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A Statistical Analysis of Weight of Newborn Babies

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Abstract: *Birth weight is an important indicator of a newborn baby's health and development. The present study focuses on the statistical analysis of the weight of newborn babies and the factors affecting it. Data were collected from hospital records including information about maternal age, gestational age, health condition, and nutrition. Statistical methods such as descriptive statistics, correlation, and regression analysis were used to study the relationship between these factors and the birth weight of newborn babies. The study classifies newborn babies into categories such as low birth weight, normal birth weight, and high birth weight. The results show that maternal health, proper nutrition, and duration of pregnancy significantly influence the birth weight of newborn babies. The findings of this study help in understanding the importance of prenatal care and proper medical support to reduce the risk of low birth weight and improve neonatal health outcomes.*

Keywords: Birth weight is an important indicator of a newborn baby's health and development.

I. INTRODUCTION

The health of a newborn baby is directly proportional to the health and nutritional status of the mother. Yet, lack of awareness and understanding about the need to ensure basic minimum intake of key nutritional factors like iron and calcium often leads to mothers giving birth to Low Birth Weight (LBW) babies. As a country fighting against the scourge of malnutrition, India is one of the highest proportions of babies born with low birth weight. In fact, with various estimates suggesting that around 7.5 million babies are born underweight each year in India. Newborn babies weighing less than 2,500 grams are considered low-birth-weight (LBW) babies. The incidence of babies born with low birth weight is highest in South Asia, specifically in India. A nutritious diet is very essential for a pregnant woman as it is she who passes the food to the baby in the womb. The quantity and quality of the diet are hugely important for her and shouldn't be compromised with. Due to lack of awareness about the right diet plan, expecting mothers often stick to the poor and unhealthy diet. More often, the expecting women are diagnosed with anemia, a condition that develops because of inadequate or faulty dietary habits. It is necessary to check effect of other factors which are not related to the diet pattern. As like area of the mother, since the lifestyle of the rural area and urban area may affect the birth weight of newborn babies. Factors like type of delivery, number of deliveries, Gender of baby may have any impact on weight of the baby. So we are going to study about the birth weight of newborn babies in such a way that 'Is there any effect of type of delivery, no. of deliveries, gender of baby and area in which mother lives on the weight of babies. In the present study, we have not considered any diet pattern of mother. A primary goal is to check an impact of factors like; type of delivery, number of deliveries, gender of baby and area in which mother lives on the new born babies weight.

II. OBJECTIVES

To check whether there is an impact of gender on weight of babies. To check whether there is an impact of no. of deliveries on weight of babies. To check whether there is an impact of type of delivery on weight of babies.To check whether there is an impact of area on weight of babies.

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III. LITERATURE REVIEW

Birth weight is a key indicator of neonatal health and survival. Several studies have examined the factors influencing newborn birth weight using statistical and medical research methods. According to the World Health Organization, low birth weight (less than 2.5 kg) is one of the leading causes of infant morbidity and mortality worldwide. The organization reports that maternal nutrition, prenatal care, and gestational age are major determinants of birth weight. A study by Robert E. Black emphasized that maternal health and proper nutrition during pregnancy significantly influence fetal growth and development. The research highlighted that improving maternal healthcare services can reduce the incidence of low birth weight babies. Research conducted by Cesar G. Victora showed that socio-economic status, maternal education, and healthcare accessibility play a crucial role in determining the birth weight of newborn babies. The study found that better healthcare facilities and maternal awareness help improve birth outcomes. Another study by José Villar analyzed the relationship between gestational age and birth weight. The results indicated that premature births are strongly associated with low birth weight, which increases the risk of neonatal complications. A study by Jennifer Zeitlin focused on maternal age and lifestyle factors affecting birth weight. The study concluded that maternal age, smoking, and nutritional status have a significant impact on fetal Statistical methods such as descriptive statistics, regression analysis, and classification techniques have been widely used in previous studies to analyze newborn birth weight data. These methods help identify the key determinants affecting birth outcomes and support healthcare professionals in improving maternal and child health programs. Overall, the literature indicates that maternal nutrition, healthcare access, socio-economic factors, and gestational duration are the major factors affecting newborn birth weight. These findings emphasize the importance of proper prenatal care and maternal health awareness to reduce the occurrence of low birth weight babies.

