

LOW BIRTH WEIGHT AND ASSOCIATED SOCIOECONOMIC AND MATERNAL CHARACTERISTICS AMONG THE BENEFICIARIES OF THE INTEGRATED CHILD DEVELOPMENT SERVICE (ICDS) OF JALPAIGURI, WEST BENGAL, INDIA: EVIDENCE FROM A COMMUNITY-BASED STUDY AND COMPARATIVE ANALYSIS

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ABSTRACT

Low birth weight (LBW, < 2.5 kg) is one of the major factors affecting child morbidity and mortality worldwide. It is considered a universal threat that creates an obstacle to child development in developing countries. The present cross-sectional study was carried out among 1240 preschool children (625 boys and 615 girls) randomly selected from 48 Integrated Child Development Scheme (ICDS) centres in Jalpaiguri district, West Bengal, India. The study aimed to assess the relationship between birth weight and anthropometric and socio-demographic factors and maternal characteristics. Anthropometric variables, such as height and weight, were measured; one derived variable – Body Mass Index (BMI) was calculated, and pre-tested questionnaires were used to collect some socioeconomic variables. The overall mean birth weight was 2.79 ± 0.48 kg, and the overall prevalence of LBW among children of Jalpaiguri, West Bengal was 26.37%. In both sexes and in all age groups, there were significant differences in height and weight between LBW and normal birth weight children. In normal birth weight children, all anthropometric variables showed significant age variation except for boys' BMI. Binary logistic regression showed that boys had a greater chance of having an LBW than girls. Ethnicity, child's birth order, father's occupational status, source of drinking water, family income category, maternal height, and maternal weight had a greater impact on LBW children compared to reference categories. Anthropometric variables serve as indicators

for determining the relative risks of LBW children, while socioeconomic demographic and maternal characteristics may be used as birth weight determinants.

Keywords: *low birth weight; socioeconomic demographic status; maternal characteristics; anthropometry; preschool children; Jalpaiguri*

INTRODUCTION

Low birth weight (LBW) is one of the major factors affecting child morbidity and mortality worldwide [1]. It has negative implications for neonate survival, postnatal growth, cognitive development, and anthropometric deformities in different phases of life [2, 3]. The World Health Organization has defined LBW as weight at birth < 2500 g [4]. According to the findings of the United Nations Inter-Agency Group for Child Mortality Estimation, the annual number of under-five deaths had fallen to 4.9 (4.6–5.4) million by 2022 [5]. Most of the infant deaths were concentrated in sub-Saharan Africa and Southern Asia. Preterm births and LBW have resulted in developmental disabilities such as cerebral palsy and learning disabilities [6]. Infants born with LBW are more vulnerable and have higher risks of neurodevelopmental disorder and under-five mortality. LBW is often accompanied by child malnutrition; malnutrition alone accounts for half of all child deaths worldwide [7]. LBW is caused primarily by two factors: preterm birth (birth before 37 weeks of gestation) and restricted foetal (intrauterine) growth [8]. Factors associated with birth weight (BW) are determined broadly through genetic, socio-demographic, and environmental conditions. Factors like ethnicity influence the BW, as studied by Cramer in 1995 [9], and the prevalence of LBW among new-borns in India [10–18].

The mother's characteristics and the physical environment play significant roles in determining both newborns' BW and health [19]. The predictors of LBW in developing countries are maternal age, illiteracy, antenatal care, follow-up, Body Mass Index (BMI), and socio-economic status. LBW is considered a universal threat in developing countries that creates a barrier to child development [20]. It is now well recognized that BW is not only a critical determinant of child survival as well as their growth and development but also a valuable indicator of maternal characteristics such as maternal health, nutrition, and quality of life. The prevention of LBW is a public health priority for better growth and development, particularly in developing countries with a high prevalence of LBW. Research has also been carried out globally to assess the

magnitude and to identify the major determinants of LBW [21]. The majority of the studies focused on maternal factors analyse the socio-demographic and socio-economic variables that influence children's BW nationally and internationally [13, 14, 22–31]. Several socioeconomic and demographic factors are potentially modifiable, and the identification of maternal risk factors associated with LBW is essential for planning and implementation of guiding programmes.

