk of LBW was observed among younger mothers (15–24 years), those with low educational attainment, women from poorer wealth quintiles, and those with severe anemia. Limited antenatal care utilization and tobacco use also positively associated with LBW prevalence. Protective factors included higher maternal education, normal BMI, birth intervals greater than 24 months, and absence of tobacco use.

Discussion: Both maternal and socio-economic conditions significantly influence birth outcomes. The strong association of LBW with low education, anemia, inadequate ANC, and poverty indicates the need for comprehensive maternal health strategies addressing nutritional, behavioral, and economic barriers.

Conclusion: Reducing LBW in India requires integrated interventions that promote maternal nutrition, ensure adequate ANC utilization, and mitigate socio-economic inequalities. Tailored policies and focused maternal health programs can contribute significantly to improving neonatal health and reducing the prevalence of LBW across the country.

Key words: LBW, Socio-economic determinants, NFHS, India

INTRODUCTION

World Health Organization (WHO) has defined Low Birth Weight (LBW) as "a birth weight of less than 2,500 gms at the time of birth, regardless of the gestational age" (UNICEF, 2023). LBW has become the new public health threat at global level, because, it is one of the strongest risk

factors associated with neonatal mortality and morbidity (Kader, 2014). LBW contributes 60–80% of neonatal deaths across the globe (WHO, 2022). According to statistics, more than 20 million babies worldwide in 2015 weighed less than 2500 gms at birth (UNICEF 2023). Infants born with LBW are more vulnerable and have higher chances of recurrent hospitalization, neuro-developmental disorders, chronic morbidities, and under-5 mortalities (Vohr, et al., 2000). Children with LBW are four-fold higher at risk of neonatal death when compared with their counterparts (Eshete A, et al.,2019). Research says that children with preterm births and LBW have resulted in developmental disabilities such as cerebral palsy, autism spectrum disorder and learning disability (Schieve LA, et al., 2016). Also, they are likely to be poor in academic performance during their schooling years (Vohr ,2000). Reducing the prevalence of LBW by 30% is a public health priority and global health commitment (WHO, 2004) The estimates indicate that one in seven live births (20.5 million infants) globally fell in the low-birth-weight category in 2015, and almost half of them is from South Asia. Moreover, around 40% of LBW infants are from India (WHO. 2011). More than one-fourth (27%) of newborns in India are LBW, which subsequently increases their death rate during the first year of life (UNICEF, 2009). The government of India and state governments have focused on strengthening national health programs to address the challenge of LBW newborns in Indian mothers. These programmatic initiatives in recent years include enhanced focus on improving the quality of ANC services and reduced out-of-pocket costs (Janani Shishu Suraksha Karyakram; Reproductive, Maternal, Newborn, Child, and Adolescent Health program), and supplementary nutrition services for pregnant mothers with weight gain monitoring (Integrated Child Development Services Scheme and POSHAN Abhiyan). The public health impact of these current initiatives in India can be understood by estimating the change in the prevalence of LBW through updated survey data. The NFHS (fifth round, 2019-21) is a large scale nationally representative cross-sectional survey that provides national-, state-, and district-level estimates of demographic, reproductive, newborn, and child health indicators. In this context public health impact of these current initiatives in India can be better understood by estimating the prevalence of LBW across socio-economic characteristics through recent survey data. Therefore, current study has following important objectives.

a) To determine the prevalence of low birth weight among facility-based deliveries in India.

b) To examine the socio-demographic, maternal, and healthcare-related determinants associated with low birth weight in India.

MATERIALS & METHODS
Methodology
Data Source
The study is based on the data from the National Family Health Survey (NFHS) 5, a nationwide survey to scientifically investigate health and its socio-economic and Demographic determinants. It gives information for 707 districts, 28 states and 8 union territories. The nationwide data collection spanned from Phase I from 17 June 2019 to 30 January 2020 covering 17 states and 5 UTs and Phase-II from 2 January 2020 to April 2021 covering 11 states and 3 UTs.

