

“Maternal Weight Gain for Prediction of Risk of Low Birth Weight Babies (LBW)”

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Abstract

Background- The health of the baby depends on the mother gaining weight throughout pregnancy. A Low Birth Weight infant may be born if mom is not in good health. Multiple studies have indicated that an alarmingly high number of infants are born to underweight moms. This emphasises the need of achieving a healthy weight increase throughout pregnancy.

Objectives- The goal is to determine whether there is a connection between the newborn's weight and socioeconomic status by measuring maternal weight growth and correlating it with the baby's birth weight.

Methods- Prospective Cohort study was carried out in Antenatal Clinic of Krishna Hospital, Karad, on 214 antenatal women. Maternal weight gain was independent variable and birth weight was dependent variable. Every consecutive healthy pregnant woman (low risk pregnancy) who has completed 12 weeks of pregnancy (first trimester) was included in the study. Pregnant women with high risk Pregnancy and who wants to change her place of delivery was excluded. Data analysis was done by using descriptive and inferential statistics.

Results- Of them, 143 (66.6%) gained from seven and fourteen pounds, 19 (8.88%) acquired more than 14 pounds, and 52 (24.30%) gained less than 7 pounds. 128 (59.81%) mothers had normal-weight infants, while 87(40.19%) women had cheap-birth-weight babies, with a mean weight increase of 10.843.126 and a mean increase in weight of 7.212.84 respectively. Incidence of LBW is 40.19 percent.

Conclusion- The rate of Low Born Weight was found to be 40.19 percent. The correlation between birth weight and total weight growth was statistically significant ($p < 0.001$). Maternal weight growth throughout pregnancy seems to be the most important factor in predicting the baby's birth size in the prenatal period.

1. Introduction:

The prevalence of premature births is a global public health concern. About 15%-20% of all newborns are considered to have low birth weight. According to regional estimates, the LBW prevalence is 28% in southeast Asia, thirteen percent in sub-Saharan Africa, and 9% in the Americas. About 40 percent of the world's

LBW burden, or 8 million newborns annually, is born to Indian mothers. LBW newborns account for roughly 75 percent of all neonatal fatalities and 50% of all infant mortality. There is a greater risk of death and illness for LBW newborns compared to babies that are born at an average weight. ¹

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Recent research studies have showed that incidence rate of LBW is still high in the country. Weight of mother, hemoglobin level, energy intake and average weight gain in third trimester of pregnancy were significantly associated with birth weight of the neonates. It suggest that adequate nutrient intake by the mother during pregnancy is most important determinant for outcome of pregnancy. Maternal weight gain can be improved through the nutrition related programs (ICDS) to rural women along with nutrition education. Regular antenatal check-up of pregnant women is required for maternal weight, hemoglobin estimation and consumption of recommended iron folic acid supplementation. ²

One of the major determinants of how well a mother is doing is her economic and social standing. Studies have shown that LBW rates are higher in areas with lower socioeconomic status. Maternal malnutrition is strongly correlated with other risk factors such as poverty, lack of education, smoking, drinking, drug use, and stress, according to statistical analyses. Maternal characteristics related with LBW were the existence of chronic medical conditions, a gestational age of 37 weeks, and a maternal weight 50 kg, according to a study done in a rural location. Sociocultural norms were shown to have a significant impact on pregnant women's food choices. ⁴

Researchers in India found that low birth weight is strongly associated with maternal malnutrition, a lack of prenatal care, and poor weight increase. Maternal weight growth throughout pregnancy is a significant factor in the infant's final birth weight. Gaining weight during pregnancy is normal. Occurrence of preterm birth is more when the maternal weight gain during the last half of pregnancy has been inadequate. The maximum rate of maternal weight gain depends on the period of gestation. Good nutrition of mother, rest, adequate antenatal care and a clean environment are the needed components that help to grow a healthy baby and helps in prevention, identification and treatment of the conditions that cause low birth weight and keep babies alive and thriving. ^{6,7}

The nutritional and health of both mother and child may be gauged by the newborn's weight at birth. Babies born prematurely have a higher mortality rate in the first two weeks of life, and those who do survive may have growth retardation and intellectual disability. Consequences may persist throughout adulthood, and those affected may be at a higher risk for developing diseases including diabetes and obesity. Human life

depends on the growth and development that occurs within the womb. Pregnancy-related maternal weight increase is essential for the health of both mother and child. Low Born Weight is associated with a higher risk of illness for both the mother and her child. This emphasises the need of achieving a healthy weight increase throughout pregnancy.