The Integrated Child Development Services (ICDS), launched in 1975, is one of the world's largest early childhood care and development programmes. It is the largest national programme to promote the health quality of mothers and children. The beneficiaries include children below 6 years, pregnant and lactating mothers, and other women in the age group of 15–44 years [32]. The ICDS scheme includes supplementary nutrition, immunization, health check-ups, referral services, nutrition and health education, and preschool education [32, 33]. Still, ICDS beneficiaries' health outcomes are determined by and dependent on various biosocial factors, i.e., socio-demographic factors and maternal characteristics. LBW is a major community health problem observed in the vulnerable section of society; hence, the present study is designed to evaluate sex- and age-specific anthropometric characteristics of LBW and normal birth weight (NBW) children. The relationship of socioeconomic demographic and maternal characteristics with BW among rural preschool children of Jalpaiguri, West Bengal, India, was studied.

MATERIAL AND METHODS

The present cross-sectional study was carried out among 1240 preschool children (625 boys and 615 girls) randomly selected from 48 Integrated Child Development Scheme centres in Maynaguri Block, Jalpaiguri district, West Bengal, India. The study was conducted from 5 August 2023 to 5 April 2024. Newborns' BW was recorded from vaccine cards provided by ICDS workers. All anthropometric measurements in the present study were taken following the standard anthropometric techniques proposed by Weiner and Lourie (1981) [34]. Height was measured by an anthropometric rod to the nearest 0.1 cm; weight was measured by a weighing machine to the nearest 0.1 kg, and BMI (weight/height, kg/m²) was calculated. Various socioeconomic data and maternal characteristics were collected by a pre-tested questionnaire. Socio-economic demographic factors (sex, age, ethnicity, birth order, family members, number of rooms, family type, occupation of father, source of drinking water, bath place, and income) and maternal characteristics (educational level of mothers, age,

height, weight, and BMI) were recorded according to the birth of newborns. Chi-square analysis was done to assess the statistical differences between NBW and LBW children in the incidence of the variables. Binary logistic regression was done to identify the risk factors of LBW children. One-way analysis of variance (ANOVA) and t-tests were performed to determine the statistical differences for age and specific sex in the anthropometric variables like height, weight, and BMI between NBW children and LBW children. All types of statistical analysis were done on SPSS (version 18) and p values <0.05 were considered significant. All the data were collected by the first author Arindam Biswas, and ethical clearance was obtained from the University of North Bengal. The existence of heterogeneity in the prevalence was tested using Cochran's Q statistic based on chi-square and the I^2 statistic score of heterogeneity between 0% and 100% (25% – low heterogeneity, 50% – moderate heterogeneity, and 75% – high heterogeneity). In the present investigation, heterogeneity scores by I^2 statistic were above 75%, showing high heterogeneity. Hence, a random effect model was considered for the analysis.

RESULTS

Table 1 shows the mean height, weight, and BMI of LBW and NBW children. Among LBW and NBW boys, the t-test shows significant sex-specific differences in mean height and weight in all age groups, but significant sex-specific differences in BMI are seen at the age of 4 and 5 years. However, for LBW and NBW girls, the t-test shows that all the age groups had significant sex-specific differences in mean height and weight, except girls' weight at the age of 5 years, while significant sex-specific differences in BMI were seen only at the age of 3 years. The F-test reveals significant age variation for LBW children in all anthropometric variables (e.g., height, weight, and BMI) in both sexes, whereas NBW children show significant age variation in all anthropometric variables except BMI in boys.

Table 1. Age- and sex-specific mean (SD) height, weight and body mass index among low birth weight and normal birth weight children

