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A STATISTICAL ANALYSIS OF THE CAUSES OF LOW BIRTH WEIGHT AMONG NEWBORN BABIES IN RIVERS STATE

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ABSTRACT

Low birth weight is one of the most important predictors of perinatal survival, infant morbidity, and mortality, as well as the risk of developmental disabilities and diseases in the future. This study aimed to identify the associated causes of low birth weight among newborn babies in Rivers State using a heteroskedastic linear regression model. A hospital-based cross-sectional study was conducted from June 5, 2025, to October 20, 2025, at the University of Port Harcourt Teaching Hospital (UPTH). A total sample of 422 newborn birth records was considered for the study. The regression model was used to assess the associated causes of low birth weight in this study area. The result was presented as crude coefficients and the probability values together with their corresponding 95% confidence intervals. In this study, it assumed that rural residence, marital status, formal education, smoking during pregnancy, attended antenatal care (ANC) visits, diabetes during pregnancy, iron supplementation, and maternal history of anemia significantly affect low birth weight of newborns in Rivers State. The results reveal a regression model of the Effect of Health History and Knowledge on Low Birth Weight Babies as $Y_{wi} = -3.569 - 0.036\beta_1 + 0.481\beta_2 - 0.06\beta_3 + 0.316\beta_4 + 0.031\beta_5 + 0.126\beta_6$. It also reveal that residence, marital status, educational status, smoking during pregnancy, ANC visit, diabetes during pregnancy, iron supplementation, and mother's history of anemia significantly affect the low birth weight. Therefore, we recommend that policymakers and public health experts/practitioners plan smoking prevention and public health promotion campaigns. However, it would be important that all health professionals properly manage the possible case of Low birth weight during pregnancy.

Keywords: Low birth weight, newborn babies, and heteroskedastic linear regression

Introduction:

Low birth weight (LBW) remains a critical public health concern worldwide, posing a significant risk to both neonates and mothers. Defined as a birth weight of less than 2500 grams (World Health Organization, 2014), LBW is associated with various adverse outcomes, including increased neonatal mortality and long-term health implications (Blencowe *et al*., 2013). The multifactorial nature of LBW necessitates a comprehensive investigation into the various determinants influencing this outcome, with a particular focus on pregnant women. The newborn's weight is the initial measurement taken after birth. It is one of the main determinants of perinatal survival, infant morbidity, and mortality, as well as the risk of developmental disabilities and illnesses in the future (Gebregzabiherher *et al*., 2017; Mingude *et al*., 2020). Low birth weight (LBW) is defined as a weight at birth of less than 2500 g (5.5 pounds) (WHO, 2019). Every year, more than 20 million babies with LBW are born around the world (Tessema *et al*., 2021). The prevalence of LBW in developing countries (16.5%) is more than twice the prevalence in developed regions (7%) (Taywade & Pisudde, 2017). Most (96.5%) of LBW births were

reported from low-income and middle-income countries and, especially, in the most vulnerable populations (Zaveri *et al*., 2020).

Africa is a continent that has high rates of children born with LBW, and the most recent studies have shown a high rate of child mortality (Tchamo *et al*., 2016). It is estimated that in sub-Saharan Africa, LBW represents 14.3%, which is approximately twice the rate of LBW in European Countries (Tchamo *et al*., 2016). In Ethiopia, according to the Summary Report of the National Newborn and Child Survival Strategy of the Federal Ministry of Health, the prevalence of LBW was found to be 20% (Mingude *et al*., 2020). Studies conducted in different parts of the country, namely Addis Ababa, Gondar, and Tigray, showed different rates of LBW 8.8%, 11.2%, and 4.6%. respectively (Adane *et al*., 2014; Gebremedhin *et al*., 2015; Mulatu *et al*., 2017).

Maternal factors play a pivotal role in fetal development, and thus, understanding the complex interplay between these factors is crucial. The age of the mother has been identified as a potential contributor to LBW, with teenage pregnancies and advanced maternal age both associated with elevated risks (Chen *et al*., 2016; Kozuki *et al*., 2013). Socioeconomic status, encompassing income, education, and employment, also emerges as a significant determinant (Mishra *et al*.,2018). Furthermore, maternal nutrition and prenatal care are key aspects influencing fetal growth and weight at birth (Siddiqua *et al*., 2019).

