Original article

A study of correlation between pre-pregnancy weight, gestational weight gain, erythropoiesis-related micronutrient levels in term pregnant women and the birth weight of the baby

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ABSTRACT

Introduction and Aim: Adequate Nutrients intake is very crucial for the health of pregnant women and the fetus. Inadequate intake will cause maternal anemia, increase the likelihood for the Antepartum and postpartum maternal complications, fetal growth restriction resulting in low birth weight (LBW) babies. Micronutrients which are involved in erythropoiesis may affect the birth weight of the newborn. The objective was to study the correlation between the pre-pregnancy weight, gestational weight gain, erythropoiesis-related micronutrient levels in apparently normal term pregnant women and birth weight of the baby.

Materials and Methods: An Institutional ethical clearance was obtained. A total of 168 term pregnant women were selected for the present study. They were apparently normal term pregnant women who were willing to participate and who gave consent were included. Maximum of 86.9% of study subjects belonged to the age group of 21-30 years. The present hospital based cross sectional study was conducted in the department of OBG of tertiary care centres of North Karnataka between December 2019 to February 2020. Sample size was estimated to be 158.

Results: In this study, we found that there is a statistically significant positive correlation between the maternal weight in first trimester, maternal weight at term, gestational weight gain, maternal serum ferritin, Serum total Iron binding capacity, Serum Vitamin B12, and Serum folic acid. The association was found between the type of anemia and birth weight of the baby with Odds ratio (95% CI): 2.01(0.71-5.64), p=0.08, though it is not statistically significant.

Conclusion: Hence there is an association between pre-pregnancy weight, gestational weight gain and erythropoiesis-related micronutrients and birth weight of the baby. Hence it is very important to provide nutrition education to pregnant women along with iron and folic acid supplementation, other micronutrients which affect the pregnancy outcome.

Keywords: Erythropoiesis-related micronutrients; gestational weight gain; birth weight.

INTRODUCTION

Adequate Nutrients intake is very crucial for the health of pregnant women and the foetus. Inadequate intake will cause the maternal anemia, increases the likelihood for the Antepartum and postpartum maternal complications, fetal growth restriction resulting in low birth weight (LBW) babies. (1). The birth weight is an important indicator of the status and services of public health, maternal health, and nutrition. Globally low birth weight (LBW) is an important health indicator and a risk factor, which contributes to 40-60% of infant mortality (1). Adequate maternal nutrition is crucial in determining the birth weight of newborn (2).

Micronutrients are crucial for normal intrauterine growth and development of the foetus and its deficiencies due to maternal inadequate intake have been found to be associated with intrauterine growth retardation, resulting in small gestational age (SGA) infants. Micronutrients have many functions; antioxidant process, interaction with intercellular signaling protein transcriptional regulation, cell proliferation etc., (3). Micronutrient deficiencies in pregnancy is an important global public health problem, yet the full extent of their burden and implications on health are not clear, because it is not routinely estimated during pregnancy. Women in low and middle-income countries will become malnourished and the extra requirement of nutrients can intensify micronutrient deficiencies with adverse

health consequences for both mother and the baby. Unlike protein-energy malnourishment, the signs and symptoms of micronutrient deficiency are not always acutely visible; it is therefore considered as hidden hunger, which is synonymously used for micronutrient deficiency (4).

Anemia during pregnancy is an important public health concern and it is linked with adverse maternal and perinatal outcomes. According to WHO, anemia is considered of a very high public health significance, if its prevalence rate is more than 40%. The causes for anemia during pregnancy in developing countries are multifactorial: these include micronutrient deficiencies such as iron, folate, vitamin A and Vitamin B12 deficiency, Malaria and hookworm infections and other chronic infections. In fact, nutritional Anemia in pregnancy due to iron deficiency is only 50%, rest all are caused due to other micronutrient deficiencies. But the policy according to the National programme Reproductive, maternal, neonatal, child health and adolescent health (RMNCH) is to supplement with iron and folic acid (IFA) during pregnancy (5). This would lead to inadequate treatment of anemia, and leads to adverse pregnancy outcomes.