	Boys				Girls					
	N	LBW (N=140)	NBW (N=485)	t	Total (N=625)	N	LBW (N=187)	NBW (N=428)	t	Total (N=615)
Age	Height (cm)									
2 years	156	84.26 (6.18)	87.67 (4.59)	-3.455***	86.60 (5.36)	143	81.93 (5.59)	86.89 (3.45)	-5.797**	85.09 (4.95)
3 years	157	91.75 (4.92)	94.70 (4.45)	-3.510***	93.84 (4.77)	167	88.87 (4.92)	93.18 (4.13)	-5.679***	91.68 (4.86)
4 years	167	99.33 (5.66)	102.13 (4.68)	-2.495*	101.65 (4.96)	191	97.18 (4.91)	101.14 (4.65)	-5.143***	99.98 (5.05)
5 years	145	104.13 (6.02)	109.12 (4.91)	-3.179***	108.57 (5.26)	114	107.45 (5.93)	106.57 (7.99)	.474	106.73 (6.33)
Total	625	92.11 (8.98)	99.10 (9.18)	-8.064***	97.54 (9.58)	615	91.52 (9.80)	97.26 (8.48)	-6.955***	95.52 (9.28)
F	71.047***					134.430***				
Age	Weight (kg)									
2 years	156	10.62 (1.83)	11.78 (1.70)	-3.754***	11.42 (1.82)	143	10.21 (1.68)	11.63 (1.78)	-4.721***	11.11 (1.87)
3 years	157	12.57 (1.47)	13.26 (1.70)	-2.572*	13.06 (1.66)	167	11.96 (1.83)	12.61 (1.75)	-2.198*	12.38 (1.80)
4 years	167	13.86 (1.90)	15.54 (3.40)	-3.823***	15.24 (2.94)	191	13.13 (1.47)	14.77 (2.36)	-5.782***	14.29 (2.26)
5 years	145	15.03 (2.61)	17.65 (3.33)	-3.649**	17.36 (3.36)	114	17.57 (5.57)	16.61 (2.95)	.765	16.78 (3.57)
Total	625	12.43 (2.38)	14.75 (3.42)	-9.084***	14.23 (3.36)	615	12.46 (3.21)	13.95 (2.90)	-5.454***	13.50 (3.08)
F	32.031***					48.120***				
Age	Body Mass Index (kg/m ²)									
2 years	156	14.91 (1.60)	15.30 (1.48)	-1.434	15.18 (1.52)	143	15.15 (1.33)	15.35 (1.73)	-.765	15.27 (1.60)
3 years	157	14.96 (1.66)	14.77 (1.52)	.647	14.83 (1.56)	167	15.10 (1.50)	14.50 (1.67)	2.363*	14.71 (1.63)
4 years	167	14.00 (1.13)	14.81 (1.99)	-2.994**	14.67 (1.89)	191	13.92 (1.44)	14.39 (1.61)	-1.935	14.25 (1.57)
5 years	145	13.73 (1.07)	14.74 (1.94)	-3.139**	14.62 (1.89)	114	14.88 (2.56)	14.55 (1.69)	.567	14.61 (1.87)
Total	625	14.60 (1.55)	14.89 (1.78)	-1.858	14.83 (1.73)	615	14.74 (1.67)	14.65 (1.70)	.560	14.68 (1.69)
F	4.959***					7.027***				
	2.453					6.796***				

p < 0.05*, p < 0.01**, p < 0.001***

Table 2 shows the association of LBW and NBW with socioeconomic demographic factors and maternal characteristics. Binary logistic regression shows that boys have a greater chance of having LBW than girls. Children of Namasudra ethnicity are more likely to have LBW; birth orders of ≥ 3 are more likely to have LBW. Father's occupational status as an agriculturist or a businessman involves a higher risk of LBW in children; source of drinking water as tap water has a higher risk of LBW in children compared to reference categories. Children coming from the monthly family income category INR < 7500 are more likely to have LBW. Maternal height < 145 cm and maternal weight ≤ 50 kg shows a higher risk of LBW children compared to reference categories. Chi-square analysis (χ^2) shows that all socio-economic and demographic variables such as the child's sex, ethnicity, birth order, number of family members, number of rooms, family type, father's occupation, source of drinking water, bath place, monthly family income, and maternal characteristics, such as mother's educational level, age, height, weight, and BMI have a significant categorical variation with BW.

Table 2. Association of birth weight with socio-economic demographic variables and maternal characteristics

Variables	Low Birth Weight (%)	Normal Birth Weight (%)	Exp (B)	95% CI	χ^2
Sex					
Boys	140 (11.29)	485 (39.11)	1.553**	(1.17–2.06)	10.234***
Girls	187 (15.08)	428 (34.52)	1		
Ethnicity					
Rajbanshi	84 (6.77)	330 (26.61)	1.219	(.83–1.78)	30.297***
Namasudra	149 (12.02)	265 (21.37)	.554***	(.38–.79)	
Nashyaseikh	94 (7.58)	318 (25.64)	1		
Birth order					
1 st	219 (17.66)	507 (40.89)	1		16.892***
2 nd	98 (7.90)	334 (26.93)	1.346	(.92–1.96)	
≥3 rd	10 (0.81)	72 (5.81)	4.412***	(1.53–8.20)	
Family members					
≤3	110 (8.87)	193 (15.56)	.828	(.42–1.63)	20.439***
4–5	138 (11.13)	465 (37.5)	1.016	(.63–1.63)	
>5	79 (6.37)	255 (20.56)	1		
Number of rooms					
1	98 (7.90)	178 (14.35)	1.058	(.67–1.67)	16.763***
2	119 (9.60)	417 (33.63)	1.313	(.90–1.91)	
≥3	110 (8.87)	318 (25.64)	1		

