ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 15, Issue, 04, pp.24241-24245, April, 2023
DOI: https://doi.org/10.24941/ijcr.45060.04.2023

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

STUDY OF MATERNAL FACTORS AS A DETERMINANT OF LOW BIRTH WEIGHT IN NEWBORNS

[1]Shari Kumbalath Raju, [2]Peter P Vazhayil, [3]Jiss Thomas and [4]Anju Mary Jose

[1]MBBS, MD PAEDIATRICS, Associate consultant, Department of Paediatrics, Mar sleeve medicity Palai; [2]MBBS,DCH,DNB(Paed), MRCPCH(UK), Associate Professor, Department of Paediatrics, Government Medical College, Ernakulam; [3]MBBS, MD PAEDIATRICS, Senior Consultant, Department of Paediatrics, Mar sleeva medicity Palai; [4]MBBS, DCHSenior Registrar, Department of Paediatrics, Mar sleeve medicity Palai

ARTICLE INFO

Article History:
Received 14th January, 2023
Received in revised form
17th February, 2023
Accepted 16th March, 2023
Published online 18th April, 2023

Key words:

Low birth weight, maternal weight, height, BMI

**Corresponding Author:*
Shari Kumbalath Raju

ABSTRACT

Introduction: World Health Organization (WHO) defines Low birth as weight at birth of less than 2,500 grams (5.5 pounds)(1).The birth weight of an infant is the single most important determinant of its chance for survival, healthy growth and development(2). Epidemiological observations show that infants weighing less than 2,500 g have approximately 20 times greater risk of neonatal mortality compared to heavier babies. Low birth weight contributes to a range of poor health outcome .Fetal and neonatal mortality and morbidity, inhibition of growth and cognitive development, and chronic diseases later in life are closely associated with low birth weight(3–6).Low birth weight also has public health significance as its outcome is influenced by consumption of reproductive health care(7). One of the key measures of child health is that of birth weight(8). Many studies had found out low maternal pre-delivery weight, poor weight gain during pregnancy and low socio-economic status as significant risk factors for LBW. Being modifiable factors, detection of any such association among Kerala babies is useful to plan preventive measures for reduction of the number of LBW babies. In this context this study is aimed at studying the maternal factors as a determinant of low birth weight in newborns. **Objectives:** To find out the association of maternal weight, height and BMI with low birth weight in term Newborns. **Methodology:** A hospital based case control study was conducted during the period of January 2015 to June 2016 in the neonatology department of Govt. Medical College Ernakulam to try to examine the determinants of low birth weight with emphasis on the maternal anthropometric determinants namely weight, height and BMI. Other factors were studied were socio demographic characteristics, obstetric history and antenatal care. **Results:** The results with respect to the maternal anthropometry were clearly indicative of associations. All the anthropometric measurements of the cases were significantly different among cases compared to control. There was significant association of LBW with maternal socioeconomic status, gestational weight gain and inadequate antenatal care. **Conclusion:** Maternal height, weight and body mass index strongly determines LBW.

Citation: ***Shari Kumbalath Raju, Peter P Vazhayil, Jiss Thomas and Anju Mary Jose.*** **2023.** "Study of maternal factors as a determinant of low birth weight in newborns*". International Journal of Current Research*, 15, (04), 24241-24245.

INTRODUCTION

Estimates show that 28% of infants born in India are LBW and about 85% of all neonatal deaths occur among them. In a developing country like India, about two-thirds of LBW are born at term but are small-for-dates. Among Indian States, Kerala has the credit of the state with admirable health status comparable to the West(10). The State is reputed to have the highest rate of hospital deliveries (above 95 percent), and excellent antenatal coverage. In spite of these achievements, prevalence of low birth weight in Kerala remains high, as shown in micro- studies done over the years (11).

