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Association Between Maternal Nutrition Status and Birth Weight of Neonates in Selected Hospitals in Mysore City, India

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Abstract: A cross sectional study designed to measure the nutritional status of women in the third trimester of pregnancy and to relate the birth weight of neonate as outcome of pregnancy. Participants comprised of 500 pregnant women in the age group 18-40 years who represented 7.5% of population. Mean height, weight, fundal height and haemoglobin of pregnant women were 155.6 cm, 59.5 kg, 34.0 cm and 10.6 g/dl respectively. Computation of nutrient intakes (based on 24 h recall method) showed that the mean intake of energy was 1785.0 kcal, protein 56.2, calcium 775.6 mg, iron 17.9 mg, zinc 8.5 mg and magnesium 482.3 mg. Percent adequacy of nutrient intake with reference to recommended allowances showed that only magnesium was adequate but other nutrients mentioned above were inadequate. The mean birth weight of neonates was 2.9 kg. Height, head and chest circumferences were 48.5, 33.6 and 32.3 cm respectively. Twenty five percent of neonates considered as low birth weight. Statistical analysis indicated that male neonates were heavier, taller and their head and chest circumferences were higher than female. Maternal height, weight, fundal height and haemoglobin level were significantly correlated with birth weight. Nutrient intakes, namely energy, protein, calcium, magnesium, iron and zinc in the third trimester were significantly correlated with birth weight. Using binary logistic regression analysis weight, fundal height, energy and protein intake of pregnant women could be considered as predictor factors for birth weight. It is suggested that consumption of enough nutrients should be emphasized in the nutrition education component of maternal health programmes.

Key words: Maternal nutrition status, birth weight, neonates, Mysore city, India

INTRODUCTION

It is a universally acknowledged medical truth that adequate nutrition before and during pregnancy has greater potential for a long term health of both mother and the child and it is important during the course of pregnancy (Singh *et al*., 2009). A woman who has been well nourished before conception begins her pregnancy with reserves of several nutrients so that the recurrent needs of the growing foetus can be met without adversely affecting her health. Infants, who have been well nourished in the womb, have an enhanced chance of entering life in very good health. Mother's diet should provide adequate nutrients so that maternal stores do not get depleted (Singh *et al*., 2009). The crucial recommendation to such pregnant women in India is to consume a balanced diet as described by the Indian Council of Medical Research (ICMR) which includes extra nutrients for pregnancy, lactation and childhood. Poor foetal growth has been attributed to widespread maternal under-nutrition. Maternal nutrition is an important factor responsible not only for health of baby, but also for the baby's long term growth (Jackson and Robinson, 2001). Therefore understanding maternal nutrition and foetal growth relationship is critical (Rao *et al*., 2001; Rao *et al*., 2007; Kramer, 2003). Assessment of maternal nutritional status relies on measure of pre-pregnancy weight and weight gain during pregnancy, weight gain at different trimesters, Height and skinfold thickness and limb circumferences. Some measures reflect a women's nutritional status or energy stores as she enters pregnancy (Nahar *et al*., 2007) and literature reviewed showed maternal height, weight and pregnancy weight gain has effect on birth weight. Birth weight is an important determinant of newborn survival, healthy growth and development. As mentioned above birth weight is an index of mother's health and nutritional status during pregnancy and a positive correlation is reported between the quality of maternal diet and birth weight of infant (Mirdula *et al*., 2003).

Birth weight of neonates is also affected by factors such as age, occupation, family income, pregnant experience and morning sickness (Bang and Lee, 2009; Freisling *et al*., 2006; Laria *et al*., 2006). In India, poor foetal growth has been attributed to widespread maternal under nutrition (Rao *et al*., 2001). Presently, about 22% of the babies born in India are low birth weight (less than 2.5 kg) (Kapil, 2009). This figure has remained more or less stationary for the last few decades in spite of striking declines in neonatal and infant mortality. Low birth weight in India has been attributed to widespread

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maternal under nutrition. Therefore understanding maternal nutrition and foetal growth relationship is critical. Various maternal anthropometric criteria (pre-pregnancy weight, height weight gain during pregnancy period have been significantly associated with intrauterine growth and prematurity. These parameters should be viewed as "predictors" of Low Birth Weight (LBW) to be used for risk detection (Sachdev, 2001). Studies on the nutritional status of pregnant women in Mysore are very few and the relationship between maternal nutritional status and birth weight of infants demands further attention. Therefore this study was designed to measure the maternal nutritional status of expectant women in the third trimester of pregnancy and to relate the birth weight as the outcome of nutritional status of pregnancy.

