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# Discovering Hidden Contributors to Low Birth Weight: A Comprehensive Analysis of Maternal and Neonatal Factors

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**Abstract:** ***Low Birth Weight (LBW) is the primary cause of major health problems of new born infants. LBW is a term used for neonatal whose weight is usually lesser than 2500 grams and potentially they have the higher risk of developing diseases than other babies. From the literature, it is understood that the common factors that play a major role on LBW are gender of the baby, the age of the mother, mother's weight gain during her gestational period, malnutrition etc. There are also some concealed factors which are being given less importance but expected to have equal significance and hence this research is focused on identifying those factors. They include, Occipito-Frontal Circumference (OFC) of the baby, blood pressure and diabetes condition of the mother during her gestational period, medical history of the mother, BMI of mother in terms of obese/normal/ overweight, single or twin pregnancy, length of the baby etc. which were considered during the gestational period of the mother in this work. The main purpose is to detect the problem at an early stage during the pregnancy stage of a mother in order to avoid further complications for the infant and to assist physicians to protect the fetus with proper care. This study underwent some statistical analyses to explore the association between the various risk factors causing LBW.***

**Keywords:** LBW, Maternal factors, Statistical Analyses.

## 1. Introduction

According to the World Health Organization, babies weighing less than 2,500 grams at birth are considered Low Birth Weight babies [1]. Low birth weight is usually caused by giving birth before the 37th week of pregnancy [2]. Considerable consumption of iron is essential for a woman in gestational period from a public health perspective for the healthy growth and development of the child inside the uterus because newborn babies are more likely to become ill after birth and are exposed to non-communicable diseases throughout their lives [3]. Knowing the risks associated with premature birth can help prevent it.

Maternal factors such as illness, health, and age have been reported to be associated with preterm birth [4]. Biological characteristics such as women's height, weight, Body Mass Index (BMI), age, number of twins are associated with LBW [5].

Malnutrition and obesity during the childbearing age are global health problems and affect many determinant outcomes. These include maternal factors such as maternal age and diabetes, high blood pressure, poor prenatal care; In addition to determinants of health such as health, access to healthcare, and environment, genetics, parental stress, and dispositions may also play a role in reproductive decisions. The interaction of these decisions can affect fetal development and increase the risk of birth defects; this highlights the importance of considering multiple interventions to improve maternal and infant health outcomes [2]. The inadequate availability of data and maternal risk factors such as anemia and malnutrition result in LBW babies in rural India [6].

People at risk include young mothers, new mothers, and mothers who are malnourished before and during pregnancy. To achieve the goal of reducing child mortality, sufficient evidence needs to be provided regarding the severity and impact of low birth rates so that timely intervention can be made. Therefore, these data measure the overall prevalence and associated characteristics of low birth weight [7]. Many researchers use statistical methods to identify health risks at an early stage. This study involves collecting information from public records and analyzing the collected data, comparing different groups in the data such as maternal age, birth weight, BMI and OFC. This study may help protect the fetus and prevent premature death by providing a deeper insight and understanding of the factors associated with Low Birth Weight (LBW).

## 2. Literature Review

Researchers in the healthcare system have been attempting to forecast the risk factors related with preterm birth in recent years. There are numerous studies going on in evaluating the most informative risk factors using various algorithms based on machine learning to predict LBW [5]. Although numerous interventions aim at addressing this issue, the prevalence of LBW is rising globally and threatens to be a major issue globally [8].

G. M. Monawar Hosain *et al*. [9] observed the mother's overall health, including her weight, weight growth, and anemia are considered as the major risk factors that cause

LBW. In order to avoid LBW deliveries, women in reproductive age groups must participate in comprehensive nutritional programs aimed at improving their overall health, managing their weight, and reducing anemia. It is necessary to provide programs related to improving the nutrition for women far in advance of pregnancy. In the past, health care professionals have placed too much emphasis on screening for biological issues, whereas health promotion and education have been less specifically targeted. Interventions beyond pregnancy, such Antenatal Care and home visits, are necessary for the prevention of LBW. Prolonged primary prevention tactics that enhance the social standing of women in the family might prove to be more successful than pregnancy-specific therapies.