That the etiology of LBW is multifactorial is generally acknowledged. Both in developed and developing countries it has been reported thatmaternal anthropometric measurements are associated with birth outcome (12,13). There is a strong and significant positive correlation between maternal nutritional status and birth weight. Maternal weight (prepregnancy), maternal stature, and maternal weight gain during pregnancy have direct association with maternal nutrition and correlate with fetal growth (14). Maternal nutrition and supply of nutrients to the fetus affects fetal growth significantly. A high percentage of LBW therefore points to deficient health status of pregnant women and inadequate prenatal care and the need for improved care of the newborn. In developing countries like India the

nutritional status of women in the reproductive age group is far from satisfactory. The existing cycle of low birth weight begins from early childhood and extends to adulthood wherein their diets are deficient of calories and many other essential nutrients and their fertility rates are high. Poor body size of mother is the outcome of this long term nutritional deprivation. Pregnancy in such undernourished mothers with low maternal weight and low dietary intake throughout the gestation will inevitably result in delivery of low birth weight baby.

MATERIALS AND METHODS

Study Design: Hospital based Case control Study.

Study setting: The study was conducted inDepartment of Neonatology, Government .

Medical College, Ernakulam, Kalamassery, a tertiary care centre.

Study population:

Cases: Term, singleton, live, neonate having birth weight less than 2.5kg and their mothers who had registered and delivered at Government Medical college, Ernakulam.

Controls: Term, Singleton, live, neonate having birth weight more than 2.5kg and their mothers who had registered and delivered at Government Medical College, Ernakulam.

Inclusion criteria:

Pregnant mothers who

- are 19 years or more of age
- had their first visit at or less than 13 weeks of age
- Babies
- whose gestational age is exactly known either from LMP or USG
- had their birth at term(37 completed to 41 weeks)

Exclusion criteria

Pregnant mothers who:

- Do not have clear data of gestational week at registration
- Had diseases such as hypertension, diabetes mellitus, heart disease, renal disease, epilepsy, rheumatoid arthritis, thyroid disease and anemia
- Babies
- Born preterm(less than 37 weeks)
- Born post term(more than 41 weeks)
- Diagnosed to be syndromic

Study period: 1 year starting from January 2015 to December 2015

Sample size: The sample size was calculated for both cases and controls as 173(1:1).

SAMPLING TECHNIQUE

Every consecutive case who satisfies the inclusion and exclusion criteria will be taken until the required sample size is reached. A consecutive sex matched control corresponding to the case who satisfies the exclusion and inclusion criteria will be included from the setting.

STUDY METHODOLOGY

Methodology: This is a case control study to try to examine the determinants of low birth weight, with emphasis on the maternal anthropometric determinants namely weight, height and BMI.

In Kerala, 95-97% of deliveries occur in the hospitals and therefore it was possible to do hospital based case-control study. After enrolling the babies, written informed consent was taken from their parents. Information was collected from the mothers of the newborns at a period of 24-48 hours after delivery using a pre designed, pre tested questionnaire The relevant data was collected using

A questionnaire which had items in the following divisions:

- Socio-demographic characteristics of mother and her family
- Obstetric history especially information about previous births/abortions
- Details about antenatal care including antenatal clinic (ANC) registration, antenatal visits and check-ups, tetanus toxoid injections, consumption of iron and folic acid tablets, information relating to heavy work done and rest timings. This information was cross checked with the available records such as ANC cards and case sheets to minimize the recall bias. Adequate antenatal care was considered when the pregnant woman was registered at any time, had at leastthree antenatal checkups, was adequately vaccinated against tetanus, had consumed at least 100 tablets of iron and folic acid, was not involved in hard work, and had taken adequate rest during pregnancy (minimum 2 hours sleep during day and 8 hours sleep during night)
- Maternal anthropometry- Weight and height of the pregnant mothers was recorded by nursing assistant posted in the gynecology outpatient department during their first antenatal visit and recorded in ANC card. Mothers were weighed using spring scales to the closest kilogram and height was measured to the closest millimeter . The cut off of 145cm for maternal height and 40 kg for maternal weight as has been indicated in the literature. To examine the combined effect of height and weight, the bmi has also been computed and classified. Weight gain was calculated by subtracting weight of the mother at12 weeks or before from weight of the mother at term, considering negligible weight gain up to 12 weeks ofgestation (72).
- Information about delivery and newborn- Weight of newborn was recorded to the closest kilogram within 24 hours of delivery in the labor room by the nursing assistant using an electronic scale. Gestational age was assessed from the LMP. Confirmation of gestational age was done in all babies using Cappuro's method—a simplification of the Dubowitz score, which includes only five somatic and two neurological parameters.