MATERIALS AND METHODS

A survey of the hospitals existing in Mysore city was done to identify the hospitals to select the subjects. Four hospitals among 20 hospitals in Mysore city namely, Chaluvamba Hospital (KR. Hospital), Basapa Memorial Hospital (BM. Hospital), Kamakshi Hospital and Apollo Hospital were selected based on their acceptance and willingness to extend support for the study. With the help of a statistician and based on statistics of deliveries per year in each hospitals, 7.5% of pregnant women were selected to represent the target population i.e., pregnant women. Total pregnant women included for the study was as follow; BM. Hospital 60, Apollo Hospital 80, Kamakshi Hospital 110 and KR. Hospital 250 to represent different section of social economic status. All the 500 participants were healthy, between 18-40 years of age and had continuously the selected hospital visited for the three trimesters and registered for delivery and followed up for a week after delivery. The inclusive criteria were age group (18-40 years) and who continuously visited for health care during the three trimesters of pregnancy in selected hospitals. The pregnant women with diabetes mellitus and Cardio Vascular Disease (CVD) and the pregnant women who had parity more than four were excluded from the study. The study was carried out from November 2007 to August 2008.

A written consent to participate in the study was obtained from each subject. The study was approved by the Human Ethical Committee of the University of Mysore. The required information about various aspects proposed to study was obtained by structured questionnaires. Suitable questionnaires were constructed in the Department of Food Science and Nutrition, Manasaganghotri, University of Mysore, India and pre-tested in with small population (pilot study) and suitable modifications were introduced so as to obtain standard questioners.

Anthropometric measurements namely height and weight were carried out by investigator using standard methodology as described by Jelliffee (1966). The measurements were made on the participants wearing a minimum amount of clothing. The weight of pregnant women was recorded at the time of registration by using digital weighing balance to the nearest 100 g (Calibrated after every 10 measurements). Height was measured using a locally made stadiometer. The pregnant women was asked to maintain an upright and erect posture with her feet together and the back of her heels touching the pole anthropometer the horizontal headpiece was lowered onto the women's head and the measurements was taken to the nearest 0.1 cm. Fundal height was measured by a physician as distance between the symphysis pubis and the highest point of the uterine fundus, defined with a gentle pressure on a plain at right angle of the abdominal wall and was marked.

The dietary assessment of pregnant women was done at the end of the third trimester, by investigator and nutrient intake was obtained using 24-h dietary recall method. Probing questions were used to help the subjects to remember all foods and drinks consumed on previous day. Questions were extended to methods of food preparation, portion sizes, as well as to approximate sizes of meals. Standard cups were used to measure the quantity of intake of the cooked food (Thimmayamma and Parvathi, 1996). The information about the quantity of raw material (raw quantity) taken for cooking as well as the cooked food by the subject was recorded in terms of household measures/number/kg to find out the quantum of raw food intake. From the information provided, the cooked and raw amount of foods consumed by each subject was then calculated. The mean intake of different nutrients consumed was then computed for a day the help of ready recknor to calculate nutritive value. The ready recknor was developed by Department of Food Science and Nutrition, Manasa ganghotri, University of Mysore, using nutritive value given in food composition table from Indian Council and Medical Research (ICMR, 1998). Nutrient adequacy was calculated using nutrient intake data and compared with recent ICMR recommendation (National Institute of Nutrition, 2009).

The haemoglobin value of each subject was taken from clinical records, when the subjects were hospitalized for child birth. It was analyzed in laboratory hospital by cyanmetheamoglobin Method (WHO, 1998).

