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Original Article

Study of sociodemographic determinants of low birth weight in Wardha district, India

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ABSTRACT

Introduction: Birth weight is one of the most important criteria for determining the neonatal and infant survival. More than 20 million infants worldwide, representing 15.5% of all births, are born with low birth weight (LBW), 95.6% of them in developing countries. The level of LBW in developing countries (16.5%) is more than double the level in developed regions (7%). The prevalence of LBW is estimated to be 15% worldwide with a range of 3.3–38% and occurs mostly in developing countries. According to NFHS III, prevalence of low birth in India is 22%. LBW remains an unresolved important national concern in India. The goal of reducing LBW incidence by at least one-third between 2000 and 2010 is one of the major goals in 'A World Fit for Children.' Hence, the present study is being proposed to explore the determinants of LBW.

Objective: To study the sociodemographic determinants of LBW babies in Wardha district.

Material and methods: A case-control study was conducted in Wardha civil hospital to investigate the determinants of LBW. Cases were defined as singleton live born when the birth weight was less than 2500 g as per WHO. One control was selected for each case from consecutive live births, in which the birth weight was equal to or more than 2500 g in the same hospital. Information was obtained by maternal interview, from medical records, and by anthropometric measurement of mother and infants taken within 48 h after birth. Data were entered and analysis was done with the help of a computer using EPI-INFO 6.04.

Results: Among various sociodemographic and socioeconomic determinants of LBW studied, the determinants that were found associated with high odds of LBW were as follows: maternal age less than 20 years or more than 30 years, nuclear family, poor standard of living, tobacco use by father, female sex of the baby, and among environment and housing characteristics, the absence of sanitary latrine was found to have significant association with LBW.

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1. Introduction

Birth weight is one of the most important criteria for determining the neonatal and infant survival. Low birth weight (LBW) has been defined by the World Health Organization (WHO) as weight at birth of less than 2500 g.¹ This practical cut-off for international comparison is based on epidemiological observations that infants weighing less than 2500 g are approximately 20 times more likely to die than heavier babies.² Birth weight is a useful parameter in predicting the future growth and development of child. It can be used in identifying “at-risk” families and help in decision making during the implementation of intervention programs, especially in countries and regions with limited resources.³

Mortality, morbidity, and disability in neonates, at infancy, and in childhood are more common in developing than developed countries; a birth weight below 2500 g contributes to a range of poor health outcomes. LBW has long-term impact on health outcomes in adult life. LBW results in substantial costs to the health sector and imposes a significant burden on the society as a whole.⁴ LBW leads to an impaired growth of infant with its attendant risk factors of higher mortality rate, increased morbidity, impaired mental development, and risk of chronic adult diseases.⁵

LBW babies are likely to start school late, drop out of school, complete fewer years of schooling, grow into stunted adult, and suffer from lower productivity and chronic diseases in later life due to indirect consequences.⁶

It is now well recognized that birth weight is not only a critical determinant of survival, growth, and development, but also a valuable indicator of maternal health, nutrition, and quality of life. LBW remains an unresolved important national concern in India. Twenty-nine percent of infant mortality rate is associated with LBW in India.⁷ Three-fourth of all neonatal deaths occur in LBW babies who are at 11–13 times higher risk of mortality during the neonatal period compared to normal birth weight babies.⁸

The reduction of LBW is also an important component of Millennium Development Goals (MDGs) for reducing child mortality. Activities toward the achievement of the MDGs will need to ensure a healthy start in life for children by making certain that women commence pregnancy healthily, and go through pregnancy and childbirth safely. LBW is therefore an important indicator for monitoring progress toward the internationally agreed goals.⁹ In India, one of the major child survival goals to be achieved by 2000 AD was to reduce the proportion of LBW babies to below 10%, which could not be achieved.¹⁰

It is generally acknowledged that the etiology of LBW is multifactorial. Determinants of LBW are likely to vary between populations. In a meta-analysis, Kramer reviewed 895 studies on determinants of LBW.² In the meta-analysis, 43 potential factors were identified, which were mainly genetic and constitutional factors, obstetric factors, demographic and psychosocial factors, nutritional factors, maternal morbidity during pregnancy, care during pregnancy etc. Also, various studies have been carried out globally to assess the magnitude and to identify the major determinants of LBW.^{2,8,11}

Birth weight of a newborn depends on the stay in utero, his intrauterine environment, and effect of maternal factors. LBW

may indicate that the baby did not remain in utero long enough or it did not develop enough.¹² The identification of factors contributing to low birth is therefore of considerable importance. Genetic factors, sociodemographic factors, obstetric factors, nutritional factors, maternal morbidity during pregnancy, toxic exposures, and antenatal care are all reported to influence the occurrence of LBW. The prevention of LBW is a public health priority, particularly in developing countries with high prevalence. Majority of the studies focused on the maternal factors; there are very few studies that analyzed the sociodemographic and socioeconomic variables too. Independent effect of each of these factors is still debatable. Hence, the present study was carried out to explore the determinants of LBW.