DATA MANAGEMENT AND STATISTICAL ANALYSIS

The data was numerically coded and entered in Microsoft excel spread sheet. Descriptive analysis of dependent and independent variable was performed using frequency tables, graphs and diagrams. Bivariate analysis was planned taking low birth weight and normal birth weight as outcome variable and BMI classification of obese/non obese as predictor variable. Accordingly 2X2 tables was created and exposure rates among cases and controls was calculated. Statistical analysis was performed using chi square test, taking into consideration 95% confidence interval and 'p' value of 0.05. Odds ratio was also be calculated and interpreted. Logistic regression analysis was done to find out an independent determinant.

RESULTS

A 1:1 sex matched case control study was done. Upon comparison of maternal age, maternal religion, area of residence, type of family, number of previous abortions, birth spacing, number of antenatal visits, doses of TT taken between cases and controls ,the p value was greater than the significance level of 0.05 and hence the difference was not significant. Whereas on comparing maternal education, maternal occupation, maternal socioeconomic status, maternal parity, heavy work done, maternal sleep hours, maternal antenatal care, maternal height, maternal pre-delivery weight, gestational weight

gain, maternal BMI between cases and controls the p value was lesser than the significance level of 0.05 and hence the difference was significant.

Table 1. Comparison of BMI between Case and Control

BMI	Case (N=173)	Control (N=173)	Odds Ratio (95% CI)	p - value
Under Weight	50 (28.9%)	6 (3.5%)	4.076** (2.354 - 7.057)	0.000
Normal	118 (68.2%)	148 (85.5%)		
Over Weight	0 (0.0%)	19 (11.0%)		
Obese	5 (2.9%)	0 (0.0%)		

** Difference is significant at 0.01 level.

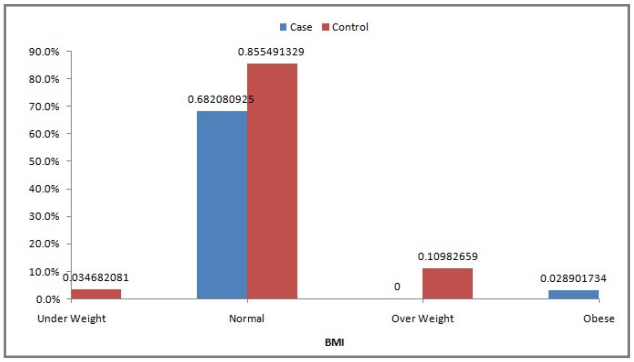

Figure 1. Comparison of BMI between Case and Control

Table 2. Comparison of Antenatal Care between Case and Control

Antenatal Care	Case (N=173)	Control (N=173)	Odds Ratio (95% CI)	p - value
Adequate	59 (34.1%)	115 (66.5%)	3.831** (2.451 - 5.988)	0.000
Inadequate	114 (65.9%)	58 (33.5%)		

** Difference is significant at 0.01 level.

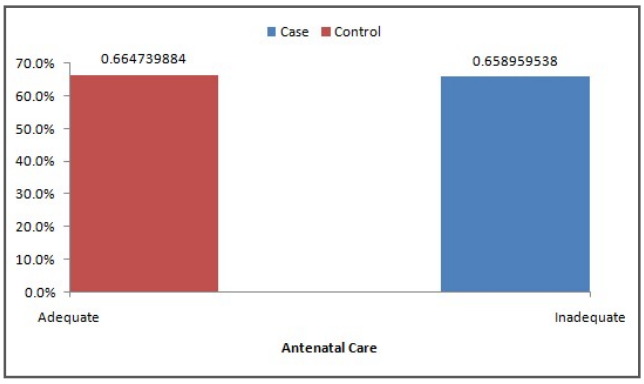

Figure 2. Comparison of Antenatal Care between Case and Control

DISCUSSION

The number of cases of low birth weight babies necessary was determined to be 173. The controls represented consecutively born term normal weight babies during the same period. The analysis included 173 cases and 173 controls. All the cases and controls for whom data was collected were included in the analysis.

