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Original research article

Maternal Serum Level of Iron, Folic Acid & Vitamin B_{12} and Weight Gain at the end of 2nd & 3rd Trimester and their Correlation with Birth Weight of Neonates

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Abstract

Purpose: To find the relation between maternal serum levels of Iron, Folic acid & vitamin B12 and weight gain with birth weight of newborn.

Methods: A prospective observational study on 100 pregnant women was carried out in the GMH Rewa and peripheral health centres like PHC, CHC, CH, & DH. Their blood parameters and weight gain were analysed and noted in successive 2nd & 3rd trimesters then correlates with the pregnancy outcome, i.e., newborn birth weight.

Results: Out of 100 pregnant women, In 2nd trimester of pregnancy, 12(12%) had inadequate weight gain which has 46(46%) low birth weight newborn and, 54(54%) had low maternal serum iron level which has 46(46%) low birth weight newborn. In 3rd trimester, 3(3%) of pregnant women had inadequate weight gain have 46(46%) low birth weight newborn, 83(83%) had low serum iron level have 46(46%) low birth weight newborn.

Conclusion: Nutrition along with important micronutrients level, especially Iron, during pregnancy affects health status of mother, weight gain and newborn birth weight.

Keywords: Pregnant women, weight gain, maternal serum iron, serum folic acid, serum vitamin B12, newborn birth weight.

Introduction

Food quality with adequate macro and micro-nutrient intake during pregnancy, is crucial for the health status of the mother and newborn [(1)]. Poor maternal nutritional status, starting from the pre-conception period, has been related to adverse birth outcomes and influenced by many biological, socio economical, and demographical factors [(2)]. Inadequate antenatal weight gain

is a significant risk factor for intra-uterine growth restriction (IUGR), preterm delivery and low birth weight (LBW) in newborn. Nutrients in combinations that have been most commonly associated with birth outcomes, including energy, protein, carbohydrates, fat, EFA (specifically omega-3 fatty acids), iron, folic acid, calcium & vitamin D, vit B12, etc supplements.

Given the breadth of the topic, we limit our focus to the 3 major Nutrients (iron, folate and vitamin B12) and adverse birth outcomes includes LBW, preterm birth, or IUGR. These adverse birth outcomes shows the leading causes of neonatal morbidity and mortality among children born without congenital anomalies [(2)]. During pregnancy, iron requirement progressively increases until the 1st trimester, in parallel deposition in fetal tissues. Inadequate intakes or deficiency in pregnancy may affect growth and development of the fetus and increase the risk of preterm delivery and LBW [(3)]. Maternal supplementation with folic acid is widely recommended to all childbearing age women to reduce the risk of congenital heart disease and perticularly to reduce the risk of NTD and support proper development of the placenta. Vitamin B12 plays a vital role in neuronal and brain development. Vitamin B12 deficiency in pregnancy is prevalent and has been associated with preterm birth (GA <37 weeks) and non linear association was observed in LBW.

Material & Methods:
It was the health facility based prospective observational study conducted among 100 booked pregnant women attending ANC clinic at GMH Rewa, peripheral health care centres like PHC/CHC/CH/DH and Aganwadi Kendra. Basic information and data of pregnant women was collected from filled proforma and ANC register. Pregnant women was followed-up at the end of 2nd & 3rd trimester, blood samples for the mentioned serum nutrients i.e., serum Iron/folic acid/Vitamin B12, had taken and these findings were then correlates with the final outcome of the pregnancy, i.e., newborn birth weight.

Statistical analysis:
All the data was selected randomly and was entered in to the Microsoft excel and tabulated, then the data will be analyzed with appropriate statistical tools "SPSS version 24". Data was presented as mean with standard deviation or proportions as appropriate. Mean, median, standard deviation and variance was calculated and following statistical significance tests were applied: Gaussian Test for normal distribution/Test for single mean. The Qualitative or Categorical variables were presented in the form of frequency and percentage. For all those data statistical analysis was done by using "Chi – square Test". The qualitative variables were presented in the form of frequency and percentage. For all those data statistical analysis was done by using |Z| proportion Test. Pearson's Correlation Coefficient and linear regression analysis was used to determine the association between continuous quantitative variables.