2. Material and methods

A case-control study was conducted from January 2013 to December 2013 in the Obstetric ward of a District Hospital. Singleton live born babies with term gestation, having birth weight below 2500 g, at the district hospital were registered as cases.¹ The cases were selected sequentially till the required numbers were completed. Cases were excluded when the family was not willing to participate in the study, the baby was born after multiple pregnancies, and the baby was born to a mother with chronic illness. Singleton live born babies of birth weight equal to or more than 2500 g delivered with term gestation in the same hospital were taken as control for the study. For each case, the next available newborn baby born within 5 days of the birth was selected as control. One control was selected per case. When selecting the controls, frequency matching by categories of gestational age was done. The gestational age was categorized as <39 weeks, ≥39 to <41 weeks, and ≥41 weeks. Inclusion and exclusion criteria for the controls were same as the cases. Sample size was calculated with 95% confidence and 80% power to detect a minimum odds ratio of 2.0 assuming that the least prevalent factor will be present in minimum 10% of the controls as reported by Anand¹³ in his study. Sample size was calculated using the STATCALC program of EPI6, which calculated a sample size of 307 cases and 307 controls.

Data were collected on the basis of a predesigned and pretested questionnaire by interviewing the mother after obtaining informed consent. The questionnaire included information on sociodemographic factors and social-economic status: socioeconomic status was taken into the account of household measure called the standard of living index (SLI). Index of standard of living was calculated using the criteria of NFHS II.^{14,15} The data entry and analysis were done with the help of a computer using EPI-INFO version 6.04. Odds ratio was calculated to find out the association of various factors under study with LBW. Prior approval from the institutional ethical committee was obtained.

3. Results

When enrolling, the controls frequency matching for gestational age of the baby was done by dividing the babies into

three categories of gestational age: (a) <39 weeks, (b) ≥39 to <41 weeks, and (c) ≥41 weeks. Table 1 gives the distribution of cases and controls as per the gestational age categories.

Table 2 shows various sociodemographic factors like usual place of residence, religion, caste, type of family, ration card, and standard of living index. Among the various factors, family type and standard of living index were significantly associated with LBW. Other factors – usual place of residence, religion, caste, and type of ration card – had no statistical significance with LBW.

A higher proportion of cases belonged to nuclear families (45.6%) than controls (30.9%). The odds ratio for being born in nuclear family was 1.87 (95% CI: 1.33–2.64; *p*-value = 0.001) for cases.

Standard of living index was low or medium among 61.2% of cases against 51.8% of controls. Cases had odds of 1.47 (OR: 1.47; 95% CI: 1.05–2.05; *p*-value = 0.022) of being born in families with low or medium standard of living index than controls, as per criteria used in NFHS 2.¹⁴

Religion, caste, usual place of residence of family, and ration card did not show a significant odds ratio of delivering LBW babies.

Table 2 shows relationship of various paternal characteristics – age, years of schooling, and occupation among cases and controls. Only maternal age was found to have statistically significant association with LBW babies. Among the cases, 20.8% of mothers were below 20 years of age against only 12.7% of mothers in the control group. The odds of mothers being less than 20 years of age was 1.9 (95% CI: 1.20–3.01; *p*-value = 0.004) among cases. This was statistically significant. A higher proportion of mothers among cases were aged 30 or more years as compared to controls (OR: 2.12; 95% CI: 1.01–4.67; *p*-value = 0.04).

Majority of the mothers of the study subjects had completed their 8 years of schooling. Among the cases, 21.2% of mothers had less than 8 years of schooling compared to 17.6% of controls. Maternal education was not found to have statistically significant odds ratio for delivering LBW babies. Almost three-fourth of the mothers of study subjects were housewives. The odds ratio for maternal occupation was not statistically significant.

Majority of the fathers belonged to the age group of 24 years or more and more than three-fourth of the fathers were laborers by occupation. The father's characteristics – age, years of schooling, or occupation – were not found to have statistically significant association with LBW babies.