MS Tools: MS-Excel, Ms- Word

Software: Python, R-software

IV. METHODOLOGY

The methodology of this study involves data collection, data classification.

Data Collection

The data were collected from hospital records of newborn babies. The dataset includes variables such as birth weight, maternal age, gestational age, and maternal health condition. The data collected is secondary data from the hospitals namely 1) C.P.R. hospital, Kolhapur 2) Seva Rugnalaya, Bawda and 3) Panchganga Hospital, Kolhapur. The data corresponding to the variables Baby weight, Age of mother, Area of living, Number of delivery, Type of deliveries taken for 619 patients. We didn't consider the observations related to twins delivery in the data.

Data Classification

Newborn babies were classified into three categories:

Low Birth Weight: Less than 2.5 kg

Normal Birth Weight: 2.5 kg – 4 kg

High Birth Weight: More than 4 kg

Graphical Tools: Bar diagram

Test: Kruskal-Wallis Test, Mann Whitney U Test.

V. GRAPHICAL REPRESENTATION:

The fig.1 From the above graph it is clear that the more observations are from the rural areas as that of urban area.

Fig.2 From the above bar chart it is clear that numbers of babies born normally are more than that of by caesarean delivery. But there is no more difference in the counts from this we can say that due to poor health of mother the caesarean deliveries are increasing.

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Fig.1

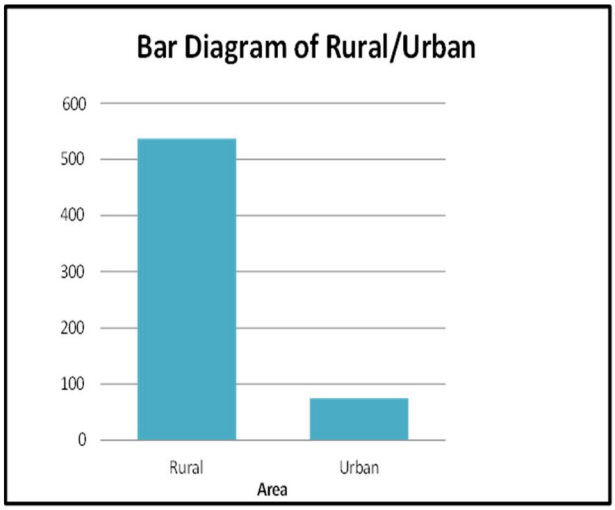
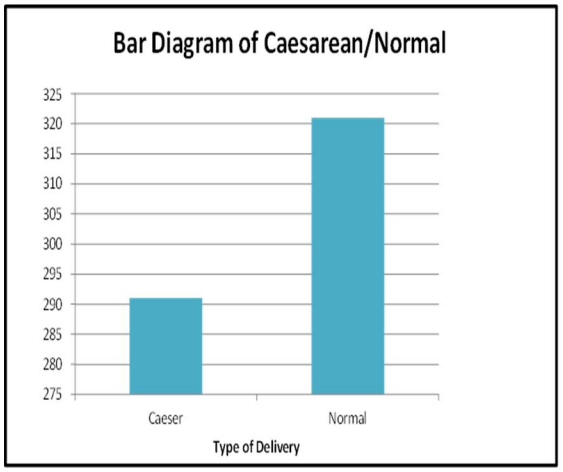
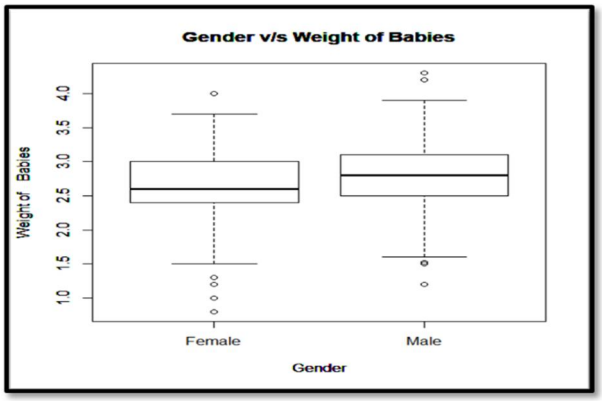