Low Birth Weight is one of the major public health issues in developing countries like India where its prevalence rate is as high as 30%. The birth weight of infant is a powerful predictor of infant growth and survival and causes of LBW are multi-factorial. Most of these causes are modifiable and preventable by simple interventions. It has massive contribution in neonatal, infant and childhood mortality and morbidity. ¹⁰

Estimates for the prevalence of premature or underweight babies range from 5% to 7% in wealthy nations to 19% in impoverished ones. In addition to being a crucial factor in the baby's future health, growth, and development, the mother's well-being, diet, and standard of life are also highly correlated with the newborn's birth weight. For India, LBW is still a major unsolved health concern on a national scale.

Enhancing the mother's nutritional health, addressing illnesses related to pregnancy, and offering sufficient prenatal care, perinatal medical care, and social support are all important parts of a worldwide strategy to reduce the prevalence of Low Born Weight. ¹³ By considering present national scenario we need to take positive steps to prevent and reduce incidence of LBW. This can be possible only when the risk of having LBW can be predicted in antenatal period. ¹ It is important to diagnose the risk of Low Birth Weight baby in antenatal period.

2. Research Methodology

Prospective Cohort study was carried out in Antenatal Clinic at Krishna Hospital, Karad with objectives of to assess weight during pregnancy and correlate with Birth Weight. Gestational weight gain was independent variable and Birth Weight was dependent variable. Data was collected from 320 pregnant women and who are filling inclusion criteria. Every consecutive healthy Pregnant Women (low risk pregnancy) who have completed 12 weeks of pregnancy was included in the study. Pregnant women with high risk Pregnancy and who wants to change place of delivery were excluded.

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Sample size was calculated based on study conducted by Dayanithi M.¹

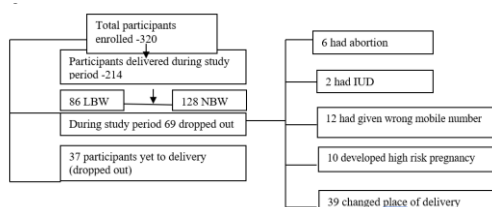
$$\text{Formula used was: } n = \frac{4 \times p \times q}{L^2}$$

P= Prevalence of LBW, According to previous study percentage is 31.8 % L= allowable error considered 10%

$$q=100-p=68.2\% \quad n = \frac{4 \times 31.8 \times 68.2}{(10)^2} \quad n=86.75$$

According to formula sample size was 86.75 of low birth weight babies.

Flow diagram-



Total participants studied and analyzed were -214 till found 86 low birth weight babies. : Tool was prepared by reviewing the literature from books, journals, Internet and suggestions and modifications by the experts. The study was approved by the KIMSDU Ethical Committee and permission was obtained from authorities of Krishna Hospital Karad. Participants were selected according to

inclusion and exclusion criteria. Purpose of the study was explained and informed consent was obtained. Data was collected by conducting interview technique. Height and weight was checked by standardized height measuring scale, and digital weighing scale. Follow up was taken after every 15 days from 12 weeks of gestation till delivery and weight gain, BMI was recorded. Weight of baby was observed soon after delivery on digital weighing scale. Baby weight was categorized into three grades. Data was collected from 10 July 2019 and last delivery of the cohort (LBW) were took place on 10 march 2020. Data was analyzed by using descriptive statistics and inferential statistics.

3. Results-

Table no 1 shows that, those mother having age between 18-21 years and staying in joint families have delivered 50% and 40.52% of LBW respectively. 51.35%, 47.54%, 47.37%, 44.44% LBW was born in family, in which members were more than five, Illiterate mothers, less than 18 years of age at marriage and who have married life ≥ 11 years respectively. 43.70% of LBW were found in Lower middle socio-economic class, 43.27% in those mothers having height 145-161cm, 41.62% in housewife mothers, and 40.61% in mothers having non-consanguineous marriage. 41.67%, 41.34%, 41.32% LBW was born in the mothers from other religion, mothers from rural area, taking mixed type of diet respectively.