Among the cases, 54.7% were girls as compared to 42.3% among controls. The odds ratio for girls having LBW was 1.65 (95% CI: 1.18–2.29; *p*-value = 0.002). This was found to be statistically significant.

Table 1 – Distribution of cases and controls by gestational age.

Gestational age categories	Cases N = 307 (%)	Controls N = 307 (%)
<39 weeks	100 (32.6)	100 (32.6)
≥39 to <41 weeks	171 (55.7)	171 (55.7)
≥41 weeks	36 (11.7)	36 (11.7)

Table 2 also shows parental use of tobacco. Less than 10% of mothers were used to tobacco as against more than half of the fathers. A higher proportion of fathers among cases (62.2%) were used to tobacco as compared to controls (53.7%). The odds ratio for fathers for tobacco use was 1.42 (95% CI: 1.01–1.99; *p*-value = 0.03) among cases. This was found to be statistically significant. Less than 10% of the mothers were used to tobacco. Maternal tobacco use was not found to have a statistically significant odds ratio for delivery of LBW babies. Table 2 also shows the environmental, housing, and type of fuel being used in the households of cases and controls. No sanitary latrine was available in 56.7% of households under cases as against 48.5% of controls; the corresponding odds ratio was 1.39 (95% CI: 1.01–1.93; *p*-value = 0.04). The odds ratio was statistically significant. A small proportion of households of study subjects were classified to have unsafe drinking water. This proportion was higher by 2.3% among cases than among controls (0.7%), resulting in odds ratio of 3.56. However, this was not statistically significant.

More than half of the families were using traditional chullah for cooking in cases and control, respectively (58.0% and 55.0%). However, no statistically significant difference was found between the households cases and controls for use of traditional chullah for cooking.

4. Discussion

LBW is a major public health problem in many developing countries, including India. The last half of the century has witnessed many changes in the reproductive habits of population, technologies, and management of childbirth. However, during the last three decades, there had hardly been change in incidence of LBW in India.

During the last three decades, the effect of various factors responsible for LBW has been a subject of great interest. Although India experiences one of the highest LBW rates in the world, well-documented studies to assess the determinants of LBW are few in India.^{12,16–20} So, it becomes important to study factors that can help in identifying high-risk mothers and thus enables future intervention.

The present study was conducted in the obstetric ward of a district hospital. A total of 307 singleton cases (birth weight <2500 g) and equal number (307) of controls (birth weight ≥2500 g) with term gestation born in the same hospital after fulfillment of inclusion and exclusion criteria were enrolled for the present study.

It is now universally acknowledged that maternal age is an important factor influencing the incidence of LBW. Moreover, the rate of LBW decreases significantly with increasing age of mother after 18 years. In the present study, a higher proportion of mothers among cases were aged either less than 20 years (OR: 1.9; 95% CI: 1.20–3.01) or more than 30 years (OR: 2.21; 95% CI: 1.01–4.67) as compared to controls. Kramer in his meta-analysis on determinants of LBW had observed low maternal age as an important risk factor and its causal effect was established.² Similar findings have been observed by various studies.^{21–24}

Majority of the fathers in the present study were in the age group of 24 years or more. Paternal age was not found to be

Table 2 – Association of sociodemographic characteristics with low birth weight.