In a Study by Basel PL *et al*. [10] suggested that LBW has been linked to co-morbidity throughout pregnancy; premature delivery and weight increase during the second and third trimesters of pregnancy. By taking simple and manageable precautions that a family may implement and the mother can readily follow out, recognized risk factors can be effectively prevented. Programs for maternal health can be focused on encouraging and monitoring expectant mothers to take all of the recommended iron supplements during their pregnancy. Consuming a balanced diet is crucial for the fetus's proper growth and development within the uterus. The mother's family should support her in maintaining a healthy lifestyle, getting enough sleep, and abstaining from the risk factors were the findings of this study.

Islam Pollob SMA *et al*. [5] proposed a study which highlighted that when the babies grow into adulthood, LBW may be a major contributing factor to a variety of disorders. In order to predict LBW this study identified the major contributing risk factors and used ML based algorithms. Nonetheless, compared to women without education, women with education had a lower chance of giving birth to a child with LBW. There was a substantial correlation found between LBW and other characteristics such as mother height, twin child, wealth index, geography, and living child. The appropriate actions should be taken by health authorities to improve the financial circumstances of the impoverished and other important aspects of our nation. The authors concluded that addressing the primary causes of LBW will help doctors make more accurate LBW predictions.

Bansal *et al*. [11] performed analysis on newborns with LBW and found that this is substantially correlated with socio-cultural and maternal risk factors, such as time of gestation, food intake, and afternoon rest throughout pregnancy. Birth of LBW babies is a problem that can be mitigated because nearly all these factors are easily addressed by providing appropriate and efficient prenatal care and making the most of them. Additionally, home care can be improved by emphasizing education of mothers and other family members, which will lower the rates of infant and child mortality. Razia Shaheen *et al*. [12] identified that maternal age less than 19 years was the major risk factor of LBW. Their assessment was done through univariate regression models. Similar findings were reported in a more recent study, which linked an increased risk of preterm birth to both younger mothers (20–24 years old) and older mothers (40 years and older). According to Gul R *et al*. [13], maternal nutritional condition affects weight increase of the fetus, occipito-frontal circumference and length.

## 3. Materials and Methods

Examining the relationship between LBW and a number of other parameters such as BMI, birth weight, gestational age, length at birth, OFC, maternal age and pregnancy is the main focus of the current study. The dataset used by [13] has been utilized for the present study. The dataset consists of 2766 records and 31 parameters of female patients. As the initial step, those records which are considered as LBW and not LBW are separated into two categories (Category – I & Category – II) and their mean values for the afore mentioned parameters have been observed. The following table Table-1 shows the observed mean values for the above factors.

**Table 1:** Characteristics of each Category (LBW-Y/N) with respect to the Specified parameter

| Parameters | Category – I LBW-Yes | Category – IILBW-No |
|---|---|---|
| Birth Weight | 2.205723906 | 3.365667 |
| OFC at Birth | 32.1969697 | 33.70367 |
| Maternal Age | 28.01346801 | 28.36667 |
| Length at Birth | 45.27373737 | 48.51033 |
| Gestational Age | 38.11279461 | 38.4 |

The following statistical analyses were performed: (i) Correlation analysis (ii) Analysis of Variance (ANOVA) and (iii) Linear regression. The tests indicated above were carried out to assess the desired null hypothesis, which states that there is a strong positive correlation between LBW and other parameters, in order to determine the statistical significance of the study.

