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Original Article

Association of Maternal Lifestyle Factors and Hemoglobin with Low Birth Weight

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ABSTRACT

Background: Low birth weight (LBW) is a major global public health problem and a leading cause of neonatal mortality, as well as a significant risk factor for infant and under-five morbidity and mortality.

Objective: The study aimed to determine the association between maternal lifestyle factors and low birth weight, and to investigate the relationship between maternal hemoglobin levels and LBW infants.

Methods: A total of 518 samples were included in the study, comprising 259 cases and 259 controls. Data were collected using a standard questionnaire administered through interviews and medical record reviews. The questionnaire covered maternal lifestyle factors and hemoglobin levels. Logistic regression was employed to analyze the associations between maternal lifestyle risk factors, hemoglobin levels, and low birth weight. Descriptive statistics were calculated for each variable, and statistical relationships were assessed using IBM SPSS version 25, with a significance level set at 0.05.

Results: The study found that maternal hemoglobin levels (OR=0.742, 95% CI: 0.644-0.855, p<0.001) and gestational age (OR=0.776, 95% CI: 0.696-0.866, p<0.001) were inversely associated with low birth weight. Conversely, previous pregnancies (OR=5.043, 95% CI: 2.004-12.689, p=0.001 for one previous pregnancy), low maternal income (OR=7.156, 95% CI: 2.369-21.617, p<0.001), specific occupations (OR=2.354, 95% CI: 1.416-3.914, p=0.001), and being underweight (OR=26.829, p<0.001) were positively associated with low birth weight.

Conclusion: These findings emphasize the importance of considering various socio-economic and health factors in the prevention and management of low birth weight, with a particular focus on maternal occupational status, income, previous pregnancies, gestational age, pregnancy complications, and maternal hemoglobin levels.

Keywords: Low birth weight, maternal lifestyle factors, maternal hemoglobin, neonatal mortality.

INTRODUCTION

Low birth weight (LBW) represents a major global public health challenge, significantly contributing to neonatal morbidity and mortality as well as under-five mortality. Defined by the World Health Organization (WHO) as a birth weight less than 2500 grams (1-3), LBW can severely restrict an infant's growth and development both during childhood and later in life. Statistically, one in every seven infants worldwide is born with LBW, making it a pervasive issue. Annually, over 20 million infants, accounting for 15.5% of all live births, are born underweight, with more than 95% of these cases occurring in low-income countries. The incidence of LBW is notably higher in developing nations, at 16.5%, compared to 7.0% in developed countries (1).

LBW is primarily attributed to two main factors: preterm delivery and being born small for gestational age, with some cases involving a combination of both. Several determinants contribute to LBW, which can be categorized as direct or indirect. Indirect factors include maternal age, household food security, socio-economic status, and the utilization of maternal healthcare services. Direct determinants encompass maternal race, pre-pregnancy weight and height, weight gain during pregnancy, caloric intake, prenatal illnesses, fetal gender, and a history of preterm births (4). The prevalence of LBW serves as a crucial indicator of public health,

reflecting inadequate maternal nutrition, overall poor health, and insufficient healthcare during pregnancy within a population. On an individual level, LBW is a significant predictor of neonatal health and survival, being associated with a higher likelihood of behavioral and psychological disorders, learning and sensory disabilities, and impaired cognitive function in developing children and adolescents. These challenges extend into adulthood, where LBW is linked to cardiovascular diseases, childhood hypertension, metabolic syndrome, and diabetes. Additionally, LBW increases the risk of abnormal neurological symptoms affecting tension, coordination, and reflexes, leading to impaired motor development (3).

The aim of this study is to investigate the association between maternal lifestyle factors and low birth weight, with a particular focus on the relationship between maternal hemoglobin levels and the incidence of LBW. Understanding these associations is crucial for developing effective interventions and policies to prevent and manage LBW, thereby improving neonatal and maternal health outcomes (5). This research will contribute to the existing body of knowledge by examining various socio-economic and health factors, such as occupational status, income level, previous pregnancies, gestational age, pregnancy complications, and maternal hemoglobin levels, and their impact on birth weight. By identifying and addressing these factors, healthcare providers and policymakers can implement targeted strategies to reduce the prevalence of LBW and its associated health risks (4).

MATERIAL AND METHODS

The study was approved by the Departmental and Ethics Review Committee of City University of Science and Information Technology, Peshawar, Pakistan, and adhered to the principles outlined in the Declaration of Helsinki. The research adopted a case-control design, focusing on mothers of low birth weight (LBW) infants as cases and mothers of adequate birth weight infants as controls. Data were collected from various hospitals in Peshawar, Khyber Pakhtunkhwa province, Pakistan, from December 2022 to June 2023 (6).