Characteristics of the controls: Term, Singleton, live, neonate having birth weight more than 2.5kg and their mothers who had registered and delivered at Government Medical College, Ernakulam during the period of Jan 1-Dec 31,2015 were taken as controls. There were 173 controls in the ratio of 1:1 to the cases. All the controls were included in the analysis. Out of the 173 controls 77 (44.5%) were males and 96 (55.5%) were females. Slightly above a third of the controls 67(38.7%) were delivered through normal delivery and 106 (61.3%) by caesarean sections. As almost all (98%) of the deliveries are institutional in Kerala, the controls are representative of the babies of normal birth weight.

Characteristics of the cases: There were 173 cases in the study and all of them were included in the analysis. Term, singleton, live, neonate having birth weight less than 2.5kg and their mothers who had registered and delivered at Government Medical college, Ernakulam were taken as cases. Among the socio-demographic characteristics, the age of the mothers were classified into groups; up to 25years, 26-30 and above 30. The present study showed no significant difference between the cases and controls by this categorization of age. However many studies have found that younger and older mothers are at higher risk of low-birth weight infants, thereby demonstrating a U-shape relationship between maternal age and low birth weight. The education of the mother was significantly different between cases and control. SES of the household strongly determined LBW status of the baby. Low socioeconomic status and low educational status indirectly leads to low health consciousness, lower nutritional status and low antenatal attendance, thereby increasing the risk of LBW babies.

We compared the proportion of mothers in the case and control group belonging to economically different classes, namely APL and BPL(above and below poverty line) Among the cases 56.1% belonged to BPL and 43.9% to APL status. The p value was 0.027(<0.05) which was statistically significant. The association of low socioeconomic status with low birth weight observed in this study has also been reported by Desmukh *et al*(23).Other studies from both developed and developing countries have reported similar association(25,32). The place of residence of the cases and the controls also did not show any significant difference. A majority of mothers in both the groups were from the rural areas. The religion to which the mothers belonged was not significantly different between the cases and the controls. There was also no significant difference between cases and controls with respect to type of family. The type of families were classified as nuclear and joint.

The results with respect to the maternal anthropometry were clearly indicative of Associations. Maternal height, weight and body mass index strongly determines LBW. All the anthropometric measurements of the cases were significantly different among cases compared to controls. Considering maternal height, almost double the number i.e 19.7% of mothers among cases had height less than 145cm compared to 8.7% in controls. .While 25.4% of mothers in cases measured between 146-150cm, it was only 16.2% among controls. The p value was 0.000 (<0.000) which was statistically significant .Among Indian studies, while Ghosh *et al (32)*and Desmukh (23) documented that mothers who were less than 140 cm in height were more prone to have LBW, study by ICMR(21) and Mumbare *et al* (24). observed that height less than 145cm is an important risk factor associated with low birth weight babies .The finding of maternal stature as a significant risk factor for LBW is consistent with the literature from western world as well. Ferraz *et al* did find an association of low height (<150cm)(17) with increased risk of IUGR . The proportion of the mothers under 45 kg(56.1%) were more among the cases compared to controls(15%) .

The p value was 0.000 (<0.05) which was statistically significant. In a hospital based case control study done by Manju Nair(27) in Trivandrum maternal weight less than 40 kg was associated with 3.63 times as much risk of having a low birth weight baby compared to maternal weight of more than 40kg. Maternal weight (<45kg) and maternal height (<145cm) have been identified as potential risk factors for LBW babies by Kramer's meta-analysis (12). Consequently the BMI of mothers also differed significantly between cases and controls. Among the mothers in case group 28.9% were underweight while 85.5% of mothers in the control group had a normal BMI. The p value was 0.000(<0.05)which was statistically significant The findings in this study was also corroborated by the study done by Frederick *et al* where in pre-pregnancy BMI was independently and positively associated with infant birth weight . The present study also revealed that poor maternal weight gain was