## 4. Results and Discussion

A closer examination of Table-1 reveals several observations based on the provided categories. The average birth weight for Category- I is less than 2.5 kg, whereas it is greater than 2.5 kg for Category II. Though the maternal age and gestational age are almost similar for both the categories, the OFC at birth of the babies show a lesser value in Category-I than in Category-II. The other factor Length at birth shows a difference among the categories. For Category-I, in the case of LBW-Yes, the Length at birth is lower than that of LBW-No category.

The correlation depicted in the above figure, Figure.1 highlights the association between LBW and several indicated parameters. It is evident that LBW exhibits a more pronounced correlation with pregnancy (single/twin babies) compared to other factors. While a moderate correlation exists between LBW and pregnancy, it is not substantial enough to conclude a direct linkage between the two. Consequently, an ANOVA test is deemed appropriate to analyze the various factors comprehensively.

The following table, Table–2 shows the correlation among LBW and some other factors.

**Table 2:** Correlation among LBW and other parameters.

| Parameter/ Correlation | Pregnancy (Single / Twin) | BMI | Anemial Blood Transfusion | Gestational Age | Length at birth | OFC |
|---|---|---|---|---|---|---|
| LBW | 0.301013 | 0.106476 | 0.084777 | 0.052075 | 0.250813 | 0.184316 |

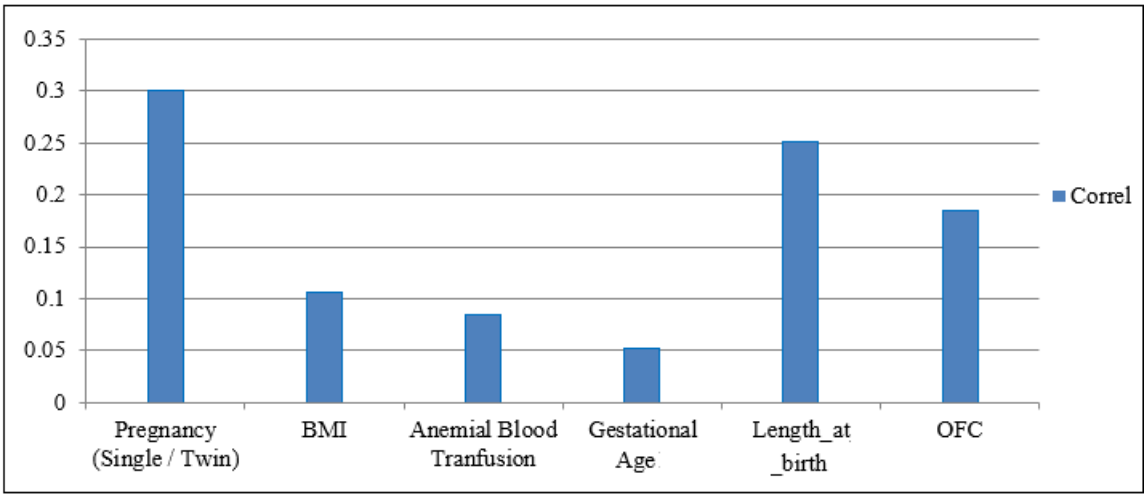


**Figure 1**: Correlation among LBW and other factors.

**Table 3:** ANOVA - experimental results

| Parameter mean values | P - Value |
|---|---|
| Birth Weight | 0.0007 |
| OFC | 0.53 |
| Maternal Age | 0.0198 |
| Length at birth | 0.1 |

In general, ANOVA analysis compares averages across different groups and identifies statistical variances among the means. Its main objective is to assess the statistical significance among these group means by computing the p-value. A significance level of 0.05 represents a 5% risk, meaning a 5% chance of concluding dissimilarity when there is none. If the calculated p-value is below this significance level, the null hypothesis is rejected, indicating a significant difference among the group means. The p-values obtained for the notable factors in association with LBW are shown in the above table Table-3. Though there are other more factors available in the dataset, these factors showed considerable significance in the outcome for identifying LBW. Hence, the ANOVA tests were carried out for these few factors. ANOVA results prove that if the observed p-value is considerable low, then the null hypothesis could be rejected. This results in the fact that means there is a difference among groups. Also, in Table 3 above, the p-value associated with the 'birth weight' factor indicates a significant variation in birth weights between the two groups. Following this, 'maternal age' emerges as a potentially crucial factor for identifying LBW. The p-value for 'Length at birth' stands at 0.1, suggesting it warrants attention as well. Conversely, the p-value of 0.5 for OFC suggests it may be disregarded when assessing LBW.