Table 1: Demographic Characteristics of Mother and Birth Weight (n=214)

Socio-Demographic Variables	Total No (%)	LBWNo (%)	NBWNo (%)
Age (years)			
18-21	42(19.63)	21 (50)	21(50)
22-25	91(42.52)	31(34.07)	60 (65.93)
26-30	81(37.85)	34(41.98)	47(58.02)
Family type			
Nuclear	24(21.96)	9(37.5)	15(62.5)
Joint	190(56.54)	77(40.52)	113(59.47)
No. of family members			

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Socio-Demographic Variables	Total No (%)	LBWNo (%)	NBWNo (%)
>5	74(34.58)	38(51.35)	36(48.65)
<5	140(65.42)	48(34.29)	92(65.71)
Age at marriage (years)			
<18	19(8.88)	9(47.37)	10(52.63)
18-25	176(82.24)	70(39.77)	106(60.23)
>25	19(8.88)	7(36.84)	12(63.16)
Duration of married life (years)			
≤1	71(33.18)	28(39.44)	43(60.56)
2-10 years	134(62.62)	54(40.30)	80(59.70)
≥11	9(4.21)	4(44.44)	5(55.56)
Maternal height			
145-161cm	171(79.91)	74(43.27)	97(56.73)
162-177cm	43(20.09)	12(27.91)	31(72.09)
Consanguineous marriage			
Yes	49(22.90)	19(38.78)	30(61.22)
No	165(77.10)	67(40.61)	98(59.39)
Maternal education			
Illiterate	1(0.47)	1(100)	0(0)
Primary and Secondary	61(28.50)	29(47.54)	32(52.46)
higher secondary	55(25.70)	23(41.82)	32(58.18)
Graduation and above	97(45.33)	33(34.02)	64(65.98)
Maternal occupation			
Housewife	197(92.06)	82(41.62)	115(58.38)
Self employed	4(1.87)	1(25)	3(75)
Service	13(6.07)	3(23.08)	10(76.92)

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Socio-Demographic Variables	Total No (%)	LBWNo (%)	NBWNo (%)
Religion			
Hindu	202(94.39)	81(40.10)	121(59.90)
Other than Hindu	12(5.61)	5(41.67)	7(58.33)
Residence			
Urban	47(21.96)	17(36.17)	30(63.83)
Rural	167(78.04)	69(41.32)	98(58.68)
Type of Diet			
Vegetarian	35(16.36)	12(34.29)	23(65.71)
Non-vegetarian	179(83.64)	74(41.34)	105(58.66)
Socioeconomic class			
Upper (I)	2(0.93)	0(0)	2(100)
Upper middle (II)	67(31.31)	26(38.81)	41(61.19)
Lower middle (III)	119(55.61)	52(43.70)	67(56.30)
Upper lower(IV)	26(12.15)	8(30.77)	18(69.23)

Table 2: Birth Weight According to Obstetric Characteristics. (n=214)

Obstetric Characteristics	TOTAL No (%)	LBW No (%)	NBWNo (%)
Gravida			
Primigravida	107(50)	45(42.06)	62(57.94)
Second gravida	58(27.10)	21(36.21)	37(63.79)
Multigravida	49(22.90)	20(40.82)	29(59.18)
Para			
Nulliparous	123(57.48)	53(43.09)	70(56.91)
Primipara	70(32.71)	22(31.43)	48(68.57)
Multipara	21(9.81)	11(52.38)	10(47.62)

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Abortion			
No Abortion	164(76.64)	65(39.63)	99(60.37)
1-3	50(23.36)	21(42)	29(58)
Stillbirth			
No Stillbirth	211(98.60)	85(40.28)	126(59.72)
Stillbirth	3(1.40)	1(33.33)	2(66.67)
Death			
No death of child	212(99.07)	84(39.62)	128(60.38)
death of child	2(0.93)	2(100)	0(0)
Number of living children			
No previous child	127(59.35)	56(44.09)	71(55.91)
1-2	82(38.32)	28(34.15)	54(65.85)
≥3	5(2.34)	2(40)	3(60)
Birth interval from last child			
No interval	131(61.21)	58(44.27)	73(55.73)
≤2 years	16(7.48)	6(37.50)	10(62.50)
≥3 years	67(31.31)	22(32.84)	45(67.16)
History of infertility			
Yes	38(17.76)	15(39.47)	23(60.53)
No	176(82.24)	71(40.34)	105(59.66)
Planned pregnancy			
Yes	190(88.79)	80(42.11)	110(57.89)
No	24(11.21)	6(25)	18(75)
Hemoglobin status			
Moderate (6.5-8 g/dl)	7(3.27)	4(57.14)	3(42.86)

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Mild (8.1-10 g/dl)	55(25.70)	20(36.36)	35(34.55)
Normal \geq 10.1)	152(71.03)	62(40.79)	90(59.21)

Table no 2 shows that, Primi-gravid and multi-gravid mothers delivered 42.06%, 40.82% of LBW respectively and 2.38 % of LBW was delivered by multipara mothers. Mothers, who had history of abortion more than one time, having children \geq 3 and birth Interval $<$ 2 years delivered 42%, 40%, and 37.50% LBW respectively. Mothers who had Hemoglobin level 6.5-8 g/dl in second trimester delivered 57.14% of LBW.