Variables	Low Birth Weight (%)	Normal Birth Weight (%)	Exp (B)	95% CI	χ ²
Family type					
Nuclear	198 (15.97)	491 (39.60)	.816	(.51–1.29)	10.684**
Joint	44 (3.55)	96 (7.74)	.600	(.35–1.01)	
Extended	85 (6.85)	326 (26.29)	1		
Occupation of father					
Labourer	113 (9.11)	224 (18.06)	1		13.975**
Agriculturist	107 (8.63)	308 (24.84)	.899*	(.67–1.42)	
Businessman	54 (4.35)	195 (15.72)	.910*	(.64–1.64)	
Employee	30 (2.42)	103 (8.31)	.360	(.43–1.37)	
Others	23 (1.85)	83 (6.69)	.784	(.62–1.95)	
Source of drinking water					
Tubewell	238 (19.19)	659 (53.15)	1		16.162***
Tap water	25 (2.02)	28 (2.26)	.447*	(.23–.86)	
Well	45 (3.63)	177 (14.27)	1.372	(.93–2.06)	
Mineral	19 (1.53)	49 (3.95)	.785	(.42–1.51)	
Bath place					
Open	150 (12.10)	326 (26.29)	.887	(.64–1.22)	10.519***
Closed	177 (14.27)	587 (47.10)	1		
Monthly family income					
INR <7500	123 (9.92)	215 (17.34)	.522*	(.29–.93)	25.079***
INR 7500–15000	167 (13.47)	547 (44.11)	.749	(.46–1.22)	
INR 15000	37 (2.98)	151 (12.18)	1		
Educational level of mothers					
Primary	153 (12.24)	352 (28.39)	.780*	(.51–1.19)	6.903*
Secondary	112 (9.03)	352 (28.39)	1.048	(.70–1.57)	
Higher secondary and above	62 (5.00)	209 (16.85)	1		
Maternal age					
<25 years	114 (9.19)	232 (18.71)	.871	(.55–1.37)	19.523***
25–29 years	158 (12.74)	427 (34.43)	.969	(.65–1.45)	
>29 years	55 (4.43)	254 (20.48)	1		
Maternal height					
<145 cm	110 (8.87)	99 (7.98)	.297***	(.17–.50)	108.915***
145–150 cm	110 (8.87)	271 (21.85)	.635	(.40–1.0)	
150.1–155 cm	65 (5.24)	304 (24.52)	.908	(.58–1.43)	
>155 cm	42 (3.39)	239 (19.27)	1		

Variables	Low Birth Weight (%)	Normal Birth Weight (%)	Exp (B)	95% CI	χ^2
Maternal weight					
≤50 kg	240 (19.35)	424 (34.19)	.564*	(.39–.94)	70.324***
>50 kg	87 (7.01)	489 (39.43)	1		
Maternal BMI					
<18.5 kg/m ²	40 (3.22)	94 (7.58)	.967	(.61–1.57)	38.994***
18.5–22.99 kg/m ²	207 (16.69)	418 (33.71)	1		
>23 kg/m ²	80 (6.45)	401 (32.34)	1.263	(.77–2.06)	