This statistical analysis aims to extend our comprehension of LBW by simultaneously examining multiple factors. The rationale behind employing multivariate analysis lies in its ability to discern the collective impact of diverse variables, providing a more nuanced understanding of their intricate relationships. By incorporating maternal age, socioeconomic status, nutritional habits, and prenatal care into the analysis, this research seeks to identify potential interactions and synergies among these factors. Such an approach aligns with the call for comprehensive investigations to address the complexity of LBW determinants (Frederiksen *et al*., 2017). The significance of this study extends beyond academic interest, reaching into the realms of healthcare policy and intervention strategies. Identifying specific factors contributing to LBW allows for the development of targeted interventions to mitigate associated risks. This aligns with the World Health Organization's call for evidence-based strategies to improve maternal and child health outcomes (World Health Organization, 2018). Ultimately, the findings from this multivariate analysis hold the potential to inform both clinical practices and public health initiatives, contributing to the global effort to reduce the prevalence of LBW and its associated complications.

Problem Statement/Justification:

Low birth weight (LBW) persists as a critical public health issue globally, posing substantial risks to neonatal health and development. Despite advances in medical science and healthcare, LBW remains a prevalent concern, with a myriad of adverse outcomes for infants, including increased mortality rates and long-term health complications. The complexity of LBW stems from its multifactorial nature, involving a web of interconnected maternal and environmental factors. Identifying the specific determinants contributing to LBW is crucial for developing targeted interventions and preventive strategies. A comprehensive problem statement is necessary to articulate the gravity of the issue, emphasizing the need for in-depth research to uncover the intricate interactions among maternal age, socioeconomic status, nutritional habits, and prenatal care that collectively influence birth weight outcomes.

Maternal age emerges as a salient factor influencing LBW, with both teenage pregnancies and advanced maternal age associated with elevated risks (Chen *et al*., 2016; Kozuki *et al*., 2013). Socioeconomic status, encompassing income, education, and employment, is another key determinant, highlighting health disparities that affect birth outcomes (Mishra *et al*., 2018). Maternal nutritional status and the quality of prenatal care further contribute to the complexity of the issue (Siddiqua *et al*., 2019).

In Nigeria, the under-five mortality rate is 39 per 1,000 live births (Gebrehawerya *et al*., 2018). LBW alone can be considered an important predictor of child mortality risk (Vilanova *et al*., 2019). Understanding the causes of LBW is important for designing cost-effective intervention strategies to reduce LBW rates. However, in Nigeria, there is limited research on the associated factors of LBW, particularly in the South-South region of Nigeria. Several studies have shown that LBW was significantly associated with maternal residence, marital status, age at first pregnancy, mother's history of spontaneous abortion, maternal nutritional status, inter-pregnancy interval, antenatal care (ANC) follow-up, pregnancy-induced hypertension, anemia at pregnancy, and cigarette smoking (Girma *et al*., 2019). LBW is the most significant risk factor for neonatal and infant mortality. It is one of the major public health problems in developing countries, especially in Rivers State, Nigeria (Katiso *et al*., 2020).

The problem here emphasizes the urgent need to unravel the intricate relationships among these variables to inform evidence-based interventions and address the persistent challenge of LBW. Therefore, this study aimed to identify the associated causes of low birth weight among newborn babies in Rivers State.

Objective(s) of the Study:

The aim of this study is to examine the cause of low birth weight among newborn babies in Rivers State using regression model. The specific objectives of this study are as follows:

1. Determine the association between mother's age, residence, marital status, educational status, occupation and low birth weight among newborn babies in Rivers State.
2. Investigate the significant relationship between a mother's alcohol consumption during pregnancy, smoking during pregnancy and low birth weight among newborn babies in Rivers State.
3. Establish the significant relationship between a mother's history of spontaneous abortion, antenatal care (ANC) visits, diabetes during pregnancy, and iron supplementation during pregnancy, history of gestational hypertension, history of anemia and low birth weight among newborn babies in Rivers State.

Hypotheses

The following null hypotheses were formulated in line with the objective(s) of the study:

1. There is no association between a mother's age, residence, marital status, educational status, occupation and low birth weight among newborn babies in Rivers State.

2. There is no significant relationship between a mother's alcohol consumption during pregnancy, smoking during pregnancy and low birth weight among newborn babies in Rivers State.