Table 3: Birth Weight According to Outcome of Delivery. (n=214)

Outcome	TOTAL No (%)	LBW No (%)	NBW No (%)
Gestational age at birth			
<37weeks	27(12.62)	23(85.19)	4(14.81)
37-40 weeks	126(58.88)	45(35.71)	81(64.29)
>40 weeks	61(28.50)	18(29.51)	43(70.40)
Complaints on admission			
Leaking	37(17.29)	21(56.76)	16(43.24)
Labor pain	129(60.28)	40(31.01)	80(62.02)
Due date	41(19.16)	10(24.39)	31(75.61)
Decreased fetal movements	7(3.27)	6(85.71)	1(14.29)
Type of labor			
Spontaneous	120(56.07)	50(41.67)	70(58.33)
Induced	94(43.93)	36(38.30)	58(61.70)
Type of delivery			
Normal vaginal	120(56.07)	46(38.33)	74(61.67)
C-Section	91(42.52)	39(42.86)	52(57.14)
Instrumental	3(1.40)	1(33.33)	2(66.67)
Sex of baby			

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Male	103(48.13)	34(33.01)	69(66.99)
Female	111(51.87)	52(46.85)	59(53.15)
Baby cried immediately			
Yes	211(98.60)	85(40.28)	126(59.72)
No	3(1.40)	1(33.33)	2(66.67)
NICU admission			
Yes	10(4.67)	8(80)	2(20)
No	204(95.33)	78(38.24)	126(61.76)
H/o hospitalization during pregnancy			
Yes	21(9.81)	14(66.67)	7(33.33)
No	193(90.19)	72(37.31)	121(62.69)

Table no 3 shows that, mothers who had gestational age less than 37 weeks delivered 85.19% of LBW. Those mothers came with leaking and spontaneous labor had delivered 56.76%, 41.67% of LBW respectively. Higher rate of LBW was in 42.86% mothers who delivered by C-section. Female newborn shows 46.85% percentage of LBW. 80% LBW babies required NICU admission and mothers who had history of hospitalization during pregnancy delivered 66.67% of LBW.

Above figure depicts that, among 214 pregnant women those gained weight <7 kg, 7-14 kg and >14 kg delivered 82.69%, 29.37% and 5.26% of LBW babies respectively. Mean weight gain of pregnant women who gave birth to baby who had weight <2500 gm was 7.21 ± 2.84 and who had weight >2500 gm was 10.84 ± 3.126 .

Above figure shows that, out of 214 newborns 59.81% were having normal birth weight and 40.18 % having low birth weight.

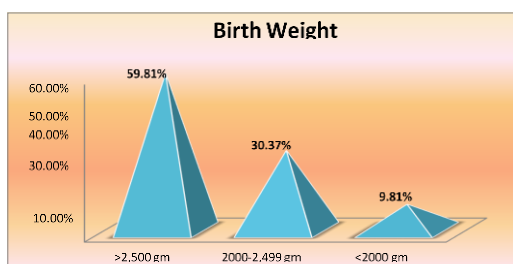
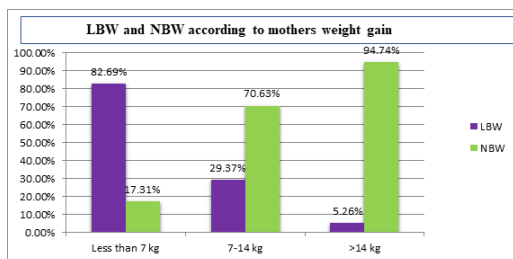


Table 4: Correlation of maternal weight gain with birth weight

Correlation Coefficient Test	Value
correlation coefficient (r)	0.5378
95% confidence interval	0.4350 to 0.6267
coefficient of determination (r squared)	0.2892
p value	<0.001

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Table no 4 reveals that, there was significant correlation found between maternal weight gain and birth weight ($p < 0.001$).