The study population consisted of mothers who had recently given birth. For the cases, mothers who delivered newborns weighing less than 2500 grams were included, while the control group comprised mothers who delivered newborns with a birth weight of 2500 grams or more. Inclusion criteria required participants to be willing to participate in the study. Exclusion criteria included women who experienced intrauterine death or had pregnancies extending beyond 42 weeks gestational age, as well as those with incomplete questionnaires (7-9).

A sample size of 518 was determined, with 259 cases and 259 controls. The sample size calculation followed the guidelines suggested by Costello and Osborne (2005), employing a 20-to-1 ratio for both control and case groups. Data were collected using a structured questionnaire consisting of 14 items: 13 related to maternal lifestyle factors and one quantifying maternal hemoglobin levels. The questionnaire was administered through interviews and medical record reviews.

Data collection was conducted in both private and government hospitals, ensuring a diverse sample. Participants were assured of confidentiality and anonymity, and their participation was entirely voluntary. The questionnaire comprised two parts: the first part collected categorical information on maternal lifestyle, while the second part focused on the continuous variable of maternal hemoglobin levels.

Statistical analysis was performed using IBM SPSS version 25 for Windows. Descriptive statistics, including frequencies and percentages, were calculated for each variable. The analysis included variables such as the sex of the newborn, maternal education level, physical activity, occupation, household income, number of maternity service visits, previous pregnancies, pregnancy complications, and body mass index (BMI). Logistic regression was used to assess the statistical relationships between these variables and low birth weight, with a significance level set at 0.05. Odds ratios (OR) and 95% confidence intervals (CI) were reported for each variable (10-13).

The analysis accounted for missing data by highlighting any outliers or missing values through frequency distribution. Appropriate steps were taken to complete the data or perform list-wise deletions as necessary. The study aimed to provide a comprehensive understanding of the association between maternal lifestyle factors, maternal hemoglobin levels, and low birth weight, thereby contributing to the development of targeted interventions to reduce the incidence of LBW and improve neonatal health outcomes (14-16).

RESULTS

The study included a total of 518 participants, with 259 cases and 259 controls. Among the participants, 48.1% were female and 51.9% were male. The majority of mothers (58.3%) had an education level of illiterate or primary and secondary school, while 41.7% had medium to higher education. Physical activity levels varied, with 77% of mothers engaging in less than 30 minutes of physical activity once a week, 15.8% engaging once a week or more, and 7.1% engaging in moderate intensity activity for at least 30 minutes.

Descriptive Analysis

Table 1 presents the distribution of gender, education, physical activity, and nature of treatment among the sampled population.

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Table 1: Descriptive Analysis of Participants

Variable	Frequency (%)
Gender (Female)	48.1
Gender (Male)	51.9
Education (Illiterate/Primary)	58.3
Education (Secondary/Higher)	41.7
Physical Activity (<30 min/week)	77.0
Physical Activity (≥30 min/week)	15.8
Physical Activity (Moderate)	7.1

Household Income and BMI

Table 2 shows the distribution of household income per month and BMI among the participants.

Table 2: Household Income and BMI

Variable	Frequency (%)
Household Income < $200	35.9
Household Income $200-$500	40.0
Household Income > $500	24.1
BMI (Underweight)	19.2
BMI (Normal)	50.8
BMI (Overweight/Obese)	30.0

Table 3: Maternal Occupations

Occupation	Frequency (%)
Housewife	60.0
Housemaid/Labor	8.5
Other	31.5

Logistic Regression Analysis

The logistic regression analysis revealed significant associations between several maternal factors and low birth weight. Maternal hemoglobin levels and gestational age were inversely associated with low birth weight. In contrast, previous pregnancies, maternal income level, occupation, and being underweight were positively associated with low birth weight.