3. There is no significant relationship between a mother's history of spontaneous abortion, antenatal care (ANC) visits, diabetes during pregnancy, iron supplementation during pregnancy, history of gestational hypertension, history of anemia and low birth weight among newborn babies in Rivers State.

Significance of the Study

The study on a "Statistical Analysis of the Causes of Low Birth Weight among Newborn Babies in Rivers State", employing a regression model, holds significant implications for various stakeholders, including health practitioners, the healthcare sector, higher institutions of learning, the hospital under study, the Ministry of Health, the Ministry of Education, and future researchers. Firstly, health practitioners stand to benefit as the study sheds light on the multifaceted factors contributing to low birth weight. By understanding these causes through the regression model, healthcare professionals can tailor interventions to address specific risk factors and enhance prenatal care, ultimately improving birth outcomes. The healthcare sector, including the hospital under study, can use the findings to develop targeted programs and policies aimed at preventing and managing low birth weight cases. This knowledge can inform the allocation of resources, training of healthcare personnel, and the implementation of evidence-based practices, contributing to overall improvements in maternal care and child health care.

Higher institutions of learning can incorporate the study's results into their curricula, ensuring that future healthcare professionals are well-equipped with knowledge on the causes of low birth weight and the application of logistic regression models. This integration facilitates a more comprehensive and up-to-date education, fostering a workforce capable of addressing contemporary health challenges. The Ministry of Health can use the study's findings to refine existing public health strategies and policies related to maternal and child health. This may involve targeted interventions, awareness campaigns, and the development of guidelines to improve prenatal care and reduce the incidence of low birth weight in the region. The Ministry of Education can leverage on the study to emphasize the importance of research in informing healthcare practices. Encouraging collaboration between academia and healthcare practitioners can foster a research culture that continually generates evidence to enhance health outcomes. For future researchers, the study provides a foundation for further investigation into the complex factors influencing low birth weight. It encourages the exploration of additional variables,

methodologies, and interventions, contributing to the collective body of knowledge and facilitating ongoing improvements in maternal care and child healthcare.

Scope and Limitation

The scope of this study is comprehensive and multifaceted. Firstly, the geographical scope covers a selected hospital within Rivers State, which is University of Port Harcourt Teaching Hospital (UPTH), providing a localized understanding of the factors contributing to low birth weight in this specific region. By focusing on a defined area, the study allows for a nuanced exploration of regional variations, healthcare infrastructure, and socio-economic influences that may impact birth outcomes. Secondly, the study's scope extends methodologically to the use of a logistic regression model, enabling a quantitative analysis of various potential factors associated with low birth weight. This statistical approach allows for the identification and assessment of multiple variables simultaneously, providing a more nuanced and statistically robust examination of the complex interplay between factors contributing to low birth weight. By employing logistic regression, the study aims to uncover the relative importance of different variables, aiding in the development of targeted interventions and evidence-based strategies to address the issue effectively in the selected hospital within Rivers State.

Materials and Method

Design

A hospital-based cross-sectional survey design will be used in this study.

Areas of the Study

The study was carried out in government owned hospital in River State, which is the University of Port Harcourt Teaching Hospital (UPTH). UPTH is located in East-West Road, Port Harcourt, Rivers State, Nigeria with coordinates of 4053'58N 655'43"E. It serves about 3,840 deliveries annually (Wikipedia, 2024). The hospital currently serves approximately 413,000 thousand people in its catchment area and is used as a teaching hospital for different disciplines of medical and health sciences students of University of Port Harcourt (Wikipedia, 2024). Annually, nearly more than 3,205 neonates were admitted to the neonatal intensive care unit with different health problems. It has 782 beds, 210 doctors, 40 pediatricians, and 600 nurses, of which 75 are neonatal nurses.

Population of the Study

The target population of this study comprise of all the 3,205 neonates (newborn babies) admitted to the neonatal intensive care unit with different health problems.

Sample and Sampling Technique

A single population proportion formula was used to determine the sample size at 95% confidence level, marginal error of 5% with 50% proportion of LBW, and adding a non-response rate of 10%. Therefore, the calculated sample size will be n = 422 (i.e. 384 plus 38 which is 10% of 384). A simple random sampling technique was used to select the study participants. Birth records will also be selected using a lottery, based on their identification number.

