

# Effect of maternal dietary intake on the weight of the newborn in Aligarh city, India

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## ABSTRACT

**Background:** This study aimed (1) To record the nutrient intake of the respondents and compare the same with the available recommended dietary allowances (RDA). (2) To assess the correlation between maternal dietary intake and the weight of newborn. **Materials and Methods:** Two hundred and ninety two pregnant women. Study Area: Five hospitals of Aligarh city, Uttar Pradesh. Study Tool and Data Collection: Interview schedule was administered to record information regarding dietary intake and weight of newborn. The data collection was initiated in April 2009 and was completed in March 2010. Data Analysis: Statistical analysis was done by using version SPSS 17. Frequency distributions were calculated for all variables. Univariate and multivariate analysis were performed to determine the influence of the dietary intake on the birth weight of newborn. **Results:** Results revealed that the nutrient intake in all trimesters of pregnancy was lower as compared to RDA. There were significant correlations between the nutrient intake of the mothers and the weight of newborn in all trimesters of pregnancy ( $P=0.01$ ). **Conclusion:** It was found that the dietary intake during all trimesters of pregnancy were significantly associated with the birth weight.

**Key words:** Birth weight, dietary intake, pregnancy, recommended dietary allowance

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## INTRODUCTION

Maternal nutrition and health are considered as the most important regulators of human fetal growth. A healthy mother can produce a healthy child. If women are not well-nourished, they are more likely to give birth to weak babies resulting in a high infant mortality rate.<sup>1</sup> A woman's normal nutritional requirement increases during pregnancy in order to meet the needs of the growing fetus and of the maternal tissues associated with pregnancy. Proper dietary balance is necessary to ensure sufficient energy intake for adequate growth of the fetus without drawing on the mother's own tissues to maintain her pregnancy.<sup>2</sup> The weight of the infant at birth is a powerful predictor of infant growth and survival, and is dependent on maternal health and nutrition during pregnancy.<sup>3</sup> Hence, the present study was undertaken to assess the effect of maternal dietary intake on the weight of a newborn.

## MATERIALS AND METHODS

This follow-up study was conducted in five hospitals of Aligarh city, Uttar Pradesh (UP). These five hospitals were chosen on the basis of highest delivery data per year and they represent the whole city. The sample size was based on the prevalence of low birth weight in India which was 30% in 2008 (UNICEF, 2008).<sup>4</sup> Based on this assumption, the sample size was 323, with 95% confidence level and 5% allowable error. For this study the sample size was 324. As it was a follow-up study, three months (April 2009-June 2009) were selected for the participation of the pregnant women who were in the first trimester (first week – 12 weeks). During this period, altogether 324 pregnant women were enrolled. From these, 292 pregnant women for whom detailed pregnancy outcome information could be collected were enrolled in the study. Thirty-two cases of twin pregnancy, abortion, stillbirth and non-cooperation were excluded from the study. The data collection was initiated in April 2009 and was completed in March 2010.

Structured interview schedule was used to collect information regarding detailed demographic data of the pregnant women such as level of education, family income, birth order, pregnancy weight, dietary intake and weight of newborn. Interviews were done by a research scholar. Data collected from the pregnant women were checked by the doctors at the respective hospitals and the supervisor.

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Each subject was questioned in detail about her dietary intake employing the 24-h dietary recall method for the previous day. The subject recalled what and how much food was consumed and when it was consumed. In order to help in quantifying the amounts of foods consumed, the subjects were asked to express the consumption of all food items in terms of exact *katori* size (large, medium, small) etc., or chapatti size (large, medium, small) or spoon size etc. All correct household measurements e.g. teaspoon, table spoon, cup, glass, etc. of large, medium or small size were asked to the subjects. The information thus obtained was used to compute the daily intake of foods by converting the household measures into grams or kilograms. The consumption of daily diet was calculated in terms of the following food groups (in grams) cereals; pulses; meat/fish poultry; vegetable A (green leafy vegetables); vegetable B (other vegetables); fruits; fat; and sugars. The daily intake of calories (Kcal); proteins (g); calcium (mg); iron (mg); fat (g); and folic acid ( $\mu\text{g}$ ) was calculated and compared with Recommended Dietary Allowance (RDA) tables provided by the Indian Council of Medical Research (ICMR) (Gopalan *et al.*, 2002) for deficient or appropriate consumption. Care was taken to note the food record for each trimester, between five to eight weeks for the first trimester, 21-24 weeks for the second trimester and 29-32 weeks for the third trimester of pregnancy.