Fig.2



VI. TESTING OF HYPOTHESIS

Effect of Gender on the Birth Weight:



We are interested to check whether there is an effect of gender on weight of babies. The box plot between gender v/s birth weights is given as below,

Interpretation:

It is observed that the box plot pattern is different for male and female baby weights. The average weight of male babies is greater than that of female babies. The weight of male babies are distributed symmetrically (about M=2.8), but the weight of female babies is not symmetrically distributed (about M=2.6). For female babies, median is more shifted towards the lower weights so we can say that more no. of female babies have lower weights.

Gender	Average weight of babies	S.D of weight of babies
F	2.624758621	0.470958
M	2.796770186	0.491487

From the above table, the average weight of male babies is greater than average weight of female babies. The standard deviation for both baby weights is equal i.e. both the data have equal spread.

Here we are interested to test the hypothesis that,

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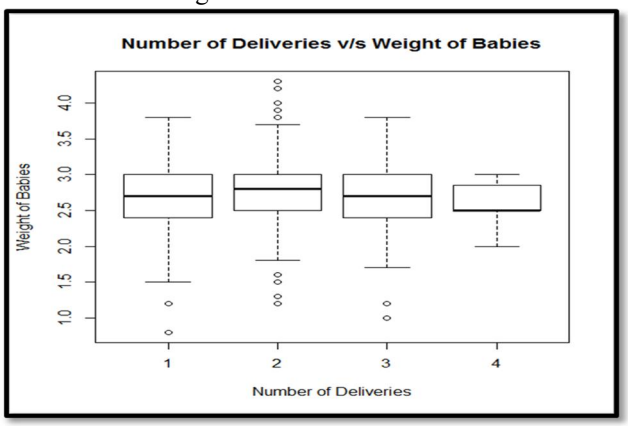
H0: Average weight of male babies and female babies are equal. v/s
H1: Average weight of male babies is greater than that of female babies.
To test the above hypothesis we use the Mann-Whitney U test. The results using this test are as follows
Zcal= 4.6047
Ztab = 1.64 Here,
Zcal > Ztab
Then, Reject Ho at α % level of significance. Conclusion:
Average weight of male babies is greater than that of female babies.
Effect of Number of Deliveries on the Birth Weight:



We have weights of babies corresponding to number of deliveries=1, 2, 3 and 4. The box plot between Birth Weight v/s Number of deliveries shown in figure below,

Interpretation:

It is observed that, box plot pattern is different for number of deliveries=1, 2, 3 and 4. The mothers, who have given birth to second child has birth weight maximum and lowest birth weight is observed corresponding to the mothers who have given birth to the 4th child.

Results by actual calculation:

Number of Deliveries	Average of baby weights	Standard deviation of baby weights
1	2.6675	0.4935
2	2.7774	0.4835
3	2.6785	0.5133
4	2.6	0.3066

Kruskall- Wallis test is performed to compare the average weights of the babies corresponding to the number of deliveries
The null hypothesis to test is
H0: Average birth weights of the babies corresponding to number of deliveries are equal. Against
H1: Average birth weights of the babies corresponding to number of deliveries are not equal. This test is easily available on R-software. So the results using R-code are,
$\chi^2 = 6.4633$, degrees of freedom = 3, p-value = 0.0911, χ^2tab=7.8147

Conclusion:

Here, $\chi^2 < \chi^2$tab then accept H0 i.e. average birth weights of the babies corresponding to number of deliveries are equal at 5% level of significance.
It is concluded that, the mothers who have given the birth to second child have maximum birth weights with the standard deviation 0.483 which is less than that for first and third child. The standard deviation for the mothers giving birth to fourth child is less than the all, because the sample size is small for fourth delivery.