**Table 4:** Regression results for LBW and other factors

| Parameters | Gestational Age (GA) | Anemial Blood Transfusion (ABT) | Body Mass Index (BMI) | Pregnancy Single/ Twin |
|---|---|---|---|---|
| LBW | 5.64 | 4.34 | -1.83 | 3.71 |

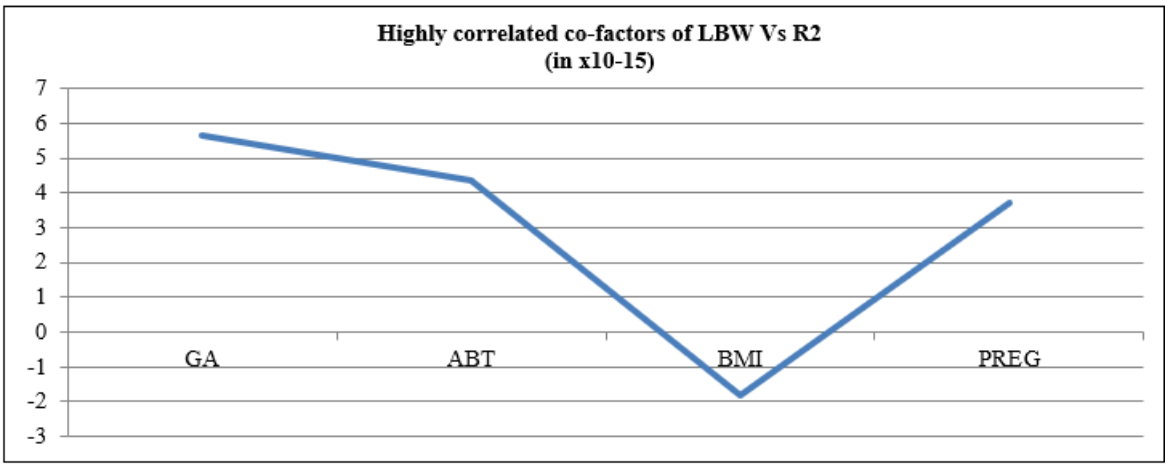


**Figure 2:** Regression Analysis outcome

After examining prominent factors contributing to LBW and conducting Linear Regression analysis, the R-Squared values, which are close to 0 for all factors, suggest a lack of significant relationships among the variables studied. The statistical experiments consistently yield low variance outcomes, prompting the need for further exploration using

machine learning algorithms to predict the primary factors influencing LBW.

## 5. Conclusion

Discovering the maternal risk factors for expectant mothers was the main goal of this investigation. This research aids in the early detection of issues in expectant mothers and makes it easier to reduce risks that could result in low birth weight babies. While a lot of pregnant women attain serious health issues, there are situations where this could be dangerous for the mother and the fetus. Low birth weight babies' health and well-being is still impacted. In lead of this work, the issue was looked into and some statistical analyses were done to determine the factors causing LBW. Correlation results show the moderate relationship between the 'pregnancy (single / twin)' factor, ANOVA results show that 'maternal age 'admits to be an important factor for determining LBW while Regression analysis results show a lack of significant relationship among the factors being considered along with LBW. Due to the inconsistency in results of the conducted statistical experiments, this study has to be further explored using machine learning and deep learning algorithms for getting accurate results and to predict the important factor causing LBW.

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