Inclusion Criteria and Exclusion Criteria

All newborns delivered at University of Port Harcourt Teaching Hospital and met the inclusion criteria was recruited for the study and used as a source population. A preterm baby (preterm birth is when a baby is born too early, the gestational age from 28 completed weeks to 37 completed weeks), births with comorbidities such as twin delivery, still birth, and newborns above normal birth weight (birth weight>4,000 g) will be excluded from this study.

Method of Data Collection

The data collection instrument was pre-tested on 21 respondents out of the total sample size in UPTH before actual data collection will be made. The pre-test will be used to check for language clarity, appropriateness of data collection tools, time estimation and for the necessary adjustment. Training concerning the data collection tools and data collection process was given to both data collectors and supervisors. During the data collection, supervision will be conducted by supervisors and principal investigator for the quality of data. Finally, all the

collected data was also checked by the supervisor and investigator for its completeness and accuracy. Consistency will as well be examined through a random selection of a checklist.

Variables in the Study

- **Dependent Variable**: The response variable for this study was the birth weight of newborn categorized as normal birth weight (birth weight >2,500g and <4,000g) and LBW (birth weight <2,500g) (WHO, 2014).
- **Independent Variables**: The study used 13 independent variables. These independent variables include the sex of the newborn, the age of the mother, the residence of the mother. Marital status of the mother, the educational status of the mother, smoking during pregnancy, alcohol consumption during pregnancy, the history of spontaneous abortion of the mother, ANC visits (ANC at least four times increases the likelihood of receiving effective maternal health interventions during the antenatal period), iron supplementation during the pregnancy, the history of hypertension during pregnancy, the history of anemia during pregnancy, and gestational diabetes during pregnancy.

Method of Data Analysis

Data was extracted using Microsoft word version 16 and then exported to Stata 17 Statistical software for further analysis Descriptive statistics including frequencies and percentages will be computed to describe study participants. Multicollinearity diagnostics was performed using SPSS version 23 to check for collinearity between independent variables and evaluate whether each of the independent variables in the multiple analysis had a tolerance value > 0.1 against every other independent variable. Therefore, a heteroskedastic linear regression analysis will be performed to identify predictors of LBW. The 95% confidence interval (CI) and p-value<.05 was used to claim statistical significance.

Results

The frequency of the mother's personal characteristics in Table 1 showed that 11(2.6%) mothers were single, 367 (87%) were married women while 35(8.3%) and 9(2.1%) were divorced and widowed respectively. The educational level of the mother's showed that majority of the mother's 268(63.5%) were of tertiary education, followed by secondary 121(28.7%) while those of primary and no formal education were 26(6.2%) and 7(1.7%). In terms of occupation, most of the mothers were artisan 96(22.7%) followed by others with 89(21.1%). From the mother's response, we observed that, majority of the mothers were in the range of 50,000-100,000 Naira monthly income with a frequency of 247(58.5%), and many of them were resident of Urban areas with a frequency of 301 (71.3%) followed by those that resided in semi-urban with a frequency of 72(17.1%).

Table 1: Distribution of the respondents on Personal Characteristics

Characteristics	Frequency	Percentage (%)
Marital status Single	11	2.6
Married	367	87
Divorced	35	8.3
Widowed	9	2.1
Educational level		
No formal education	7	1.7
Primary	26	6.2
Secondary	121	28.7
Tertiary	268	63.5
Occupation		
Unemployed	64	15.2
Trading	69	23.5

Civil servant	65	15.4
Farming	9	2.1
Artisan	96	22.7
Others	89	21.1
Monthly income (₦)		
Below 50,000	147	34.8
50,000 – 100,000	247	58.5
Above 100,000	28	6.6
Place of residence		
Urban	301	71.3
Semi-urban	72	17.1
Rural	49	11.6
Woman Age interval		
10—15	2	0.5
16-20	28	6.6
21-30	284	67.3
31-40	98	23.2
41 and above	10	2.4
Gestational age at delivery	**Gestational age at delivery**	
< 37 weeks	16	3.8
37–42 weeks	39	9.8
42 weeks	367	87
Did you register for ANC?	**Did you register for ANC?**	
Yes	403	4.5
No	19	95.5
Number of antenatal care (ANC) visits during pregnancy	**Number of antenatal care (ANC) visits during pregnancy**	**Number of antenatal care (ANC) visits during pregnancy**
None	2	0.5
1–3 visits	41	9.7
4–7 visits	340	80.6
8 and above	39	9.2

Table 2: Personal characteristics with babies' weight (kg)