Characteristics	Cases N = 307 (%)	Controls N = 307 (%)	Odds ratio	95% CI	p-Value
Residence					
Rural	213 (69.4)	205 (66.8)	1.13	0.79–1.61	0.49
Urban	94 (30.6)	102 (33.2)	1		
Religion					
Others	89 (29.0)	96 (31.3)	0.90	0.63–1.29	0.54
Hindu	218 (71.0)	211 (68.7)	1		
Caste					
SC/STs	111 (36.2)	114 (37.1)	0.96	0.68–1.35	0.80
Open/OBC/others	196 (63.8)	193 (62.9)	1		
Family type					
Nuclear	140 (45.6)	95 (30.9)	1.87	1.33–2.64	0.001*
Joint	167 (54.4)	212 (69.1)	1	–	
Ration card					
No ration card	109 (35.5)	97 (31.6)	1.35	0.88–2.09	0.15
BPL	124 (40.4)	121 (39.4)	1.23	0.81–1.87	0.30
APL	74 (24.1)	89 (29.0)	1	–	
Standard of living index (SLI)					
Low or medium	188 (61.2)	159 (51.8)	1.47	1.05–2.05	0.022*
High	119 (38.8)	148 (48.2)	1	–	
Mother's age (years)					
<20	64 (20.8)	39 (12.7)	1.90	1.20–3.01	0.004*
20–29	221 (72.0)	256 (83.4)	1	–	
≥30	22 (7.2)	12 (3.9)	2.12	1.01–4.67	0.043*
Mother's education					
<8	65 (21.2)	54 (17.6)	1.26	0.83–1.92	0.262
≥8	242 (78.8)	253 (82.4)	1	–	
Mother's occupation					
Working	79 (25.7)	66 (21.5)	1.27	0.86–1.87	0.221
Housewife	228 (74.3)	241 (78.5)	1	–	
Father's age (years)					
<24	27 (8.8)	23 (7.5)	1.19	0.64–2.21	0.553
≥24	280 (91.2)	284 (92.5)	1		
Father's education					
<8	92 (30.0)	79 (25.7)	1.23	0.85–1.79	0.243
≥8	215 (70.0)	228 (74.3)	1		
Father's occupation					
Laborer	238 (77.5)	228 (74.3)	1.20	0.81–1.76	0.343
Service	69 (22.5)	79 (25.7)	1		
Sex of baby					
Female	168 (54.7)	130 (42.3)	1.65	1.18–2.29	0.002*
Male	139 (45.3)	177 (57.7)	1	–	
Mother using tobacco					
Yes	28 (9.1)	25 (8.1)	1.13	0.62–2.08	0.663
No	279 (90.9)	282 (91.9)	1	–	
Father using tobacco					
Yes	191 (62.2)	165 (53.7)	1.42	1.01–1.99	0.033*
No	116 (37.8)	142 (46.3)	1	–	
Drinking water					
Unsafe	7 (2.3)	2 (0.7)	3.56	0.67–24.97	0.091
Safe	300 (97.7)	305 (99.3)	1		
Sanitary latrine					
Absent	174 (56.7)	149 (48.5)	1.39	1.01–1.93	0.043*
Present	133 (43.3)	158 (51.5)	1		
Type of fuel					
Smoky fuel	178 (58.0)	169 (55.0)	1.13	0.81–1.57	0.5
LPGs	129 (42.0)	138 (45.0)	1		

Table 2 (Continued)

Characteristics	Cases N = 307 (%)	Controls N = 307 (%)	Odds ratio	95% CI	p-Value
Housing					
Kaccha	144 (46.9)	133 (43.3)	1.16	0.83–1.61	0.371
Pucca/semi-pucca	163 (53.1)	174 (56.7)	1		

* Significance p value < 0.05.

statistically significant. Out of all the studies reviewed, only two studies, one by Reichman and another by Shah, found that father's age was also associated with high likelihood for the LBW babies (OR: 0.7; 95% CI: 0.5–1.0).^{20,25}

In the present study, usual place of residence of family was statistically not significant. A similar finding was found in a study from Vellore.²⁶ However, in the national collaborative study done by ICMR under the guidance of Bhargava covering both urban and rural population, the prevalence of LBW ranged from 27 to 56% in urban and 31 to 41% in rural births. Nearly one-third (38%) among the rural cohort had birth weight of 2500 g or less as compared to 41.4% in the urban area.²⁷ A study from Haryana by Makhija found that mean birth weight of newborn from an urban background was 2371 g as against 2669 g for those from the rural areas ($p < 0.01$). Usual place of residence was found to be statistically significant.¹⁷

In the present study, more than two-thirds of the cases and controls (71% of cases and 68.7% of controls) were Hindu by religion. Nearly one-third of the cases and control belonged to scheduled caste and tribes. Neither religion nor caste was associated with LBW. This finding was similar to other studies.^{28–30} Amin found that the percentage of scheduled caste mother who delivered LBW babies was 47.1%, which was less when compared to the mothers of other caste who delivered LBW (54.4%) babies.³¹ Similarly, Joshi and Nair showed that incidence of LBW was similar in different castes.^{24,32} However, Nair found that incidence of LBW was significantly higher among SC/STs when compared to Hindus.³²

In the present study, a higher proportion of cases belonged to nuclear families (45.6%) than controls (30.9%). In contrast to this, Vijayalaxmi in her study conducted in urban area of Bangalore found that majority of the women who delivered LBW babies were living in joint families (54.0%).³³

Standard of living index was low or medium among 61.2% of cases against 51.8% of controls. Cases had higher odds of being born in families with low or medium standard of living index than controls. Kramer in his meta-analysis on determinants of LBW had observed socioeconomic status as an important risk factor and its causal effect was established.² Ghosh et al. reported that the incidence of babies with birth weight <2500 g was almost the same in low (less than Rs 50 per capita income) and middle income groups (Rs 51–200 per capita income) but significantly lower in high income groups (Rs 201 and more per capita income).¹⁶ Similarly, other studies found that risk of LBW was significantly higher for lower socioeconomic status.^{13,22,24}