In all the hospitals, the newborns were weighed by using a beam-type weighing scale immediately after the delivery by doctors and well-trained experienced nurses.

### Data analysis

Finally, data entry and statistical analysis was done by using Software SPSS Version 17.0. Frequency distributions were calculated for all variables. Univariate and multivariate analyses were performed to determine the influence of the dietary intake on the birth weight of a newborn.

## RESULTS AND DISCUSSION

### Demographic profile

On analysis, the maternal educational level revealed that 32.9% of the pregnant women were illiterate, whereas the remaining 67.1% had educational level from primary to postgraduation. According to per capita income, 46.6% women belonged to the poor group, followed by 31.5% below the poverty line with only 6.5% respondents in the high upper high group. The obstetrical pattern of the respondents revealed that 33.2% pregnant women were primigravida. Only 3.4% pregnant women were grand multipara with 36.3%, 14.4%, and 4.1% first, second, and third parity respectively.

The average daily intake of different nutrients by pregnant women during the first, second, and third trimesters in comparison with RDA is presented in Table 1. RDA is

**Table 1: Average daily nutrient intake by pregnant women during the first, second, and third trimesters in comparison with recommended dietary allowances**

Nutrients	RDA	Actual intake		% Excess/Deficit
		Mean	SD	
Calorie Intake	2175 Kcal			
1 <sup>st</sup> trimester		913.27	295.97	-58.01
2 <sup>nd</sup> trimester		1115.83	343.64	-48.69
3 <sup>rd</sup> trimester		1199.25	327.98	-44.86
Protein Intake	65 g/d			
1 <sup>st</sup> trimester		29.86	10.79	-54.06
2 <sup>nd</sup> trimester		36.63	12.56	-43.64
3 <sup>rd</sup> trimester		38.86	12.12	-40.21
Calcium Intake	1000 mg/d			
1 <sup>st</sup> trimester		409.97	224.27	-59.00
2 <sup>nd</sup> trimester		565.06	340.79	-43.49
3 <sup>rd</sup> trimester		644.48	322.22	-35.55
Iron Intake	38 mg/d			
1 <sup>st</sup> trimester		8.08	3.59	-78.73
2 <sup>nd</sup> trimester		9.21	3.07	-75.76
3 <sup>rd</sup> trimester		10.84	5.44	-71.47
Fat Intake	30 g/d			
1 <sup>st</sup> trimester		23.87	10.12	-20.43
2 <sup>nd</sup> trimester		29.73	13.97	-0.9
3 <sup>rd</sup> trimester		32.14	12.93	7.13
Folic acid intake	400 $\mu\text{g}/\text{d}$			
1 <sup>st</sup> trimester		85.95	59.92	-78.51
2 <sup>nd</sup> trimester		96.53	48.07	-75.86
3 <sup>rd</sup> trimester		109.89	66.38	-75.52

RDA – Recommended dietary allowances

the intake of nutrients derived from the diet that keeps nearly all people in good health. It takes into account the individual variation in nutrient needs and also availability of nutrients, which may vary from diet to diet.<sup>5</sup> As per the RDA, the energy consumption for pregnant woman should have been 2175 Kcal/d. It is evident from Table 1 that the average energy consumption of pregnant women was lesser by 58.01%, 48.69%, 44.86% than RDA in the first, second, and third trimesters, respectively. During pregnancy, a protein-rich diet promotes optimum fetal growth. RDA for protein in pregnancy is 65 g/d. In this study the mean protein intake was lesser by 54.06%, 43.64%, 40.21% than RDA in the first, second, and third trimesters, respectively. The recommended calcium intake during pregnancy is 1000 mg/d. But the mean calcium intake of the mothers was lesser by 59.0%, 43.49%, and 35.55% than RDA in the first, second, and third trimesters respectively. The percentage of iron deficit was higher (78.73%, 75.76%, 71.47% during the first, second, and third trimester respectively) when compared to the RDA. The low intake of calcium and iron noted among pregnant women might have been due to the inadequate intake of green leafy vegetables.

Recommended fat intake is 30 g/d during pregnancy. The average fat consumption of pregnant women was considerably low (20.43%, 0.9% in the first and second

trimester) as compared to RDA. Only the fat intake during the third trimester of pregnancy was 7.13% excess than RDA. RDA for folic acid in pregnancy was 400 µg/d. The mean intake of folic acid was lesser by 78.51%, 75.86% and 75.52% than RDA in the first, second, and third trimesters. This might be due to the inclusion of inadequate amounts of green leafy vegetables and dairy foods.