NFHS 5 gathered information from 636,699 households,724,115 women, and 101,839 men. Two stages of stratification were used to create the NFHS-5 sample. The sampling frame used to choose the PSUs (Population Sample Units) was the census from 2011. PSUs were Census Enumeration Blocks (CEBs) in urban regions and villages in rural areas. Less than 40-household PSUs were connected to the PSU that was closest to them. Villages were chosen from the sample frame inside each rural stratum with

a probability proportionate to size (PPS). Prior to the main survey, a thorough household mapping and listing operation was carried out in each chosen rural and urban PSU. Selected PSUs with at least 300 estimated households were divided into smaller units with 100 to 150 households each. The survey used systematic sampling with probability proportional to segment size, and two of the segments were randomly chosen. An NFHS-5 cluster is thus either a PSU or a PSU section. In the second step, 22 homes were randomly chosen using systematic sampling from each chosen rural and urban cluster. In this present study a total of 149,279 women aged 15–59 years were included for the analysis who were interviewed by individual schedule

Inclusion criteria
The study considered most recent child born (last birth) in the family, children delivered only in the health care institutions to avoid any kind of vagueness of birth weight taken at home, further we have considered only single born child so that influence of twin births, triplets on birth weight is avoided. Further, birth weight information was collected from health cards or mothers' self-reported data.

Outcome variable
The outcome variable is the birth weight of the newborn. Information on birth weight in NFHS-5 was obtained from the written record and from the mother's recall. The birth weight variable is considered "low birth weight" if it was less than 2.5 kg and "normal birth weight" if equal to or more than 2.5 kg (as per WHO definition)

Independent variable
The independent variables considered in the study on the basis of the available literatures that suggest possible association of individual factors and household level factors with LBW. Age, education, employment, BMI, ANC visits, Anemia level, sex of the child, birth interval,

pregnancy complications, iron supply and tobacco use are the individual level explanatory variables in the study. In addition, the household characteristics like residence of respondent, religion, caste and wealth index are also considered.

Data Analysis
Descriptive statistics was used to give the results and association between dependent and predictor variable were assessed through chi-square test.In addition logistic regression analysis was also used to estimate odds-ratio. Further, figures and graphs were be used wherever found suitable to display results. The data was analyzed through STATA 16.1 version.

RESULT
Profile of respondents
This section explains economic and demographic characteristics of 148,947 respondents. A majority of them are young adults aged 25–34 years (**59.03%**). Most of the respondents reside in rural areas (**76.84%**), indicating a largely rural sample. The dominant religion among respondents is Hinduism (**75.65%**). Educationally, more than half have completed secondary schooling (**54.9%**), reflecting moderate education levels. Caste distribution shows that OBC respondents form the largest group (**41%**). Employment levels are low, as a high proportion are currently not working (**80.73%**). Most respondents are living with their life partner (**89.12%**), suggesting stable household arrangements. Health insurance coverage remains limited, with a majority having no insurance (**71.73%**). In terms of wealth status, a considerable proportion of respondents are from the poorest quintile (**21.11%**). Overall, the table highlights a young, rural, Hindu-majority population with moderate educational attainment but low workforce participation and inadequate financial protection.

Prevalence of LBW according to socio-economic and Demographic characteristics of respondents

Table 1 shows prevalence of LBW according to socio-economic and Demographic characteristics of respondents. As a whole at national level around 17% of neonates among most recent deliveries in health facilities are having LBW. However, such LBW concern varied considerably across socio-economic and demographic characteristics of respondents. It is evident from the table that that prevalence of LBW neonates is more (19%) among respondents age 15-24 compared to higher age group (age 25-34 and age >=35). Such difference is around 3% points. Rural respondents are having LBW neonates marginally lesser (16%) than urban counterparts (17.48%). Further it is noticed from the table that LBW neonates are lesser among more educated respondents when compared to respondents having primary education or no education. For instance, there is a 6% points difference in prevalence

of LBW neonates between respondents having no education and respondents who are attained higher education. ANC visit found to be having significant impact over birth weight. It is witnessed here that, women who had 5 or more ANC visit have lesser LBW neonates when compared to women who had no ANV visits. Anemia level of women too observed to be having a considerable influence over birth weight. The women with severe anemia have higher proration of LBW neonates (25%) when compared to moderate (18%) or no anemic women (16%). Tobacco habit has negative influence over birth weight. Women who have tobacco habit found to be having more proportion of LBW neonates by 3 percent points than women who do not have such habits. Economic status of women has considerable influence over low birth weight. It is observed from the data table that women belonging to richest wealth quintiles likely to have lesser LBW neonates by 6% points than women belonging to poorest wealth class.