Association between Birth Weight and Demographic and Obstetric characteristics - Mother height was shown to be correlated with the birth weight ($t=3.302; p < 0.001$). Other socioeconomic characteristics were not found to have a statistically significant relationship with birth weight ($p = p > 0.05$). Total maternal weight increase was associated with a higher birth weight ($p < 0.001$).

4. Discussion:

The primary objective was to establish a connection between maternal weight growth and infant birth weight. Birth weight and the mother's overall weight increase during pregnancy were shown to be significantly correlated ($p < 0.001$). Nirmali Gogoi¹⁴, who found a similar correlation between maternal height and infant birth weight, lends credence to these conclusions. This data implies that prenatal care providers should pay more attention to women who are shorter than 145 centimetres. This research's results showing there was no correlation between birth weight and socioeconomic status ($p = 0.41$), which are corroborated by those of Heba et al.¹⁶, are consistent with those of the latter study.

In this study gestational age at birth was shown significant association with birth weight ($p < 0.001$). Similar findings were noted by Nirmali Gogoi¹⁴ they found that LBW was significantly associated with Gestational age < 37 weeks ($p < 0.001$). In our study 80% newborn required NICU admission, similar findings were noted by Dr. Heba et al.¹⁶ rate of NICU admission was higher in LBW newborns (80%) than the normal birth weight newborns. Another study by P.S. Thomre¹⁷ et al noted significant association between complaints on admission, NICU admission and History of hospitalization and birth weight of newborn ($p = 0.0022, 0.0095, 0.0106$ respectively). This shows that pregnant women should manage and control minor disorders in pregnancy using home remedies and doctors' advice and they should avoid hospitalization for minor complaints.

In the present study Mean \pm SD birth weight was 2.667 ± 503.83 and prevalence of LBW was 40.66%. Our

findings were higher than the findings of Naziya Noor et al.¹⁸ reported that, proportion of LBW was 36.8% in the rural area and prevalence of LBW in well developed countries was 10-13%. They also noted that prevalence of LBW is increasing in rural area. Hence there is needed to take proper care of pregnant women in rural area. Role of health care member is important in reduction of prevalence rate of LBW. With the help of effective antenatal care can reduce this rate.

In our study 46.85% of LBW was found in the mothers who delivered female babies. These findings were supported by Sanjay Kumar et al.¹⁹, female newborns shows higher rate of LBW (46.85%) than the male newborns.

We discovered that moms who had kids with low birth weight gained an average of 7.21 lb (2.84 kg) while mothers who delivered babies with a normal birth weight gained 10.84 lb (3.126 kg). The correlation between weight growth and initial body mass index was statistically significant ($p < 0.001$). According to research by Tela FG et al.²¹, a one-kilogram rise in maternal weight is connected with a 97-gram increase in birth weight. The results of the research showed that maternal weight increase during pregnancy significantly affected infant birth weight. As a result, preventing low birth weight requires that ANC counselling programmes stress mother weight growth. Weight gain throughout pregnancy, a key measure of nutrition throughout pregnancy, is thought to have a major role in fostering intra-uterine foetal development.²² Another research conducted in Taiwan found that weight increase during pregnancy accounted for the largest portion of the BW variance.²³ Also, an Iranian research found that pregnant women who had babies weighing less than 2500 grammes gained much less weight than those who delivered babies weighing more than this amount.²⁴ Correlation The birth weight was significantly correlated with the mother's overall weight increase ($p < 0.001$). This data shows that mother weight increase throughout pregnancy is very important in predicting birth weight in the prenatal period and may be the single most important predictor of pregnancy outcome. S Rijvi et al.²⁵ reported similar results, noting a statistically significant ($p < 0.05$) correlation between a mean weight gain of 10.723.72 Kg and a rise in the mean weight at birth. Inadequate weight increase was associated with a lower foetal weight

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compared to regular weight gain ($p=0.001$), as was found by Mefkure Eraslan et al. Baby newborn weight was shown to be correlated with mother's weight increase ($p=0.03$, CI 95%; S.Lumbhanraja et al.27).

Above findings suggest that weight gain during pregnancy is strong predictor of birth weight of infant. Hence it should be considered seriously there is need to pay more attention on weight gain pattern in pregnancy. This step can prevent and predict the risk of giving birth to LBW infant.

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