In the present study, majority of the mothers of the study subjects had completed their 8 years of schooling. Among the cases, 21.2% of mothers had less than 8 years of schooling as compared to 17.6% of controls. Years of schooling of the

mothers was not found to be statistically significant for the LBW babies due to inadequate sample size. Amin, Malik et al., and Radhakrishnan did not find any association between educational status of mothers and risk of delivering LBW babies.^{29,32,33} However, Kramer in his meta-analysis on determinants of LBW found maternal education as an important risk factor and its causal effect was established.² Mavalankar also reported low level of maternal education to be significantly associated with increased risk of LBW.¹¹ Similar finding has been found by various others researchers in their studies.^{13,16,24,34–37}

Almost three-fourths of the mothers of the study subjects were housewives. Among the cases, 25.7% of the mothers were working against 21.5% of the controls. Occupation of mothers was not found statistically significant for LBW babies in the present study. Siza and Roudbari also did not find significant association between occupation and LBW.^{38,39} However, other researchers from various studies found significant association between occupation and LBW.^{13,32,40}

In regard with sex of infant, the present study revealed that among the cases, 54.7% were female infants, as compared to 42.3% among the controls. This finding was statistically significant. Kramer in his meta-analysis on determinants of LBW had observed sex of infant as an important risk factor and its causal effect was established.² Similar finding has been reported by various researchers.^{16,22,34,41} However, few studies did not report any association between LBW and sex of the infant.^{29,42}

In the present study, less than 10% of the mothers were using some form of tobacco as against more than half of the fathers. Maternal use of tobacco was not found to have a statistically significant odds ratio for delivery of LBW babies. However, Kramer in his meta-analysis found that tobacco chewing, cigarette smoking, and indoor smoke were potentially important and its causal effect was established.² Several studies have shown statistically significant association between tobacco exposure and LBW.^{23,43,44}

A higher proportion of fathers among cases (62.2%) were using some form of tobacco as compared to controls (53.3%). The odds for fathers consuming tobacco in some form was 1.42 among cases. This was statistically significant. Fathers' smoking habits can lead to passive smoking in prenatal period and can affect the birth weight, as also documented in other studies.^{45,46} Among environment and housing characteristics, the absence of sanitary latrine was found to be significantly associated with LBW. Use of unsafe drinking water, smoky fuel, and housing were not found to have significant association with LBW. However, several studies found that unsafe drinking water,⁶ exposure to smoky fuel,^{47,48} and housing condition^{32,33} were associated with increased risk of LBW.

The present study tries to address sociodemographic determinants of LBW in Wardha district situated in central India. The strength of the study was that both cases and controls were taken from government hospital that caters to maximum number of dwellers in the district; this helped in having homogenous study subjects, and thus reducing the bias. We tried to involve nearly all sociodemographic determinants as derived from review literature. A major limitation of the study can be the deliveries that took place at remotest places of the district, which were not represented in the study. Other reasons having effects on birth weight may have biased the study results, which we tried to compensate by taking appropriate inclusion and exclusion criteria. Due to limitation of time and resources, further exploration of determinants as associated with LBW was not done. There is still need to conduct studies with large sample size at a local level and advanced analysis of the data to take necessary corrective action for prevention of LBW.

5. Conclusion

From the literature, we already known that maternal age, nuclear family, poor standard of living, and female sex of baby were found to be significant factors associated with LBW. This study also confirms the findings. This study also adds that tobacco use by father and absence of sanitary latrine at home for mother were also having significant association with LBW in the study area.

To conclude, maternal age less than 20 years or more than 30 years, nuclear family, poor standard of living, tobacco use by father, female sex of the baby, and among environment and housing characteristics, the absence of sanitary latrine were found to have significant association with LBW.

Recommendation

The present study states that different sociodemographic characteristics of the population is still the important factor in causing LBW among the newborn. It can be recommended that birth must be properly planned with the help of community health workers. Full utilization of the services from the health system must be made so that the nation gets healthy newborns and they lead a healthy life for building a better India.

Author's contribution

Both the authors have substantially contributed to the conception and design of the work, collection of data, analysis, or interpretation of data for the present work. The drafting and revising of the present work and its intellectual content have been done by the authors together.

Conflicts of interest

The authors have none to declare.

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