P < 0.05*; p < 0.01**; p < 0.001***

Table 3 indicates the prevalence of LBW; among national studies, the lowest prevalence was found in Manipal, India – 11.41% (95% CI: 9.16–13.98) and the highest prevalence was found in Mumbai, India – 45.20% (95% CI: 34.65–46.41). Among international studies, however, the lowest prevalence was found in the children of Tehran [38] – 3.80% (95% CI: 2.30–5.87) and the highest prevalence was found in the children of Tshwane, South Africa – 48.18% (95% CI: 45.15–51.22). Very low prevalence of LBW was found among the children of Tehran (3.80%), Kilis, Turkey (6.69%), São Paulo, Brazil (7.61%), Wolaita Sodo, Ethiopia (8.10%), Addis Ababa, Ethiopia (8.75%), Pokhara, Nepal (8.50%), Hosanna, Ethiopia (9.80%), Amhara, Ethiopia (10.34%), Tigray, Ethiopia (10.50%). Compared to the present study, very high prevalence of LBW was found among the children of Puruliya, India (31.21%), Amhara, Ethiopia (33.33%), Mekelle, Ethiopia (33.33%), Southern Nations, Nationalities and Peoples Region (SNNPR), Ethiopia (33.33%), Kerala, India (33.33%), Debre Berhan, Ethiopia (33.33%), Oromia, Ethiopia (34.20%), Telangana, India (36.33%), Aligarh, Uttar Pradesh, India (40.00%), Mysore, India (42.40%), Mumbai, India (45.20%), Tshwane, South Africa (48.18%) [3, 9, 10, 13, 14, 16, 37–74]. Based on a random-effects model, the analysis revealed significant heterogeneity, with $I^2 = 98.07\%$ (95% CI: 97.82–98.29). The Q-test yielded a significant value of 2695.122, indicating significant variation in the prevalence of LBW ($p < 0.0001$). The overall prevalence was 21.07% (95% CI: 19.28–22.90) as depicted by the random effect model. Figure 1 shows the forest plot for the proportion of LBW among the populations. Each horizontal line represents an individual study done by researchers, and the box shows the result with the line depicted in the 95% confidence interval of the result. The average of all combined individual results is depicted by the diamond at the bottom.

Table 3. Prevalence of low birth weight in relation to other national and international studies.

Study area	Sample Size	Proportion (%)	95 % CI	Weight (%)		Reference
				Fixed	Random	
Dhaka, Bangladesh	316	15.19	11.41–19.63	0.14	1.81	Dhar et al. 2002 ¹⁰
Puruliya, West Bengal, India	487	31.21	27.12–35.53	0.22	1.89	Biswas et al. 2008 ¹¹
Pokhara, Nepal	400	31.21	05.96–11.67	0.18	1.86	Sreeramareddy et al. 2008 ³⁶
Slum area of Mumbai, India	282	40.43	34.65–46.41	0.13	1.79	Velankar 2009 ¹²
Siliguri, West Bengal, India	503	17.30	14.09–20.89	0.23	1.89	Sen, Roy & Mondal 2010 ¹³
Tehran	500	3.80	2.30–5.87	0.22	1.89	Sajjadian et al. 2011 ³⁸
Rural Karnataka	1138	22.93	20.52–25.49	0.51	1.97	Metgud, Naik & Mallapur 2012 ⁸⁰
Uganda	706	12.04	9.73–14.67	0.32	1.93	Elizabeth, Christopher & Patrick 2013 ⁴⁷
Tigray, Ethiopia	308	14.61	10.86–19.06	0.14	1.81	Gebremedhin et al. 2015 ⁴⁸
Haryana, India	500	28.80	24.87–32.99	0.22	1.89	Saini, Singh & Mittal 2016 ¹⁵
Addis Ababa, Ethiopia	457	8.75	6.33–11.73	0.21	1.88	Mulatu et al. 2016 ⁴²
Hosanna, Ethiopia	327	9.79	6.79–13.54	0.15	1.82	Abdo, Endalemaw & Tesso 2016 ⁴²
Aligarh, Uttar Pradesh, India	160	40.00	32.35–48.03	0.07	1.64	Juneja et al. 2016 ⁷³
Kerala, India	330	33.33	28.27–38.70	0.15	1.82	Ismail & Venugopalan 2016 ⁶⁹
Mysore, India	500	42.40	38.02–46.87	0.22	1.89	Jyothi and Gopal 2016 ⁷⁴
Manipal, India	710	11.41	9.16–13.98	0.32	1.93	Tellapragada et al. 2016 ⁴⁶
Haryana, India	800	17.00	14.46–19.79	0.36	1.94	Kumar et al. 2017 ¹⁶
Mekelle, Ethiopia	422	27.01	22.83–31.52	0.19	1.86	Hadush, Berhe & Medhanyie 2017 ³
Maharashtra, India	615	13.82	11.19–16.80	0.28	1.92	Ahankari et al. 2017 ³⁵
Tigray, Ethiopia	1152	10.50	8.79–12.42	0.52	1.82	Mengesha et al. 2017 ⁴⁵
Burdwan, West Bengal, India	332	27.41	22.68–32.55	0.15	1.82	Kumar et al. 2018 ⁶⁴
Siliguri, West Bengal, India	13423	19.19	18.52–19.87	6.01	2.03	Mondal, Dey & Sen 2018 ¹⁴