Results:
The study group had a cohort of reproductive age group with a mean age of 25.25 ± 3.62 years & mean pre pregnancy weight 52.52 ± 6.28 kg and consists of 59(59%) male & 41(41%) female newborn with mean birth weight of 2.46 ± 0.55 kg. In 2nd trimester of pregnancy, mean maternal serum iron was 42.93 ± 9.35 mg/dl (p-value <0.0001), mean maternal serum folic acid was 9.56 ± 3.01 ng/ml (p-value <0.0001), mean maternal vitamin B12 was 248.94 ± 52.29 pg/dl (p-value <0.001) and mean maternal weight gain was 5.54 ± 0.85 kg and 12(12%) had inadequate weight gain (p-value = 0.0979) and 54(54%) had low serum iron level (p-value =0.0004) with 46(46%) had have low birth weight. In 3rd trimester of pregnancy, mean maternal serum iron was 37.065 ± 9.48 mg/dl (p-value <0.0001), mean maternal serum folic acid was 10.70 ± 3.36 ng/ml (p-value <0.0001), mean maternal vitamin B12 was 211.73 ± 105.60 pg/dl

(p-value= 0.8404) and mean maternal weight gain was 11.59 ± 1.56 kg and 3(3%) of pregnant women had inadequate weight gain (p-value <0.0001) and 83(83%) had low serum iron level (p-value =0.1019) with 46(46%) had have low birth weight (Table 1,2,3,4,5).

Table 01: Maternal demographic parameters

Demographic parameters		No. of patients (n=100)	Percentage
Maternal age	< 20 year	8	8%
	20-30 year	85	85%
	>30 year	7	7%
	Mean ±SD	25.25 ± 3.62 years	
Locality	RURAL	68	68%
	URBAN	32	32%
Maternal Pre Pregnancy Weight	< 50 kg	50	50%
	50– 55 kg	24	24%
	>55 kg	26	26%
	Mean ± SD	52.52 ± 6.28 kg	

For test of significance, here we use **CHI – SQUARE TEST {$|\chi^2|$ - test},
***|Z| - PROPORTION TEST NS: - Not Significant S: - Significant**

Table 02 : Correlation between neonatal birth weights with mother's weight gain and serum level in 2nd & 3rd trimester

Parameters	Trimesters	Mean ± SD	P- value	Result
Birth weight (kg)	----------	2.46 ± 0.55	<0.0001	Significant *
Maternal weight gain (kg)	2nd trimester	5.54 ± 0.85	<0.0001	Significant **
	3rd trimester	11.59 ± 1.56		
Serum Iron (mcg/dl)	2nd trimester	42.93 ± 9.35	<0.0001	Significant **
	3rd trimester	37.065 ± 9.48		
Serum Folic acid (ng/ml)	2nd trimester	9.56 ± 3.01	0.0123	Significant **
	3rd trimester	10.70 ± 3.36		
Serum Vitamin B12 (pg/ml)	2nd trimester	248.94 ± 52.29	0.0018	Significant **
	3rd trimester	211.73 ± 105.60		

For test of significance, here we use
*TEST FOR SINGLE MEAN {|t| - test}, ** PAIRED |t| - TEST

Table 03: Correlation between neonatal birth weights with maternal weight gain

New-born Birth weight (kg) (N=100)	Maternal weight gain in **2nd trimester** (T2)		P value	Maternal weight gain in **3rd trimester** (T3)		P value
	Inadequate (< 5 kg) (n=12)	Adequate (5-8 kg) (n=88)		Inadequate (<9 kg) (n=3)	Adequate (9–15 kg) (n=97)	
LBW (1–2.499) (n=46)	9 (9%)	37 (37%)	0.0015 (S)	1 (1%)	45 (45%)	<0.0001 (S)
Normal (2.5 – 3.899) (n=53)	3 (3%)	50 (50%)	<0.0001 (S)	2 (2%)	51 (51%)	<0.0001 (S)
LGA (>3.9) (n=1)	0 (0%)	1 (1%)	0.1373 (NS)	0 (0%)	1 (1%)	0.1373 (NS)