statistically significant. While 13.3% of mothers among cases had gained less than 5 Kg, the value was only 2.9% among controls.61.8% of mothers among cases had gained weight between 6-10 Kg and 24.9% had gained weight above 10 Kg. The p value was 0.000(<0.05) which was statistically significant. These findings are in conformity with the observations of the ICMR study that revealed a strong correlation LBW and maternal weight gained during pregnancy below 5 kg. So also the study by Leela Raman showed that weight gain below 6 kg during pregnancy is associated with more than 55% of infants being born with intra uterine malnutrition. Parity is also an important determinant of birth weight. In the present study, primiparous mothers were higher(28.9%)among the cases when compared to the control group(10.4%).The p value was 0.000(>0.05) which was statistically significant. In the study done by Desmukh *et al* primipara had 1.62 times more risk of delivering LBW babies. Interpregnancy interval of less than 13 months is associated with increased risk of giving birth to a LBW baby. The present study did not find any statistically significant association between birth spacing and LBW. However the study by ICMR showed aninter pregnancy interval below 24 months to be significantly associated with LBW. Study by Mumbare at that found that spacing <36 months was a significant risk for LBW. There was no significant difference between the mothers of cases and controls with respect to the number of abortions. The difference in number of ANC visits between case and control was not found to be statistically significant. The distribution of number of ANC visits was more or less same in both case and control. The present study showed heavy work to be a significant risk factor for LBW. The p-value was 0.000(<0.05) which is statistically significant. The proportion of mothers who had done heavy work were high among cases (15.6%) compared to controls (2.9%). Mothers who were sleep deprived which translates into inadequate rest were also found to be at significant risk of delivering LBW babies. The p-value was 0.000(<0.05) which is statistically significant. Mothers with 6-7 hours (30.6%) and 8-9 hours of sleep (30.1%) were high among cases compared to controls (16.2% and 17.3% respectively). The present study has shown that full term low birth weight was significantly associated with inadequate antenatal care. The p-value is 0.000(<0.05) which is statistically significant. This is in conformity with the study by Mumbare *et al*

CONCLUSION

- LBW was not significantly related to maternal age, area of residence, religion, history of previous abortions or birth spacing.
- Maternal anthropometry which includes maternal weight, height and BMI were found to be important factors contributing to LBW.
- Maternal socio economic status comprising of maternal education ,family income and Maternal occupation were found be having strong relationship with development of LBW.

- Mothers with inadequate antenatal care were also found to be at significant risk of delivering LBW babies.

Key points

- This study signifies the importance of poor maternal nutritional status as reflected by poor weight gain in giving rise to LBW babies.
- Every woman has the right to pre-pregnancy health check -up, general and nutritional guidance, and essential vaccines. Conflict of interest: There is no conflict of interest

Funding source: **NIL**

GLOSSARY OF ABBREVIATIONS:

Abbreviation	Expansion
ANC	Antenatal clinic
BMI	Body mass index
LBW	Low birth weight
WHO	World health organization

REFERENCES

Wardlaw TM, World Health Organization, UNICEF, editors. Low birthweight: country, regional and global estimates. Geneva : New York: WHO ; UNICEF; 2004. 27 p.

Agarwal G, Ahmad S. Maternal Risk Factors Associated with Low Birth Weight Neonates in a Tertiary Care Hospital, Northern India. J Community Med Health Educ [Internet]. 2012 [cited 2016 Oct 21];2(9). Available from: http://www.omicsonline.org/maternal-risk-factors-associated-with-low-birth-weight-neonates-in-a%20tertiary-care-hospital-northern-india-2161-0711.1000177.php?aid=9601

Boucher BJ. Determinants of size at birth. QJM Mon J Assoc Physicians. 95:331–3.

Kogan MD. Social causes of low birth weight. J R Soc Med. 1995;88(11):611–615.

Minerva Thame, Clive Osmond, Rainford J. Wilks, Franklyn I. Bennett,, Norma McFarlane-Anderson, Terrence E. Forrester. Blood Pressure Is Related to Placental Volume and Birth Weight. Hypertension. 2000 Feb;35.

Martyn CN, Barker DJ, Jespersen S, Greenwald S, Osmond C, Berry C. Growth in utero, adult blood pressure, and arterial compliance. Br Heart J. 1995;73(2):116–121.

Padilha PC, Accioly E, Chagas C, Portela E, Da Silva CL, Saunders C. Birth weight variation according to maternal characteristics and gestational weight gain in Brazilian women. Nutr Hosp. 2009;24(2):207–12.