Study area	Sample Size	Proportion (%)	95 % CI	Weight (%)		Reference
				Fixed	Random	
Dhulikhel, Nepal	2798	21.55	20.04–23.12	1.25	2.01	Prajapati, Shrestha & Bhandari 2018 ⁶¹
Oromia, Ethiopia	576	34.20	30.33–38.23	0.26	1.91	Endalamaw et al. 2018 ⁷¹
DHS, Bangladesh	2319	20.22	18.61–21.92	1.04	2.01	Khan et al. 2018 ⁵⁹
São Paulo, Brazil	788	7.61	5.86–9.69	0.35	1.94	Moreira, Sousa, & Sarno 2018 ⁴⁰
Khammam, Telangana, India	965	29.84	26.97–32.84	0.43	1.96	Neeluri & Pamarthi 2018 ⁶⁵
North Shewa, Ethiopia	470	20.00	16.48–23.91	0.21	1.88	Gizaw & Gebremedhin 2018 ⁵⁷
Debre Berhan, Ethiopia	441	33.33	28.94–37.95	0.20	1.87	Hailu & Kebede 2018 ⁷⁰
Wolaita Sodo, Ethiopia	432	8.10	5.71–11.09	0.19	1.87	Kastro, Demissie & Yohannes 2018 ⁴¹
Northwest Ethiopia	375	14.93	11.48–18.95	0.17	1.84	Kumlachew, Tezera & Endalamaw 2018 ⁴⁹
Hyderabad, India	204	25.98	20.11–32.57	0.09	1.71	Apoorva, Thomas & Kiranmai 2018 ⁶³
Maharashtra, India	1611	18.56	16.69–20.55	0.72	1.99	Narwade & More 2018 ⁵⁶
Madurai, India	185	25.40	19.30–32.31	0.08	1.68	Lakshmi & Rajkumar 2018 ⁶²
Kolkata, West Bengal, India	495	27.07	32.20–31.21	0.22	1.89	Dey, Mondal & Dasgupta 2019 ¹⁷
Dire Dawa City, Ethiopia	420	20.95	17.16–25.16	0.19	1.86	Sema et al. 2019 ⁵⁸
Amhara, Ethiopia	232	10.34	6.74–15.00	0.10	1.74	Talie, Taddele & Alemayehu 2019 ⁴⁴
Bharatpur, Nepal	220	23.64	18.18–29.81	0.10	1.73	Bansal, Garg, & Upadhyay 2019 ¹⁸
Tshwane, South Africa	1073	48.18	45.15–51.22	0.48	1.97	Tshotetsi et al. 2019 ³⁷
DHS, Afghanistan	2773	15.54	14.21–16.95	1.24	2.01	Gupta et al. 2019 ⁵¹
Amhara, Ethiopia	358	15.64	12.03–19.83	0.16	1.84	Jember et al. 2020 ⁵²
West Bengal, India	2611	21.49	19.92–23.11	1.17	2.01	Pal et al. 2020 ⁶⁰
SNNPR, Ethiopia	354	33.33	28.44–38.51	0.16	1.83	Bekela, Shimbre & Gebabo 2020 ⁶⁸
Mekelle, Ethiopia	381	33.33	28.61–38.31	0.17	1.85	Desta, Damte & Hailu 2020 ⁶⁷

Study area	Sample Size	Proportion (%)	95 % CI	Weight (%)		Reference
				Fixed	Random	
Kilis, Turkey	4379	6.70	5.97–7.47	1.96	2.02	Çam, Harunoğulları & Polat 2020 ³⁹
Kathmandu, Nepal	308	15.26	11.43–19.77	0.14	1.81	Thapa et al. 2022 ⁵⁰
BDHS report, Bangladesh	2351	16.21	14.74–17.76	1.05	2.01	Islam et al. 2022 ⁵³
NFHS 5, India	161596	16.86	16.68–17.04	72.33	2.04	Ghose 2023 ⁵⁴
Telangana, India	900	36.33	33.18–39.57	0.40	1.95	Devaguru et al. 2023 ⁷²
Uttar Pradesh, India	7615	17.54	16.97–18.42	3.41	2.03	Nayak et al. 2023 ⁵⁵
Amhara, Ethiopia	309	33.33	28.10–38.89	0.14	1.81	Minda et al. 2024 ⁶⁶
Jalpaiguri, West Bengal, India	1240	26.37	23.93–28.92	0.56	1.98	Present study
Total (fixed effect)	223356	17.40	17.24–17.56	100	100	
Total (random effect)	223356	21.07	19.28–22.90	100	100	