Table1: Prevalence of LBW among most recent delivery in health facilities in India according to Socio-economic and Demographic Characteristics of respondents

Characteristics	%	N	P Val
Age			P<0.001
15-24	19.09	46326	
25-34	16.08	87923	
>=35	15.94	14708	
Residence			P<0.001
Urban	16.07	34497	
Rural	17.48	114450	
Religion			P<0.001
Hindu	17.31	112673	
Muslim	15.86	20646	
Christian	14.83	9200	
Others	17.93	6428	
Caste			P<0.001
SC	18.64	29859	
ST	17.8	26275	
OBC	16.58	58544	
none of the caste	16.25	26882	
Education			P<0.001
no education	19.34	25,172	
Primary	20.13	16,845	
secondary	17.12	81,766	
Higher	13.2	25,164	
Living status			p=0.251
living with her	17.14	1,30,765	
staying elsewhere	16.18	15,964	

BMI			
under weight	21.92	15613	P<0.001
normal weight	16.86	79625	
over weight	14.53	20326	
Obesity	14.59	5749	
ANC Visit			P<0.001
no visit	20.35	6,441	
up to 5 visits	17.60	88,272	
up to 10 vists	15.66	43,101	
>10 visits	15.41	9,134	
Birth interval			P<0.001
<24 months	17.45	21,871	
>24 months	16.00	72,447	
anemia level			P<0.001
Severe	25.05	641	
Moderate	17.82	36581	
Mild	15.41	28141	
not anemic	15.57	31122	
Sex of the child			P<0.001
Male	15.69	68,003	
Female	18.66	56,681	
told about pregnancy complications			P=0.775
No	17.01	29,444	
Yes	16.87	1,13,062	
Iron Tablet supply			P<0.001
No	18.87	15,089	
Yes	16.84	1,33,491	
don't know	22.11	367	
Tobacco Habit			p=0.695
No	17.03	146553	
Yes	19.56	2394	
wealth index			P<0.001
Poorest	20.33	31,442	
Poorer	18.77	33,433	
Middle	16.51	30,849	
Richer	15.81	28,714	
Richest	13.86	24,509	
Total	**17.06**	**1,48,947**	

Logistic Regression estimates to socio economic attributes of respondents

Logistic regression estimates have been done (Table 3) in order to estimate the influence of various explanatory variables on Low birth weight. In this model of analysis explanatory variable are age of the respondent, residence, religion, caste, education, BMI, number of ANC visits, anemia, birth interval, sex of the baby, pregnancy complications, supply of iron tablets, tobacco use and wealth quintile of the respondent. The outcome variable is LBW. It is evident from the table that the women aged above 15-24 years less likely to have LBW neonates by 15 to 18%

Further rural women less likely to have LBW neonates by 27% compared to urban women. [OR=0.77 CI=0.62,0.95, P<0.05]. It is further observed that education has strong influence over birth weight. The data reveals that women who have higher education having almost half LBW neonates compared to those women who have no education and such association found to be statistically highly significant in our logistic model. [OR=0.55 CI=0.38,0.78 P<0.001] Further women with normal weight less likely to have LBW neonates by 25 % and such result in the model found to be statistically significant P<0.01. In addition, women who have moderate or mild anemia,

women whose birth interval is more than 24 months, if the sex of the baby is male, those women who have no tobacco habit are less likely to have LBW neonates compared to their counterparts. Further it is observed that economic status of the family has considerable influence over LBW of neonates. For instance, women who belonging to richer economic class less likely to have LBW neonates by 25% compared to poorest economic class and OR is statistically significant.

Table 2: Logistic Regression estimates on LBW According to socio economic attributes of respondents