Rosenzweig MR, Schultz TP. Estimating a household production function: Heterogeneity, the demand for health inputs, and their effects on birth weight. J Polit Econ. 1983;723–746.

Ministry of health and family welfare. Govt. of India.National Family Health Survey-3. India Rep. 2005 2006;1.

Thankappan, K. R. ; Valiathan, M. S. Health at low cost: the Kerala model. Lancet. 1998 Apr;351:1274–5.

Pelletier D, Arimond M, Johnson FC, Liang E, Low J, Mvula P, *et al* Annex: Maternal anthropometry predictors of intrauterine growth retardation and prematurity in the Malawi Maternal and Child Nutrition study. Bull World Health Organ. 1995;73(Suppl):80.

UNICEF; India. Indian Council of Medical Research [ICMR. Birth weight : a major determinant of child survival. Indian J Pediatr. 1987 Dec;801–18.

Bhatia BD, Tyagi NK, Sur AM, Satya K. Comparative evaluation of two maternal weight-height indices during pregnancy. 1989 Apr;26(4):353–7.

Deshmukh JS, Motghare DD, Zodpey SP, Wadhva SK. Low birth weight and associated maternal factors in an urban area. Indian Pediatr. 1998;35(1):33–6.

Mumbare SS, Maindarkar G, Darade R, Yenge S, Tolani MK, Patole K. Maternal risk factors associated with term low birth weight neonates: a matched-pair case control study. Indian Pediatr. 2012;49(1):25–28.

Hirve SS, Ganatra BR. Determinants of low birth weight: a community based prospective cohort study. Indian Pediatr. 1994; 31(10):1221–5.

Radhakrishnan T, Thankappan KR, Vasan RS, Sarma PS. Socioeconomic and demographic factors associated with birth weight: a community based study in Kerala. Indian Pediatr. 2000 Aug;37.

Manju Nair R. Maternal Determinants of Low Birth Weight-A Hospital Based Case Control Study in Trivandrum [Internet]. SCTIMST; 2002 [cited 2016 Nov 13]. Available from: http://dspace.sctimst.ac.in/jspui/handle/123456789/2226

Valero de Bernabé J, Soriano T, Albaladejo R, Juarranz M, Calle ME, Martínez D, *et al* Risk factors for low birth weight: a review. Eur J Obstet Gynecol Reprod Biol. 2004 Sep;116(1):3–15.

McCormick M C. Contribution of low birthweight to infant mortality and childhood morbidity. N Engl J Med. 1985;312:82–90.

Cunningham, Leveno, Bloom, Hauthe, Rouse, Spong. Williams Obstetrics. 23rd Edition. The McGraw-Hill;

World Health Organization. Perinatal mortality and morbidity.SEARO Regional technical papers.No.3.

Ghosh S, Hooja V, Mittal SK, Verma RK. Biosocial determinants of birth weight. Indian Pediatr. Indian Pediatr. 1977 Feb;14:107–13.

Trivedi CR, Mavalankar DV. Epidemiology of low birth weight in Ahmedabad. Indian J Pediatr. 1986;53(6):795–800.

Villar J, Khoury M J, Finucane F F, Delgado H L. Differences in epidemiology of prematurity and intrauterine growth retardation. Early Hum Dev. 1986;307–20.

Mavalankar DV, Gray RH, Trivedi CR. Risk factors for preterm and term low birthweight in Ahmedabad, India. Int J Epidemiol. 1992;21(2):263–272.

Pachauri S, Marwah SM. A study of the effect of certain maternal factors on birth weight. Indian J Med Sci. 1970 Oct;10:650–60.

Rathnam SS, Rao KB,, Arulkumaran S. Identification and management of high risk pregnancies. In: Gopalan S, editor. Obstetrics and Gynecology for Postgraduates. p. 9–18.

Chhabra S, Sharma S. Variables affecting fetal weight. Indian J Matern Child Hlth. 1994;5:61–3.

Swain S, Bhatia BD, Pandey S. Maternal Biosocial and nutritional parameters and birth weight. Indian J Matern Child Hlth. 1994;5:68–72.

Raman L. Maternal risk factors in intrauterine malnutrition. Indian J Pediatr. 1987;54(4):503–510.

****