Nutritional anaemia is the most frequent nutritional deficiency disorder affecting more than a large number of pregnant women worldwide (6). During pregnancy, the requirements for erythropoiesis-related micronutrients are increased for feto-placental unit development (7,8). Women entering the pregnancy with nutrition deficiency will jeopardize the situation, as there is an increased demand from growing foetus. These micronutrients, which are required for erythropoiesis such as iron, folic acid, and vitamin B12 are known to cause nutritional anemia and its consequences.

Hence the study was undertaken to study the correlation between the pre-pregnancy weight, gestational weight gain, erythropoiesis-related micronutrient levels in apparently normal term pregnant women and birth weight of the baby.

MATERIALS AND METHODS

This study was conducted in the outpatient department and Labor room of OBG Department at Tertiary Care centre of North Karnataka, India. An Institutional ethical clearance (BLDE(DU)/IEC/409/2019-20 dated 27th December 2019) was obtained. We included apparently healthy term pregnant women of ≥37 weeks. Those pregnant women who give consent to participate in the study. Multiple pregnancies like twins are diagnosed anytime during pregnancy or after delivery. Chronic medical conditions such as hepatic, renal, cardiovascular diseases, women who are known HIV, hepatitis B infection, hypertension including preeclampsia and diabetes mellitus including gestational diabetes were excluded. Babies born with severe congenital anomalies were excluded for analysis.

Sample size estimation was done using Openepi software version 2.3.1. At 95% confidence limits, and at 80% Power of the study, Zα is the standard table value for 95% CI =1.96, $Z_{1-\beta}$ is the Standard table value for 80% Power = 0.84 According to the study conducted by Wadhwani (9). The correlation coefficient between the third trimester Vitamin B-12 levels and birth weight of the baby=0.22. Formula used= $N = ([Z_\alpha + Z_\beta]/C)^2 + 3$, where C= 0.5*ln ([1 + r]/ [1 − r]) Sample size estimated is 159, which is rounded off to 165.

After obtaining ethical clearance, the present study was conducted in the outpatient department(OPD) and labor room of OBG Department of Tertiary care Centre of North Karnataka. Informed consent was obtained from the study subjects. All apparently healthy term pregnant women(≥37 weeks) who were coming to OPD for antenatal care and those who were admitted in labor rooms for safe confinement, inclusion and exclusion criteria were included in the study. The pregnant women who were willing to participate by giving the informed consent for the present study were included for the study.

A pretested questionnaire for obtaining basic demographic characteristics, dietary consumption by 24-hour recall method, questionnaire related physical activity during pregnancy. Later physical examination includes general physical examination, vitals include pulse rate, blood pressure, respiratory rate was measured. An anthropometric measurement includes Height and weight, using standard operating procedures. Weight and Height were measured using UNICEF SECA weighing scale and UNICEF SECA microtoise respectively, following the standard protocol. Investigations done during (≥37 weeks): About 5 ml of venous blood was collected by venipuncture and following investigations will be done Complete Blood Count (Using Penta ES 60 cell counter) and Peripheral smear examination was done Serum ferritin, Serum iron, serum total iron binding capacity, serum transferrin, serum vitamin B12, Serum folic acid estimation was done using Autolumo 1000, fully automated analyzer which works based on the principle of Chemiluminescence (CLIA) method. Low birth weight (LBW) is defined as the birth weight of a newborn is less than 2500 gm. IUGR/SGA was diagnosed if the birth weight is below the 10th centile for gestational age at delivery.

Statistical analysis

Data was analyzed statistically using SPSS package 'IBM SPSS Statistics for Windows, version 19 (IBM Corp., Armonk, N.Y., USA). Data was expressed as percentages and mean ±standard deviation (SD) for

qualitative and quantitative data respectively. Later the data was statistically analyzed using statistical tests such as chi-square test, odds ratio (95% CI) and student unpaired t-test. Pearson's correlation coefficient was calculated for the variables. The p value(<0.05) was considered as significant.