Coefficients

Model	**standardized Coefficients**	**standardized Coefficients**	**standardized Coefficients**	**standardized Coefficients**	**95.0 % CI for B**	**95.0 % CI for B**
Description	**Coefficient**	**Standard Error**	**T value**	**Probabilities Values**	**Lower Bound**	**Upper Bound**
Constant	-0.546	0.067	-8.48	0.000***	-0.695	-0.433
Marital Status	-0.327	0.046	-7.154	0.000***	-0.417	-0.237
Educational Level	0.071	0.032	2.225	0.027*	0.008	0.134
Occupation	-0.005	0.019	-0.27	0.787	-0.042	0.032
Monthly Income	0.07	0.042	1.684	0.093	-0.012	0.152
Place of residence	0.12	0.029	4.148	0.000***	0.063	0.177
Mother's Age Interval	0.734	0.033	22.072	0.000***	0.668	0.799
Gestational age at delivery	0.252	0.059	4.271	0.000***	0.136	0.368

Sex of the baby as dummy (female =1, 0 otherwise)	-0.084	0.036	-2.323	0.002***	-0.155	-0.013

Note: Dependent variable; birth weight of the baby (kg)*, **, *** represents significance at 10%, 5% and 1% significant level respectively

Source: Author's computation of Data collected

Model	**Correlations**	**Correlations**	**Correlations**	**Collinearity Statistics**	**Collinearity Statistics**
Description	**zero-order**	**Partial**	**part**	**tolerance**	**VIF**
Marital Status	0.614	-0.332	-0.109	0.862	2.175
Educational Level	0.654	0.109	0.034	0.836	2.334
Occupation	0.795	-0.013	-0.004	0.792	3.862
Monthly Income	0.665	0.083	0.026	0.699	3.093
Place of residence	0.786	0.2	0.063	0.766	2.012
Mother's Age Interval	0.938	0.736	0.335	0.861	2.226
Gestational age at delivery	0.632	0.206	0.065	0.849	2.732
Sex of the baby as dummy (female =1, 0 otherwise)	0.573	-0.114	-0.035	0.602	1.962

The study employed the babies' weights as the dependent variable to analyze with the personal characteristics of the mother's including sex of the baby as a dummy variable. The results showed that for the independent indicators, occupation, and monthly income were not significant while marital status, place of residence, educational level, mother's age and gestational age at delivery significantly affected the babies' weights.

The Effect of Mother's Smoking and Alcohol Consumption during Pregnancy on the Babies' Weight

Table 3: Regression model of the history of smoking and consumption of alcohol with the babies' weight (kg)

Coefficients

Model	**standardized Coefficients**	**standardized Coefficients**	**standardized Coefficients**	**standardized Coefficients**	**95.0 % CI for B**	**95.0 % CI for B**
Description	**Coefficient**	**Standard Error**	**T value**	**Probabilities Values**	**Lower Bound**	**Upper Bound**
(Constant)	.703	.108	6.500	0.000***	.491	.916
Did you consume alcohol during pregnancy?	.148	.025	6.026	0.000***	.100	.197
Did you smoke cigarettes during pregnancy?	3.364E-06	.104	.000	0.010**	-.204	.204

Note: Dependent variable; birth weight of the baby (kg)*, **, *** represents significance at 10%, 5% and 1% significant level respectively

Source: Author's computation of Data collected

Model	**Correlations**	**Correlations**	**Correlations**	**Collinearity Statistics**	**Collinearity Statistics**
Description	**zero-order**	**Partial**	**Part**	**Tolerance**	**VIF**

Did you consume alcohol during pregnancy?	.284	.282	.282	0.958	1.044
Did you smoke cigarettes during pregnancy?	.034	.000	.000	0.958	1.044

Table 4: Heteroskedastic Linear Regression on the Effect of Health History and Knowledge on Low-Birth-Weight Babies

Model	**Correlations**	**Correlations**	**Correlations**	**Collinearity Statistics**	**Collinearity Statistics**
Description	**zero-order**	**Partial**	**Part**	**Tolerance**	**VIF**
Do you believe that history of spontaneous abortion can lead to the risk of low birth weight?	-0.481	-0.069	-0.044	0.106	9.464
Number of antenatal care (ANC) visits during pregnancy	0.648	0.624	0.514	0.374	2.674
Do you agree that diabetes during pregnancy can lead to the risk of low birth weight?	-0.343	-0.114	-0.074	0.071	14.15
Did you take iron and folic acid supplements regularly?	0.069	-0.315	-0.213	0.578	1.73
Did you experience high blood pressure during pregnancy?	0.502	0.043	0.028	0.305	3.276
Do you believe that history of anemia and gestational hypertension can lead to the risk of low birth weight?	-0.246	0.254	0.169	0.11	9.128