For test of significance, here we use *|Z| - PROPORTION TEST NS: - Not Significant S: - Significant

Table: 04 Correlation between neonatal birth weights with different Serum Levels in 3rd trimester

Neonatal Birth weight (kg) (N=100)	**Different Serum level in 2nd Trimester**						**P value**	**Result**
	S.IRON (mcg/dl)		S.FA (ng/ml)		S.Vitamin B12 (pg/ml)			
	Low (<44)	Normal (44–173)	Low (<0.8)	Normal (0.8–24)	Low (<130)	Normal (130–656)		
LBW (1 – 2.499 kg) (n=46)	37 (37%)	9 (9%)	0 (0%)	46 (46%)	0 (0%)	46 (46%)	<0.0001	S
Normal (2.5 – 3.9 kg) (n=53)	17 (17%)	36 (36%)	0 (0%)	53 (53%)	0 (0%)	53 (53%)	<0.0001	S
LGA (>3.9 kg) (n=1)	0 (0%)	1 (1%)	0 (0%)	1 (1%)	0 (0%)	1 (1%)	1	NS

For test of significance, here we use **CHI – SQUARE TEST {|χ^2| - test S: - Significant

Table: 05

Neonatal Birth weight (kg) (N=100)	**Different Serum level in 3rd Trimester**						**P value**	**Result**
	S.IRON (mcg/dl)		S.FA (ng/ml)		S.Vit B12 (pg/ml)			
	Low (<44)	Normal (44–173)	Low (<0.8)	Normal (0.8–24)	Low (<130)	Normal (130–656)		
LBW (1 – 2.499 kg) (n=46)	43 (43%)	3 (3%)	0 (0%)	46 (46%)	0 (0%)	46 (46%)	<0.0001	S
Normal (2.5 – 3.9 kg) (n=53)	40 (40%)	13 (13%)	0 (0%)	53 (53%)	0 (0%)	53 (53%)	<0.0001	S
LGA (>3.9 kg) (n=1)	0 (0%)	1 (1%)	0 (0%)	1 (1%)	0 (0%)	1 (1%)	1	NS

Correlation between neonatal birth weights with different Serum Levels in 3rd trimester

For test of significance, here we usemCHI – SQUARE TEST {$|\chi^2|$ - test NS: - Not Significant**

S: - Significant

Discussion:

In this observational prospective study, it comprise of 100 pregnant women and 100 neonates, maternal mean age were 25.25 ± 3.62 years & mean pre pregnancy weight were 52.52 ± 6.28 kg and consists of 59(59%) male & 41(41%) female newborn with mean birth weight of 2.46 ± 0.55 kg. Among 100 pregnant women, In 2nd trimester of pregnancy, Out of 100 newborn, 46(46%) had have low birth weight where 37(37%) pregnant women had low serum iron level (<44 mcg/dl) and 53(53%) newborn had normal weight in which 36(36%) pregnant women have normal range serum iron level (44-173 mcg/dl) and serum folic acid (0.8-24 ng/dl) and vitamin B12 (130-656 pg/ml) were within normal range. The mean neonatal birth weight was 2.46 ± 0.55 kg and mean serum level of Iron, folic acid and vitamin B12 were 42.93 ± 9.35 mcg/dl, 9.56±3.01 ng/ml and 248.94±52.29 pg/ml respectively which shows positive association. This study is comparable to a study, randomised controlled trial, done by Julia L Finkelstein et al(8), January 2020 and found that neonates born to anaemic women had a two times more risk of LBW and preterm delivery. IDA was associated with higher risk of LBW and preterm birth and LBW, gestational age at birth. A study by Tormod Rogne et al (9), 2017 found that there was a linear association between maternal levels of vitamin B12 and preterm birth. And, non linear association was seen between maternal vitamin B12 levels in pregnancy and birth weight. In 3rd trimester of pregnancy, among 100 neonates, LBW neonates comprise of 46(46%) in which serum Iron was low in 43(43%) pregnant women and serum folic acid and vitamin b12 were relatively low but within normal range. Newborn with normal weight comprise of 53(53%) in which serum Iron was within normal range in 40(40%) pregnant women and serum folic acid (1.4-20.7 ng/ml) and vitamin b12 (99-526 pg/ml) were within normal range. The mean neonatal birth weight was 2.46 ± 0.55 kg and mean serum level of Iron, folic acid and vitamin B12 were 37.065 ± 9.48 µg/dl, 10.7±3.36ng/ml and 211.73±105.60 pg/ml respectively which show positive relation. This study can be comparable with a study done by Nuria Aranda et al(10), Dec 2011 where 82 pregnant women as sample size taken, Overall, 36% pre-pregnancy women had low serum iron. Supplemental iron had a positive impact on birth weight among women with pre-pregnancy low iron stores and did not affect birth weight among women with present iron stores. A study was done by Hannah Jonker et al(11), Jan 2020 where a total of 275,421 women were taken. Maternal FA supplementation in developing countries was associated with an increased mean BW of infants and decreases in the incidence of LBW & SGA. In 2nd trimester of pregnancy, mean maternal weight gain was 5.54 ± 0.85 kg and mean birth weight of 2.46 ± 0.55 kg which has positive linear relation, 88(88%) had adequate weight gain & 12(12%) had inadequate weight gain in which 53(53%) newborn had normal weight (2500-3899gram) and 46(46%) had low birth weight (1000-2499 gram). In 3rd trimester of pregnancy, mean maternal weight gain was 11.59 ± 1.56 kg and mean birth weight of 2.46 ± 0.55 kg which has linear relation, 97(97%) have had adequate weight gain & 3(3%) of pregnant women had inadequate weight gain in which 53(53%) newborn had normal weight (2500-3899 gram) and 46(46%) had low birth weight (1000-2499 gram). According to American Pregnancy association, average pregnancy weight gain in 2nd trimester of pregnancy is 1-2 pounds (0.45-0.9kg) per week(4), means average of 5.5-9kg weight gain occurs. In 3rd trimester of pregnancy, weight gain is 1-2 pounds (0.45-0.9kg) per week(4), means average of 9-12kg weight gain occurs. According to Institute of Medicine (US) Committee on Nutritional Status During Pregnancy and Lactation, National Academies Press

(US);1990(5), the average pregnancy weight gain in 2nd trimester of pregnancy is approx 6-7 kg and in 3rd trimester of pregnancy is approx 12.5 kg. This study can be compared with another study conducted by Santo Monte et al(6), 2011 and it shown a linear relationship between both pre-pregnancy weight and gestational weight gain with neonatal birth weight of and associated health risks. A study was carried out by Anke Diemert et al(7), Aug 2016, where 200 pregnant women and 197 infants born at term were included and concluded that for each unit increment in pre-pregnancy BMI, birth weight increased by 17 g, whereas each kg weight gained during pregnancy leads to an increase in birth weight by 20 g . An increase in birth weight by 138 g was observed per gestational week.

Conclusion:

This study highlights the importance of nutrition and micronutrients during pregnancy in term of weight gain which has direct and positive impact in weight and health status of the newborn. Maternal serum Iron, folic acid and vitamin B12 supplementation has a statistically significant and positive association (especially serum iron level) on birth weight and an inverse association with incidence of LBW, SGA and IUGR. These results and analysis shows importance of nutrition and IFA supplementation under national government scheme and detection of their deficiencies can contribute to simple low-cost interventions which aimed at reducing the incidence of LBW, SGA and IUGR. We have to provide the proper awareness and health education about the pregnancy, timely ANC visit, nutrition & encourage for the institutional delivery for the better foetal outcome.

Conflict of interest: No

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