RESULTS

Table 1: Socio-demographic and baseline characteristics of the study population

Variables	Value	No.	%
Age	<= 20	6	3.6
	21 - 30	146	86.9
	31+	16	9.5
Gravida	1	84	50.0
	2	47	28.0
	3	31	18.5
	4	4	2.4
	5	2	1.2
Socio-economic status (modified BG Prasad classification)	1	6	3.6
	2	38	22.6
	3	81	48.2
	4	42	25.0
	5	1	.6
Birth weight of baby	<= 2.4900(LBW)	46	27.3
	2.4901+(Normal)	122	72.7
	Total	168	100

In this study, a total of 168 apparently normal term pregnant women participated in the present study.
In this study, a total of 168 apparently normal term pregnant women participated in the present study. Maximum of 86.9% of study subjects were in the age group of 21-30 years. About 50% of the women were primigravids. About 70% of them belonged to class 2 and class 3 socio-economic status according to Modified B G Prasad classification. In the present study, 27.3% of them gave birth to low-birth-weight babies (Table 1).

In this study, we found that maternal weight during the first trimester and at term, gestational weight gain, Folic acid was found to be statistically significant between normal birthweight and low birth weight (Table 2). In the present study, there is a statistically significant positive correlation between the maternal weight in 1st trimester, maternal weight at term, gestational weight gain, serum ferritin, total iron binding capacity, vitamin B12, and folic acid (Table 3; Fig. 1). There was no statistically significant association between the type of anemia and Birth weight of the baby with Odds ratio (95% CI): 2.01(0.71-5.64), p=0.08 (Table 4).

Table 2: Effect of maternal weight and erythropoiesis-related micronutrient levels on birth weight of the baby

Baby birth weight (Binned)		N	Mean	Std. Deviation	t	p
Age	<= 2.4900(LBW)	46	25.39	3.543	-.415	.679
	2.4901+(Normal)	122	25.64	3.514		
Gestational age in weeks	<= 2.4900(LBW)	46	38.367391	.9791276	-1.559	.121
	2.4901+(Normal)	122	38.627273	.9555975		
Maternal weight in 1st trimester	<= 2.4900(LBW)	46	49.409	7.6148	-1.825	.070
	2.4901+(Normal)	122	52.025	8.5073		
Maternal weight at term	<= 2.4900(LBW)	46	57.96	7.857	-3.00	.003
	2.4901+(Normal)	122	62.26	8.449		
Gestational weight gain	<= 2.4900(LBW)	46	8.5273	5.00845	1.85	.050
	2.4901+(Normal)	122	9.9744	3.79760		
Hemoglobin g%	<= 2.4900(LBW)	46	10.995652	1.1236758	-.773	.078
	2.4901+(Normal)	122	11.380992	1.3005328		
Serum ferritin mg/dl	<= 2.4900(LBW)	46	13.738421	12.8862089	-.208	.836
	2.4901+(Normal)	122	14.567656	15.8831159		
Serum Iron µg/dl	<= 2.4900(LBW)	46	118.777778	126.6235112	1.675	.098
	2.4901+(Normal)	122	84.800000	54.2391211		
Total Iron Binding Capacity µg/dl	<= 2.4900(LBW)	46	420.610714	97.0929038	-.804	.424
	2.4901+(Normal)	122	445.508596	105.3296436		
Transferrin %	<= 2.4900(LBW)	46	19.572143	13.5834918	.972	.335
	2.4901+(Normal)	122	16.444364	9.9525174		
Vitamin B12 pg/ml	<= 2.4900(LBW)	46	247.50	166.235	.432	.667
	2.4901+(Normal)	122	229.51	131.688		
Folic acid ng/ml	<= 2.4900(LBW)	46	3.058	7.0963	3.154	.002
	2.4901+(Normal)	122	.728	1.8786		

Table 3: Correlation between maternal weight and erythropoiesis-related micronutrient levels and the birth weight of the baby

Variables		**Baby birth weight**
Maternal weight in 1st trimester	Pearson Correlation(r)	.209*
	Sig. (p)	.010
Gestational weight gain	Pearson Correlation(r)	.315**
	Sig. (p)	.001
Maternal weight at term	Pearson Correlation(r)	.356**
	Sig. (p)	.001
Hb%	Pearson Correlation(r)	.080
	Sig. (p)	.329
Serum ferritin µg/dl	Pearson Correlation(r)	-.173*
	Sig. (p)	.035
Serum Iron µg/dl	Pearson Correlation(r)	.068
	Sig. (p)	.407
TIBC µg/dl	Pearson Correlation(r)	-.224**
	Sig. (p)	.006
Transferrin %	Pearson Correlation(r)	-.058
	Sig. (p)	.482
Vitamin B12 pg/ml	Pearson Correlation(r)	.223
	Sig. (p)	.006
Folic acid ng/ml	Pearson Correlation(r)	.235**
	Sig. (p)	.004