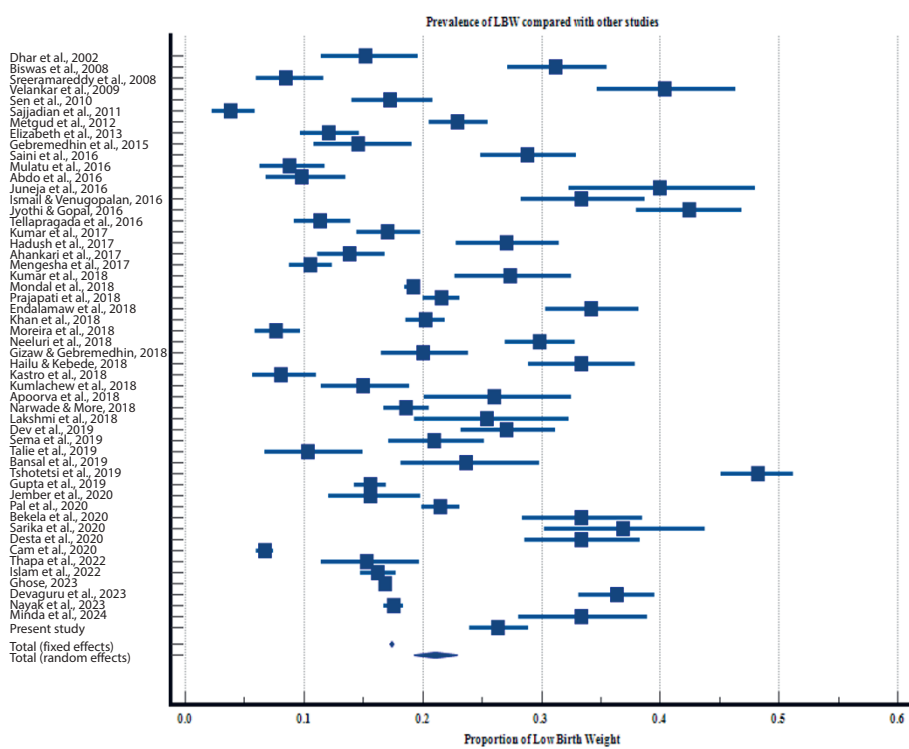


Figure 1. The forest plot presents the results of the meta-analysis on the prevalence of LBW using a random-effect model. The plot displays individual study estimates (represented by squares) of the effect size, along with their corresponding 95% CI represented by horizontal lines.

The comparative analysis generally supports the findings of the present study. The findings from Jalpaiguri are consistent with the broader evidence base from India and other developing countries. The comparative analysis, which revealed that the prevalence of LBW in the present population (26.37%) was higher than the pooled prevalence estimated from the random-effects model (21.07%), highlighted the continuing public health importance of LBW in this region.

DISCUSSION

The prevalence of LBW hinders progress toward sustainable development goals related to health, education, and reducing inequality. This study identified potential determinants of the prevalence of LBW in the Jalpaiguri district of West Bengal, India. The study also observed an increased risk of LBW among the newborns of mothers with a low height and weight compared to reference categories. The present findings reported that overall height, weight, and BMI were higher among normal BW children than among LBW children in both sexes except for girls' BMI. A significant reduction in the prevalence of LBW is necessary to achieve Sustainable Development Goals to decrease child mortality in India. The present investigation reported that the children of Jalpaiguri had an overall mean BW of 2.79 ± 0.48 kg and an overall prevalence of LBW of 26.37%. Similar studies have shown that the moderate prevalence of LBW and mean BW were 23.64% and 2.79 ± 0.58 kg in the children of Nepal. The highest mean BW found among the children of Haryana, India, was 2.83 kg (0.52) by Kumar et al. 2017 [16], and Maharashtra, India, 2.83 kg (0.44) by Ahankari et al. 2017 [35] and the lowest mean BW found among the children of Haryana, India was 2.56 kg (0.41) by Saini, Singh & Mittal 2016 [15] in national studies. In international studies, the highest mean BW found among the children of Pokhara, Nepal, was 3.29 kg (0.43) by Sreeramareddy et al. 2008 [36] and the lowest mean BW found among the children of Tashwane, South Africa, was 2.67 kg (0.61) by Tshotetsi et al. 2019 [37]

The present study focused exclusively on maternal determinants of birth weight. The current investigation simultaneously examined childhood anthropometric outcomes, socioeconomic-demographic conditions and maternal characteristics among ICDS beneficiaries. Furthermore, ethnicity-specific differences in LBW were explored, revealing elevated vulnerability among Namasudra children. Importantly, the growth disadvantage associated with LBW remained evident up to five years of age, as reflected in significantly lower anthropometric measurements among LBW children.