Table 4: Logistic Regression Analysis

Variable	B	SE	Wald	df	Sig.	OR	95% CI for OR
Constant	50.017	56840.315	0.000	1	0.999	5.274E21	
Maternal Hemoglobin	-0.298	0.072	16.954	1	0.000	0.742	0.644 - 0.855
Education	-0.324	0.256	1.608	1	0.205	0.723	0.438 - 1.194
Physical Activity	0.376	0.276	1.858	1	0.173	1.457	0.848 - 2.501
Occupation	0.856	0.259	10.894	1	0.001	2.354	1.416 - 3.914
Income	1.968	0.564	12.174	1	0.000	7.156	2.369 - 21.617
Antenatal Care (1-2 visits)	4.231	2	4.121				
Antenatal Care (3-4 visits)	2.340	1.230	3.617	1	0.057	10.378	0.931 - 115.681
Antenatal Care (5-8 visits)	0.286	0.259	1.221	1	0.269	1.332	0.801 - 2.213
Conception Age	0.057	0.030	3.711	1	0.054	1.059	0.999 - 1.122
Previous Pregnancies (1)	1.618	0.471	11.808	1	0.001	5.043	2.004 - 12.689
Previous Pregnancies (2)	0.830	0.418	3.937	1	0.047	2.294	1.010 - 5.210
Previous Pregnancies (3-7)	1.354	0.297	20.817	1	0.000	3.873	2.165 - 6.929
Gestational Age	-0.253	0.056	20.494	1	0.000	0.776	0.696 - 0.866
Complication	-0.744	0.299	10.580	1	0.001	0.475	0.304 - 0.744
Natural/Fertility Treatment	0.372	0.227	2.696	1	0.101	1.451	0.930 - 2.263

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Variable	B	SE	Wald	df	Sig.	OR	95% CI for OR
BMI (Underweight)	26.829	3	0.000			0.000	
BMI (Normal)	-19.692	40192.309	0.000	1	1.000	0.000	0.000 - 0.000
BMI (Overweight/Obese)	-21.290	40192.309	0.000	1	1.000	0.000	0.000 - 0.000

The results indicate that maternal hemoglobin levels and gestational age are inversely associated with low birth weight, suggesting that higher hemoglobin levels and longer gestational periods reduce the risk of LBW. Conversely, previous pregnancies, low maternal income, specific occupations, and being underweight significantly increase the likelihood of LBW. These findings highlight the importance of addressing socio-economic and health factors in the prevention and management of low birth weight, emphasizing the need for targeted interventions and policies to improve maternal and neonatal health outcomes (5).