Heteroskedastic linear regression	**Heteroskedastic linear regression**	**Heteroskedastic linear regression**	**Number of obs=4222**	**Number of obs=4222**	**Number of obs=4222**	
ML estimation	**ML estimation**	**ML estimation**	**LR chi2(6) = 371.94**	**LR chi2(6) = 371.94**	**LR chi2(6) = 371.94**	
Log likelihood= 154.2006	**Log likelihood= 154.2006**	**Log likelihood= 154.2006**	**Prob > chi2=0.000**	**Prob > chi2=0.000**	**Prob > chi2=0.000**	
Model	**Standardized Coefficients**	**Standardized Coefficients**	**Standardized Coefficients**	**Standardized Coefficients**	**95.0 % CI for B**	**95.0 % CI for B**
Description	**Coefficient**	**Standard Error**	**Z value**	**P>|z|**	**Lower Bound**	**Upper Bound**
Do you believe that history of spontaneous abortion can lead to the risk of low birth weight?	-0.03575	0.0253383	-1.41	0.158	-0.08541	0.013912
Number of antenatal care (ANC) visits during pregnancy	0.4808	0.0292848	16.42	0.000***	0.423403	0.05382
Do you agree that diabetes during pregnancy can lead to the risk of low birth weight?	-0.059949	0.0254232	-2.36	0.018**	-0.10978	-0.01012
Did you take iron and folic acid supplements regularly?	-0.316206	0.0464175	-6.81	0.000***	-0.40718	-0.22523
Did you experience high blood pressure during pregnancy?	0.0305072	0.0346744	0.88	0.379	-0.03745	0.098468
Do you believe that history of anemia and gestational hypertension can lead to the risk of low birth weight?	0.1259353	0.0233604	5.39	0.000***	0.08015	0.171721
cons.	-3.568685	0.1252863	-3.05	0.002	-0.27595	-0.13648

Note: *, **, *** represents significance at 10%, 5% and 1% significant level respectively

Source: Author's computation of Data collected

Discussion

In table 1, this section investigated the 6 mother's characteristics namely; marital status, educational level of the mother, occupation, income, place of residence and the mother's age. This model also includes the babies' sex as the dummy variables; the babies' weights treated as the dependent variable and then regressed against the mother's characteristics as the independent variables that have been mentioned above as the personal characteristics. The study employed the Variance Inflation Factor (VIF) to test for the presence of multi-collinearity. The value of the Variance Inflation Factor (VIF) of the variables was less than 5, in all the variables in the model, which means the variables were not correlated with other variables and multi-collinearity does not exist. The coefficient of determination R square is between 0.948. This shows that the independent variable was explained at 94.8%, the ANOVA probability value shows 0.000, which means the overall model is statistically significant and is presented in Table 2. The Tolerance values in the model variable were all greater than 0.5 which confirmed that the variables are not correlated. This also suggests that variance of the variable are well explained. The correlation columns in the result table showed the relationship of the mother's characteristics with the baby's weight. The model is written as;

$$Y_i(baby's\ weight) = -0.546 - 0.327(marital\ status) + 0.071(edu.Level) - 0.005(Occup.) + 0.70(monthly\ income) + 0.12(mother's\ residence) + 0.734(mother's\ age) + (Gestational\ age) + 0.084(sex\ of\ the\ baby) + e_i$$

From table 3, The results indicate that there is a significant difference on the mother's consumption of alcohol during pregnancy and smoking during pregnancy on the baby's weight.