Anthropometric measurements of neonates (weight, height, head and chest circumferences) were taken within 24 h after birth, using standard procedure (Jelliffee, 1966). A beam balance by which accuracy of 50 g was employed for weighing the infants. Infants were weighted, with minimum clothing, when the child was restful. Infantometers were used for measuring the recumbent length of newborn infant. A lightweight fibreglass infantometer was used to measure length up to 100 cms. Infants were laid on the board of the infantometer, which was kept on flat table. The crown of the head was in contact with the top end of the device. The knee was extended, so that the feet were at right

angles to the leg. The mobile device was then brought in contact with the feet of neonate and was allowed to be in contact with the device at the bottom end of the board. The distance between the two right angle devices was measured. The reading was recorded in centimetres with accuracy of 0.1 cms. The infant's head was steadied and the greatest circumference measured, by placing the fibreglass tape firmly round the frontal bones, just superior to the supra-orbital ridges, passing it round the head at the same level, on each side and laying it over the maximum occipital prominence at the back. The infant's chest circumference measurement was made at the nipple line, when the child was calm and breathing normally. The fibreglass tape was used for measuring the chest circumference.

The statistical analysis of data was conducted using SPSS version 11.5 (SPSS Inc., Chicago, Illinois). Descriptive statistic was used for summarization of data. The statistical difference among the groups were analyzed by student's t-test and one-way ANOVA. When the one-way ANOVA results were significant, the Bonferroni test was used to determine whether significant difference exist between different variable means. Binary logistic regression analysis was carried out to find out the 'independent' relationship of variables, which were found significant in the bivariate analysis with birth weight of neonates. Results were considered significant if $p<0.05$.

RESULTS

Details of all selected pregnant women under examination are presented in Table 1. The mean age of pregnant women was 24±4.2 years and the age range was 18-40 years. Majority (29%) of pregnant women were in age group 21-23 years and followed by 18-20 years. Highest percentage of subjects (54%) had married at the age of 18-20 years. Ninety two percent of subjects were not employed. Highest percentage of subjects (62%) were expecting first child. Forty six percent of pregnant women had higher secondary level of education, followed by graduation level. Majority (48%) of subjects had income of Rupees 5000-10000 per month; other details of the subjects are given in Table 1. Anthropometric measurements, fundal height and haemoglobin of pregnant women at the end of the third trimester are presented in Table 2. The mean height, weight, fundal height and haemoglobin were, 155.6 (cm), 59.5 (kg), 34 (cm) and 10.6 (g/dl) respectively.

Energy and nutrient intake per day of pregnant women and percent adequacy of nutrient intake with reference to ICMR recommendation (National Institute of Nutrition, 2009) were computed and are presented in Table 3. As shown in the Table, consumption of energy and protein per day were 69 and 68% respectively and they were not adequate. Among minerals magnesium intake was adequate and others like calcium, iron and zinc were inadequate.

Table 1: General information about pregnant women (n = 500)

Variables	Number
Age (year)[a]	24.0±4.2
Age group (year)[b]	
18-20	140(28)
21-23	144(29)
24-26	111(22)
27 and above	105(21)
Age at marriage	
18-20	272(54)
21-24	212(43)
25-29	16(3)
Occupation	
Non employed	462(92)
Employed	38(8)
Parity (Number of pregnancy)	
1	312(62)
2	157(31)
3-4	31(7)
Education level	
Illiterate	23(5)
Primary	66(13)
Higher and secondary	232(46)
Graduation	179(36)
Total income of family in Rs[†]. (month)	
<5000	127(25)
5000-10000	239(48)
>10000	134(27)

[a]Mean±SD; [b]Number (%); [†]Rupees (Indian currency)
[1 Euroe equal Rs. 56 and 1 USDA equal Rs. 46]

Table 2: Anthropometric, fundal height and haemoglobin measurements of pregnant women (n = 500)

Parameters	Mean±SD
Height (cm)	155.6±5.1
Weight (kg)	59.5±5.9
Fundal height (cm)	34.0±2.2
Haemoglobin (g/dl)	10.6±1.4

Table 3: Energy and nutrients intake (per day) of pregnant women with reference to RDA (ICMR, 2009) (n = 500)