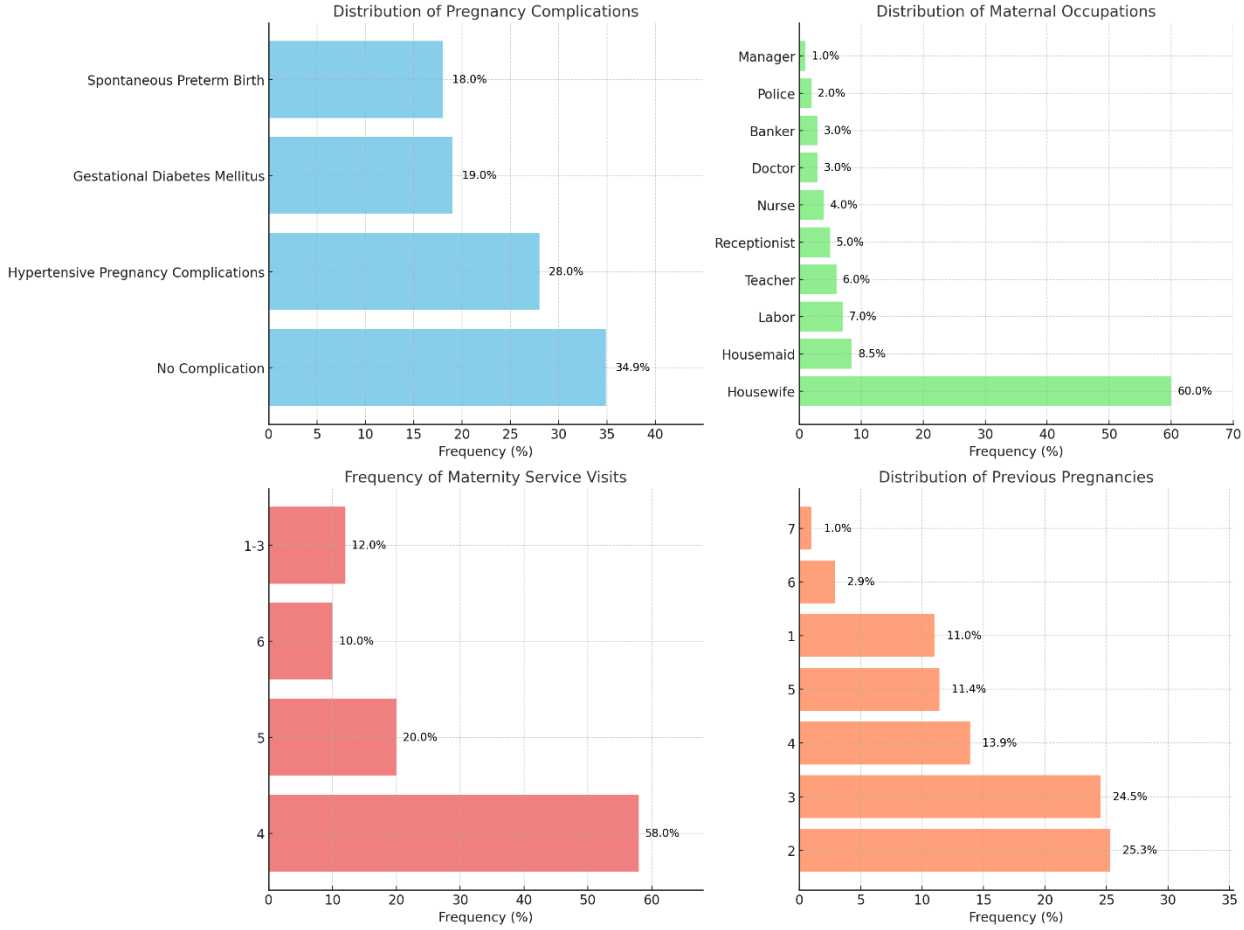

Figure 1 Pregnancy Complications

Complications and Maternal Occupation

Figure 1 presents the distribution of pregnancy complications among the mothers, with 34.9% experiencing no complications. Table 3 outlines the maternal occupations in the sample.

DISCUSSION

The study's findings revealed significant associations between various maternal lifestyle factors, maternal hemoglobin levels, and low birth weight (LBW). Maternal hemoglobin levels and gestational age were inversely associated with LBW, suggesting that higher hemoglobin levels and longer gestational periods decreased the risk of LBW. These results aligned with previous studies, which indicated that adequate maternal nutrition and extended gestational periods were crucial for fetal growth and reducing the incidence of LBW (15).

Conversely, factors such as previous pregnancies, low maternal income, specific occupations, and being underweight significantly increased the likelihood of LBW. The positive association between low income and LBW emphasized the impact of socio-economic disparities on maternal and neonatal health. These findings were consistent with other research highlighting that lower socio-economic status limited access to quality healthcare and adequate nutrition, contributing to adverse pregnancy outcomes (16).

The study also found that certain occupations, particularly those involving physical labor or low income, were associated with a higher risk of LBW. This finding supported previous research that occupational stress and physically demanding jobs could negatively affect pregnancy outcomes (17). Moreover, the association between underweight BMI and LBW highlighted the importance of maternal nutritional status before and during pregnancy, corroborating studies that linked maternal undernutrition to impaired fetal growth (5).

One of the study's strengths was its comprehensive approach to examining a wide range of maternal factors, including socio-economic status, occupational details, and maternal health indicators. This allowed for a thorough analysis of how these variables interacted to influence birth outcomes. Additionally, the use of a case-control design enabled a direct comparison between mothers of LBW infants and those with normal birth weight infants, enhancing the robustness of the findings (16).

However, the study had several limitations. The use of a convenient sampling technique might have introduced selection bias, limiting the generalizability of the results to the broader population. Additionally, the reliance on self-reported data for certain variables, such as physical activity and income, could have led to reporting bias. Another limitation was the cross-sectional nature of the study, which prevented the establishment of causality between the identified factors and LBW (17-20).

Despite these limitations, the study provided valuable insights into the complex interplay of maternal lifestyle factors and their impact on birth weight. The findings underscored the need for targeted interventions to address socio-economic disparities and improve maternal nutrition and healthcare access (21-23). Healthcare providers should prioritize routine screening for anemia and nutritional counseling to ensure adequate maternal hemoglobin levels during pregnancy. Policymakers should focus on improving socio-economic conditions for expectant mothers, particularly those in low-income or physically demanding occupations, to mitigate the risk of LBW (6, 24-25).

Future research should aim to use longitudinal designs to establish causal relationships and explore the mechanisms underlying the associations identified in this study. Additionally, larger, more representative samples would enhance the generalizability of the findings. By addressing these recommendations, future studies can build on the current research to develop effective strategies for preventing LBW and improving neonatal health outcomes (13).

CONCLUSION

The study concluded that maternal hemoglobin levels, gestational age, socio-economic status, occupation, and nutritional status significantly influenced the likelihood of low birth weight. These findings underscored the importance of comprehensive prenatal care that includes nutritional support and anemia screening, as well as the need for socio-economic interventions to support pregnant women, especially those in physically demanding or low-income jobs. Addressing these factors can reduce the incidence of low birth weight and improve neonatal health outcomes, highlighting the critical role of integrated healthcare policies and practices in maternal and child health.

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