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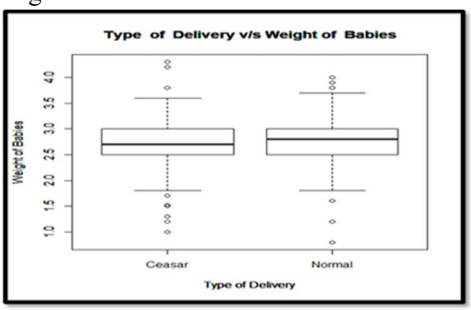
Effect of Type of Delivery on Baby Weight:



We are interested to check whether there is an impact of type of delivery on baby weight. The box plot between type of delivery and Baby weight is as follows,

Interpretation:

The box plot pattern is different for caesarean as well as normal delivery. The box plot depicts that the average baby weight in caesarean is slightly less than that of in normal delivery.

Type of delivery	Average of baby weights	Standard deviation of baby weights
Caesarean	2.6899	0.5204
Normal	2.7382	0.4585
Grand Total	2.7153	0.4891

Interpretation:

The box plot pattern is different for average baby weight in Caesarean and normal delivery. The box plot depicts that the average baby weight in Caesarean is slightly less than that of in normal delivery. The data for normal delivery has less variation than that of caesarean delivery. For normal delivery, the baby weights are slightly distributed positively skewed. For Caesarean delivery, the baby weights are slightly distributed negatively skewed.

Here we are interested to test the hypothesis that,

H0: Average weight of normal delivery babies and Caesarean delivery babies is equal. H1: Average weight of normal delivery babies is greater than that of Caesarean delivery babies.

To test the above hypothesis we use the Mann-Whitney U test. The results using this test are as follows

Zcal=-4.6049

Ztab =1.64 Here,

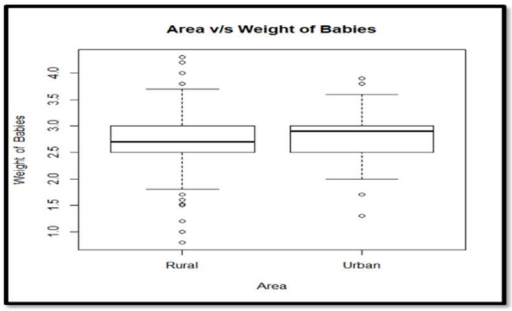
Zcal < Ztab

Then, accept Ho at α % level of significance.

Conclusion:

Average weight of normal delivery babies and Caesarean delivery babies is equal.

Effect of Area on Baby Weight



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We are interested to check whether there is an impact of area on weight of babies. The box plot between area and baby weight is as follows,

Interpretation:

The box plot pattern is different for rural as well as urban area. The average baby weight for rural area is greater that of urban area. In rural area, the box plot shows that the data is slightly positively skewed whereas in urban area the box plot shows that it is highly negatively skewed i.e. the more number of babies has weight more than the median.

Area of living	Average of Baby Weights	Standard deviation of Baby Weights
Rural	2.7083	0.4904
Urban	2.7653	0.4797
Grand Total	2.7153	0.4891

Conclusion:

The same result is shown by actual data values for both factor means.

VII. OVERALL CONCLUSION

As we have studied the data related to the weight of newborn babies. Here we get the following conclusion from data. As per biological study we know that the probability of new born baby to be male or female is equal and our study also shows the same result. Our study shows that the average weight of male babies is slightly greater than that of female babies. According to the data, the weight of new-born baby is more at the second delivery than that of other deliveries and the weight decreases when the number of delivery increases. Average weight of normal delivery babies and Caesarean delivery babies is not equal. The average weight of babies is greater in rural area.

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