In several developing countries, BW is the most decisive factor associated with perinatal, postnatal, and neonatal mortality. LBW is still considered one of the major public health problems in India, as reported by various scholars [13, 17, 75]. The population-specific BW variation is a prime concern significantly influenced by certain determinant factors, such as maternal anthropometric characteristics [76], demographic conditions [77], and socio-economic status [20]. However, population- or ethnicity-based investigation is important to identify the risk factors of LBW [78]. This requires special attention from the researcher due to estimating the magnitude of ethnic variations of biological outcomes, i.e., birth weight. The mother and the physical environment have significant roles in determining newborn BW and health (WHO 2004) [19]. The intrauterine growth retardation (IUGR) is caused primarily by maternal undernutrition and other factors [79]. The BW is considered a sensitive predictor of IUGR, the newborn's survival chance, and long-term physical and psychological development [80].

Several socio-economic, demographic, and maternal conditions (e.g., maternal age, gestational age, maternal nutrition status, anthropometric and body composition characteristics, multiple pregnancies, maternal environment, and healthcare facilities) present greater risks for newborns with LBW [13, 22–31]. The incidence of newborn LBW in the present study (26.37%) was well within the prevalence range of 3.80% to 48.18% in national and international studies. In the present study, LBW children had lower height and weight in most of the age groups than NBW children. The effect of maternal education and socio-economic backgrounds on BW have been reported by various scholars [81]. Birth order is significantly associated with BW; similar results were found, whereas there was no significant association between the parity factor and LBW children as reported by previous findings [82]. Child gender, birth order, and mother's BMI are known to be related to the BW of newborns [83]. India experiences one of the highest LBW rates in the world, and several studies have reported that the determinants of LBW are maternal age, height, weight, and BMI among newborns [26, 48, 84].

Maternal age and family type are often related to LBW, supporting the previous findings [25, 27], although some previous studies have reported that the relation between BW and family type was insignificant [85]. Family size and father's occupation have significant associations with BW, supporting a previous finding [86]. Solid fuels for cooking and drinking water sources are significantly associated with BW [28]. Maternal ethnicity and family income influence the BW of children [30]. Previous studies [31,50] have reported that parental ethnicity correlates with BW outcomes similarly to the present study. In rural

India, family size, birth order, maternal education, and nutritional status are important determinant factors that affect LBW, similarly to the present study. Maternal height has also been reported to have a significant association with BW [29, 66, 67], supporting the present finding. Boys show the highest odds of having LBW. Children belonging to the Namasudra ethnicity also show a higher chance of having LBW. Children belonging to the birth order of ≥ 3 who have a source of drinking water such as tap water, and whose fathers are occupied in agriculture or business show a higher risk of LBW. Moreover, socio-demographic economic variables and maternal characteristics are considered to be very important determinants of newborn BW in India [13, 14, 16, 17, 18, 23, 29].

A recurring observation across Indian studies is that maternal nutritional status, lower socioeconomic position, higher birth order and maternal anthropometric characteristics consistently predict LBW. Findings from Haryana [15], Maharashtra [35, 56], Uttar Pradesh [55, 73], Telangana [63, 72], and West Bengal [14, 60, 64, 86] collectively support this pattern, suggesting that maternal undernutrition and social and demographic disadvantages remain major drivers of LBW in India.

A limitation of the present study is the small sample size, its cross-sectional nature and lack of information regarding dietary habits, gestational age and prematurity status of newborns.

CONCLUSION

The present study found a moderate prevalence (26.37%) of LBW among ICDS beneficiaries of Jalpaiguri. The LBW children exhibited significantly lower height and weight than normal birth weight children across most age groups, and these differences persisted up to five years of age. Maternal height, maternal weight, socioeconomic conditions, ethnicity and birth order emerged as significant correlates of LBW. These findings highlight the importance of improving the maternal nutritional status and socioeconomic conditions for reducing the burden of low birth weight in the studied population.

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