Table 4: Relationship between type of anemia and birthweight of the baby

Baby birth weight	**Peripheral blood**		**Total**
	Microcytic Hypochromic	**Normocytic Normochromic**	
<= 2.4900(LBW)	7	39	46
	15.2%	84.8%	100.0%
2.4901+(N0rmal)	10	112	122
	8.3%	91.7%	100.0%

Chi square=1.81, p=0.08; Odds ratio (95% CI): 2.01(0.71-5.64)

DISCUSSION

Adequate nutrient intake is very crucial for the health of pregnant women and the foetus. Inadequate intake will cause maternal anemia, increase the likelihood for the Antepartum and postpartum maternal complications, fetal growth restriction resulting in low birth weight (LBW) babies. Globally LBW newborn babies contribute to 40-60% of infant mortality rate (1). Maternal nutrition is a very important factor in determining the birth weight of newborns (2). A total of 168 apparently normal term pregnant women participated in the present study.

In this study, we found that maternal weight during the first trimester and at term, gestational weight gain, Folic acid was found to be statistically significant between normal birthweight and low birth weight (Table 2). There is a statistically significant positive correlation between the maternal weight in first trimester (pre-pregnancy weight), maternal weight at term, gestational weight gain, Serum ferritin, Total Iron binding capacity (TIBC), Vitamin B12, and folic acid (Table 3). A study conducted in China, to study the effects of pre-pregnancy body mass index and gestational weight gain on neonatal birth weight found that neonatal birth weight is positively affected by both maternal pre-BMI and gestational weight gain (10) which is like the present study. Pre-Pregnancy weight and gestational weight gain was significantly correlated with the birthweight of the baby, like our observation (11,12).

Micronutrients such as vitamin B12 and folic acid function as methyl donors in one-carbon metabolism which affects cell growth and differentiation by affecting DNA synthesis and epigenetic regulation. Hence, they are important regulators of fetal growth (9,13). Vitamin B12 deficiency is more prevalent in south India has been documented (14), more so in this part of region of North Karnataka, because of inadequacy in dietary intake and the strict vegetarian diet style.

Like our study, there was a positive correlation of maternal vitamin B12 and folic acid levels with birth weight of the baby (9, 15, 16). In another study conducted in Ireland, Dietary consumption of Vitamin

B12 and Folic acid were positively correlated with birth weight of the baby (3). Although routine folic acid supplementation during per-conceptional period has been adapted for prevention of Neural tube defects (NTD), continuing supplementation of Folic acid beyond 12 weeks of pregnancy has not shown significant reduction of Low birth weight and preterm term deliveries in systematic reviews (17,18).

A study conducted in a tertiary care center in India, found that Hemoglobin levels were not associated with the birthweight of the baby (19). which is like our study. In the present study, there was no statistically significant association between the type of anemia and Birth weight of the baby with Odds ratio (95% CI): 2.01(0.71-5.64).

Iron supplementation and its impact on reduction of maternal anemia and Iron deficiency to 70% has been studied in the previous studies. The impact on pregnancy outcomes in terms of maternal and neonatal outcomes is less clear, with no statistically significant results, which is like our study (20).

CONCLUSION

Hence there is clear evidence that there is an association between pre-pregnancy weight, gestational weight gain and erythropoiesis-related micronutrients and birth weight of the baby. Hence it is very important to provide nutrition education to pregnant women along with iron and folic acid supplementation, other micronutrients which affect the pregnancy outcome. Nutrition education should include the facts about the importance of healthy weight during periconceptional period and gestational weight gain. Apart from the calories and protein intake, it is important to incorporate diverse food groups. Healthy diets with the most diverse foods, and balance in eating food provides micronutrients required for healthy mother and baby. Hence it reduces the prevalence of low birthweight.

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CONFLICT OF INTEREST

There is no conflict of interest to declare.

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