In this model, the research agrees with the ordinary least square (OLS) regression model since the VIF of the Variance in the model is less than 5, with the tolerance close to 1. This showed that there is no presence of multicollinearity in the model, and the regression equation can be written as follows:

$$Y(babies\ weight)_i = 0.703 + 0.148(mother's\ \text{consume alcohol}) + 0.003364(mother's\ smoking\ during\ Preg.)$$

Effect of the Health History and Knowledge on Low-Birth-Weight Babies

This section addresses the third objective, which tests the effect of health history and knowledge on the low birth weight babies, the dependent variables is the babies weight while the independent variables are history of spontaneous abortion (HSB), number of antenatal care visit (ANCV), agree that diabetes during pregnancy can lead to the risk of low birth weight of the babies (ADDP), take iron and folic acid supplement regularly can reduced low birth of the babies (TIFA), experience of high blood pressure during pregnancy can increase low birth weight babies (EHBP), and history of anemia can lead to the risk of low birth weight (HA). In the analysis, the research examined the data using heteroskedastic linear regression which will automatically correct the heteroskedasticity shown in the results of tolerance and VIF of some variables in the model. The purpose of this heteroskedastic linear regression is to remove the presence of multicollinearity of some variables that are highly correlated with each other in the model. The results are present in Table 4 in terms of correlation, collinearity statistics, coefficients and 95% confident interval of B values. HSB = β_1 ; ANCV = β_2 ; ADDP = β_3 ; TIFA = β_4 ; EHBP = β_5 ; HA = β_6 .

The model is shown below;

$$Y(weight\ of\ the\ baby) = -3.569 - 0.036(HSB) + 0.481(ANCV) - 0.06(ADDP) + 0.316(TIFA) + 0.031(EHBP) + 0.126(HA)$$

Table 4 results showed the effect of baby weight on the indicators; such independent variables namely (history of spontaneous abortion (HSB), numbers of antenatal care visit (ANCV), agree that diabetes during pregnancy can lead to the risk of low birth weight of the babies (ADDP), take iron and folic acid supplement regularly can reduced low birth of the babies (TIFA), experience of high blood pressure during pregnancy can increase low birth weight babies (EHBP), and history of anemia can lead to the risk of low birth weight (HA). The results indicated that number of antenatal visits during pregnancy have significant effect on the baby's weight based on the probability value of 0.000. Similar with that of agree that diabetes during pregnancy can lead to the risk of

low birth weight babies. However, the results also agree that taking iron and folic acid supplement regularly can reduce the rate of low birth weight babies, the result also agree that history of anemia and gestational hypertension can lead to the risk of the low birth weight babies.

Conclusion

The outcome of the data analysis for this study showed the following results:

1. Mothers' residence is significantly associated with low birth weight (LBW) of the babies.
2. The result of this study also reveal that the mothers' marital status is significantly associated with birth weight of a newborn. Mothers' whose marital status is "married" may be negatively associated with LBW compared to mothers' whose marital status is "never married".
3. This result might also show that the mothers' educational status is significantly associated with the weight of newborns. This could be because educated mothers' visit the health facility in a timely manner for ANC, have better knowledge of fetus growth, high dietary knowledge, and timely detection and treatment of different infections.
4. The result reveal that there is a significant difference for mothers' "who did not smoke cigarettes". This could be because smoking has adverse effects on the developing fetus by increasing the level of nicotine and carbon monoxide in the blood, resulting in a deficiency of oxygen and nutrient delivery to the growing fetus.
5. The result also shows that "mothers' who attended ANC visits" are more likely to get normal weight babies compared to "mothers who did not attend ANC visits". This might be because ANC visits are very important for both fetus and mother', as they provide opportunities for timely detection and intervention of fetal/maternal problems and enable the mother to promote her health through counseling that she might receive.
6. In addition, the result shows that the occurrence of diabetes during pregnancy could be a risk factor for LBW. The odds of LBW may be higher in mothers' who had diabetes during pregnancy compared to mothers who did not have diabetes during the pregnancy period. This inconsistency may be due to mothers' who have diabetes during pregnancy and took the medication of diabetes that affected the weight of the newborn baby.
7. Furthermore, mothers' who received iron supplementation may also be at lower risk of delivering LBW babies' than mothers' who did not receive iron supplementation during the current pregnancy. This could be because iron and folic acid supplementation for pregnant mothers' is of great importance in preventing anemia during pregnancy, thereby improving better health outcomes for both the mother and the fetus.
8. Finally, a mother's history of anemia may significantly affect the birth weight of babies'. Mothers' who had a history of anemia may be more likely to have LBW babies compared to mothers who did not have a history of anemia. This could be because anemia could alter oxygen and nutrient delivery to the fetus and delay normal intrauterine growth and also influence placental angiogenesis.

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