Table 2 shows the correlation coefficients between the mother's nutrient intake in different trimesters and the birth weight of the newborn. There were significant correlations between the nutrient intake of the mothers and the weight of the newborn in all trimesters of pregnancy ( $P=0.01$ ). Calorie intake during pregnancy was found to be positively correlated with birth weight ( $r=0.343, 0.370, 0.426$  in the first, second, and third trimesters respectively) in all trimesters. Similarly, a study has shown that the mean birth weight of newborns increased with proportionate increase in the consumption of calories by the mothers during the last trimester ( $P<0.05$ ). Mothers who consumed calories  $<1500$  kcal/d during the last trimester delivered low birth weight (LBW) ( $2242.63\pm 324.49$  g) newborns.<sup>6</sup> Similar results with regard to protein and energy intake were reported by other researchers also.<sup>7,8</sup>

Protein intake in all trimesters was also found to be positively correlated with birth weight ( $r=0.237, 0.279, 0.348$  in the first, second, and third trimesters respectively). Similarly, Rao *et al.*, (2007), reported in their study that the mean protein intake during three dietary assessments was  $50.8\pm 9.27$  g. A higher prevalence of LBW babies was observed in pregnant women with mean protein intake of less than 40 g ( $P<0.001$ ).<sup>9</sup>

Calcium consumption was found to be positively correlated with birth weight in the first ( $r=0.276$ ), second ( $r=0.355$ ) and third ( $r=0.421$ ) trimester. Similarly, significant correlations were found between adequate maternal calcium and vitamin D intake with birth weight and 1-min Apgar score of newborns.<sup>10</sup> A researcher also found that the highest mean birth weight was observed among mothers consuming  $\geq 1000$  mg/d of calcium.<sup>6</sup>

Iron intake was also found to be positively correlated with birth weight in the first ( $r=0.424$ ), second ( $r=0.288$ ) and third ( $r=0.303$ ) trimester. Similarly, Mehta *et al.*, (2004) observed that there was a linear correlation between maternal hemoglobin, serum ferritin and the infant's birth weight and birth length. The highest level of iron supplementation had the heaviest and tallest infant.<sup>11</sup> Khoushaabi *et al.*, (2010) also showed that the high intake of calcium and iron significantly influenced the birth weight of babies. Pregnant women with higher intake of minerals gave birth to neonates with normal weight, while pregnant women with lower intake gave birth to LBW neonates.<sup>7</sup>

**Table 2: Coefficient correlation of nutrient intake of pregnant women during the first, second, and third trimesters with weight of newborn**

Nutrient intake	Birth weight (Kg)	
	r	P
Calorie intake (Kcal/d)		
1 <sup>st</sup> trimester	0.343	0.01
2 <sup>nd</sup> trimester	0.370	0.01
3 <sup>rd</sup> trimester	0.426	0.01
Protein Intake (g/d)		
1 <sup>st</sup> trimester	0.237	0.01
2 <sup>nd</sup> trimester	0.279	0.01
3 <sup>rd</sup> trimester	0.348	0.01
Calcium intake (mg/d)		
1 <sup>st</sup> trimester	0.276	0.01
2 <sup>nd</sup> trimester	0.355	0.01
3 <sup>rd</sup> trimester	0.421	0.01
Iron intake (mg/d)		
1 <sup>st</sup> trimester	0.424	0.01
2 <sup>nd</sup> trimester	0.288	0.01
3 <sup>rd</sup> trimester	0.303	0.01
Fat intake (g/d)		
1 <sup>st</sup> trimester	0.279	0.01
2 <sup>nd</sup> trimester	0.323	0.01
3 <sup>rd</sup> trimester	0.438	0.01
Folic acid intake (µg/d)		
1 <sup>st</sup> trimester	0.256	0.01
2 <sup>nd</sup> trimester	0.228	0.01
3 <sup>rd</sup> trimester	0.192	0.01

A follow-up study also revealed that the iron intake was  $12.8\pm 3.1$  mg,  $14.7\pm 5.1$  mg and  $15.3\pm 5.0$  mg in the low, normal and high birth weight groups respectively, and significantly higher in the high birth weight group than the low birth weight group ( $P<0.05$ ).<sup>12</sup>