Characteristics	Odds Ratio (OR)	95% CI Lower Upper
Age		
15-24	1	[1.00,1.00]
25-34	0.82	[0.66,1.00]
<=35	0.85	[0.63,1.14]
Residence		
Urban	1	[1.00,1.00]
Rural	0.77*	[0.62,0.95]
Religion		
Hindu	1	[1.00,1.00]
Muslim	0.92	[0.73,1.17]
Christian	1.19	[0.73,1.95]
Others	1.33	[0.87,2.03]
Caste		
SC	1	[1.00,1.00]
ST	0.92	[0.71,1.20]
OBC	0.92	[0.77,1.11]
none of the caste	1.04	[0.81,1.33]
Education		
no education	1	[1.00,1.00]
Primary	1.07	[0.85,1.35]
Secondary	0.78*	[0.64,0.96]
Higher	0.55***	[0.38,0.78]
BMI		
under weight	1	[1.00,1.00]
normal weight	0.76**	[0.61,0.94]
over weight	0.72*	[0.54,0.96]
Obesity	0.94	[0.63,1.38]
ANC visits		
up to 5 visits	1	[1.00,1.00]
up to 10 visits	0.99	[0.83,1.17]
>10 visits	1.05	[0.74,1.51]
Anemia		
Severe	1	[1.00,1.00]
Moderate	0.89	[0.60,1.31]
Mild	0.76	[0.50,1.14]
not anemic	0.79	[0.53,1.18]
Birth interval		
<24 months	1	[1.00,1.00]
>24 months	0.96	[0.80,1.14]
Sex of Baby		
Male	1	[1.00,1.00]
Female	1.19*	[1.03,1.38]
Pregnancy complications		
No	1	[1.00,1.00]
Yes	1.1	[0.92,1.32]
Iron tablet given		
No	1	[1.00,1.00]

Yes	0.93	[0.71,1.23]
don't know	1.52	[0.46,5.09]
Tobacco Use		
No	1	[1.00,1.00]
Yes	1.36	[0.86,2.15]
Wealth index		
Poorest	1	[1.00,1.00]
Poorer	0.89	[0.72,1.11]
Middle	0.8	[0.62,1.02]
Richer	0.73*	[0.56,0.95]
Richest	0.75	[0.53,1.04]
*Religion Others-Sikh, Buddhists, Jain, Jewish and Paris		
95% confidence intervals in brackets* p<0.05, ** p<0.01, *** p<0.001		

CONCLUSION

The current study mainly focused on the prevalence of LBW in India and factor associated with LBW. As a whole at national level around 17% of neonates among most recent deliveries in health facilities are having LBW. However, such LBW varied considerably across socio-economic and demographic characteristics of respondents. The prevalence of LBW neonates is more among respondents age 15-24 compared to higher age group. Rural respondents are having LBW neonates marginally lesser than urban counterparts. The LBW neonates is lesser among more educated respondents when compared to respondents having primary education or no education. Education thus having critical role to play in birth weight. Women who had 5 or more ANC visit have lesser LBW neonates when compared to women who had no ANV visits. Anemia level of women too observed to be having a considerable influence over birth weight. The women with severe anemia have higher proration of LBW neonates when compared to moderate or no anemic women. Tobacco habit has negative influence over birth weight. Economic status of women has considerable influence over low birth weight. It is observed women belonging to richest wealth quintiles likely to have lesser LBW neonates than women belonging to poorest wealth class. Across the states the prevalence of LBW is not uniform. The distribution of newborns delivered in Health institutions shows variation significantly across India zones with more prevalence of LBW in northern zone, followed by Eastern Zone and western Zone. The least prevalence of LBW is found in North east zone and Central Zone.

To reduce the burden of low birth weight (LBW) in India, focused policy interventions are essential. Strengthening antenatal care (ANC) services should be prioritized to ensure regular check-ups for all pregnant women. Early registration and monitoring of high-risk pregnancies will help in timely medical support. Nutritional programs must address anemia and poor maternal BMI through iron and folic acid supplementation. Community-based nutrition counseling can improve dietary intake during pregnancy. Special attention should be given to rural and economically weaker sections, where LBW prevalence is higher. Improving access to maternal healthcare facilities in these areas is crucial. Expanding financial support schemes can reduce cost-related barriers to care. Female education should be promoted to enhance health awareness and informed maternal decisions. Health promotion campaigns must include targeted messages on LBW prevention. Tobacco cessation counseling should be routinely provided during ANC visits. Family planning services should encourage birth spacing of at least 24 months. Strengthening insurance coverage will improve utilization of essential maternal health services. Robust data monitoring systems can help track LBW trends across districts. Overall, these measures can significantly improve

maternal health and reduce LBW prevalence in India.

Declaration by Author
Ethical Approval: It is secondary study, hence not required.
Acknowledgement: None
Source of Funding: None
Conflict of Interest: No conflicts of interest declared.

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