Essential fatty acids are crucial to fetal development, particularly for membranes and the brain.<sup>13</sup> In this study, fat consumption was found to be positively correlated with birth weight in the first ( $r=0.279$ ), second ( $r=0.323$ ) and third ( $r=0.438$ ) trimester. Similarly, Muthayya, *et al.*, (2009) found increases between 100 and 200 g in birth weight between the lowest and highest fish/Docosahexaenoic acid intake groups. Women who did not eat fish during the third trimester had a significantly higher risk of giving birth to LBW infants (OR: 2.49,  $P=0.019$ ). Similarly, low Eicosapentaenoic Acid intake during the third trimester had an association with a higher risk of giving birth to LBW infants (OR: 2.75,  $P=0.011$ ).<sup>14</sup> Olsen *et al.*, (1992), have also shown that fish oil consumption increases birth weight.<sup>15</sup>

Folic acid intake in all trimesters was also found to be positively correlated with birth weight ( $r=0.256, 0.228, 0.192$  in the first, second, and third trimester respectively). Similarly, Scholl *et al.*, (1996) reported that low folate intake ( $<240$  µg/d) was associated with a >threefold increase in the risk of giving birth to LBW infant and of preterm delivery.<sup>16,17</sup>

**Table 3: Combination of factors that best predict birth weight of newborn**

Nutrient intake	Contribution to the explained variance r <sup>2</sup>	$\beta$	t	P value
(Constant)	1.642	–	14.259	0.000
Calorie intake				
1 <sup>st</sup> trimester	2.150E-5	0.014	0.102	0.919
2 <sup>nd</sup> trimester	0.001	0.799	3.305	0.001
3 <sup>rd</sup> trimester	-4.792E-6	-0.004	-0.021	0.983
Protein intake				
1 <sup>st</sup> trimester	-0.003	-0.065	-0.661	0.509
2 <sup>nd</sup> trimester	-0.014	-0.385	-2.771	0.006
3 <sup>rd</sup> trimester	-0.002	-0.044	-0.330	0.742
Calcium intake				
1 <sup>st</sup> trimester	0.000	0.079	0.961	0.337
2 <sup>nd</sup> trimester	0.000	-0.188	-1.206	0.229
3 <sup>rd</sup> trimester	5.006E-5	0.036	0.325	0.745
Iron intake				0.002
1 <sup>st</sup> trimester	0.032	0.256	3.175	
2 <sup>nd</sup> trimester	-0.025	-0.172	-1.683	.094
3 <sup>rd</sup> trimester	0.010	0.122	1.556	.121
Fat intake				
1 <sup>st</sup> trimester	0.000	-0.008	-0.085	.933
2 <sup>nd</sup> trimester	-0.005	-0.152	-1.034	0.302
3 <sup>rd</sup> trimester	0.009	0.265	2.583	0.010
Folic acid intake				
1 <sup>st</sup> trimester	0.001	0.098	1.704	0.090
2 <sup>nd</sup> trimester	0.001	0.095	1.579	0.116
3 <sup>rd</sup> trimester	-9.191E-5	-0.014	-0.204	0.839
Total R <sup>2</sup>	0.337			

Table 3 shows the association between the birth weight of a newborn (dependent variable) and nutrient intake during pregnancy in all trimesters. Calorie intake during the second trimester ( $P=0.001$ ), protein intake in the second trimester ( $P<0.05$ ), iron consumption during the first trimester ( $P<0.05$ ) and fat intake in the third trimester ( $P=0.01$ ) had a strong association with the birth weight of the newborn. Other variables such as calorie intake (first, third trimester), protein intake (first, third trimester), calcium intake (first, second and third trimester), iron intake (second and third trimester), fat intake (first, second trimester), and folic acid intake (first, second and third trimester) did not show association with the birth weight of the newborns.

## CONCLUSION

The present study clearly reflects the association between dietary intake and the weight of newborn. It was also found that the nutrient intake of the respondents was lower as compared to RDA. Thus, if mothers maintain their daily dietary intake as per the RDA for their activity, the incidence of low birth weight can be reduced significantly. To improve the nutritional status of pregnant women, prenatal programs need to focus on identifying and counseling pregnant women on appropriate care and nutrition, including breast-feeding, tetanus toxoid

immunization, iron-folate supplementation and referral of high risk pregnancies. More emphasis is needed on the quality of nutrition and behavior changes of pregnant women. Efforts are needed to identify undernourished women and begin supplementation as early as possible during pregnancy. This is because food supplementation programs may have a significant beneficial effect on the weight of the newborn among women who are genuinely at risk as a result of an inadequate diet. Dietary intervention or education should be provided at national and regional levels for pregnant women to bridge the food gap.

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