Energy and nutrients	Mean±SD	RDA	Percent adequacy
Energy (kcal)	1785.0±374.0	2590	69
Protein (g)	56.2±15.5	82	68
Calcium (mg)	775.6±297.9	1200	65
Magnesium (mg)	482.3±169.4	320	151
Iron (mg)	17.9±5.5	38	47
Zinc (mg)	8.5±2.3	12	71

Table 4: Neonate information (n = 500)

Birth weight	% (N)
Normal birth weight (2.5 kg-3.5 kg)	75(377)
Male	44(221)
Female	31(156)
Low birth weight (less than 2.5 kg)	25(123)
Male	12(58)
Female	13(65)

General information about neonates is given in Table 4. Majority (75%) of them had normal birth weight and considerable percentage (25%) belonged to Low Birth Weight (LBW). Fifty six percent of neonates were male and forty four percent of them were females. Other details like weight, height, head and chest circumferences of neonates were 2.9 (kg), 48.5 (cm),

Table 5: Anthropometric measurements of neonates (n = 500)

Parameters	Mean±SD	Male (Mean±SD)	Female (Mean±SD)	t-test results	p-value
Weight (kg)	2.9±0.5	3.0±0.5	2.8±0.5	2.7	0.015
Height (cm)	48.5±2.0	48.8±2.0	48.2±2.0	3.6	0.001
Head circumference (cm)	33.6±1.1	33.8±1.0	33.4±1.1	4.0	0.001
Chest circumference (cm)	32.3±1.8	32.5±1.9	32.0±1.6	2.9	0.004

Table 6: LBW and NBW of neonates: Nutritional status of pregnant women (Third trimester, n = 500)

Parameter	LBW (kg)	NBW (kg)	t-test results	p-value
Weight (kg)	54.4±4.3	61.2±5.3	14.1	0.001
Height (cm)	154.0±4.4	156.2±5.2	12.8	0.001
Fundal height (cm)	32.7±2.4	34.5±1.9	7.4	0.001
Haemoglobin (g/dl)	10.0±1.4	10.8±1.3	6.3	0.001
Energy (kcal/day)	1363.0±201.3	1922.0±309.8	23.1	0.001
Protein (g/day)	42.0±6.9	60.8±14.7	19.1	0.001
Calcium (mg/day)	642.4±251.0	819.1±299.5	6.4	0.001
Magnesium (mg/day)	337.6±122.3	529.5±155.3	12.5	0.001
Iron (mg/day)	13.8±4.39	19.3±5.3	11.5	0.001
Zinc (mg/day)	6.6±1.7	9.2±2.1	13.4	0.001

33.6 (cm) and 32.3 (cm) respectively (Table 5). Details about difference between anthropometric measurements based on gender of neonates are given in Table 5. Mean anthropometric measurements of neonates according gender groups indicated that, the mean weight of male neonates was 3.2 kg vs. 2.9 kg in female neonates. Mean height, head and chest circumferences in male neonates versus female were 51.3 cm vs. 49.7 cm, 34.7 cm vs. 33.9 cm and 33.0 cm vs. 32.6 cm respectively. As clear in the Table 5 male neonates were heavier, taller and their head and chest circumferences were higher than female.

DISCUSSION

As clear in the Table 3 consumption of nutrient intake showed inadequate percentage intake of energy, protein, calcium, zinc and iron with reference to ICMR recommendation (National Institute of Nutrition, 2009). The findings of the present study was similar with other study that were conducted in different socioeconomic status of urban and rural areas in India (Shihareni and Lakshmi, 2001; Kharade and Antony, 2002; Pathak *et al*., 2003; Chaturvedi *et al*.,1994; Panwar and Punia, 1998; Kapil *et al*., 1999). The results of their study showed that the mean energy and nutrients intake (protein, calcium, iron, zinc) were inadequately consumed by the subjects when compared with RDA recommendation.

Birth weight is the most sensitive and reliable indicator of health of neonates. It is strongly associated with the health and survival of infant. Mean birth weight of neonates was 2.9 kg. LBW is an indicator of poor health of the neonates. Considerable percentage of neonates (25%) was classified as LBW and 75% showed NBW (Normal Birth Weight). Similar results in Mysore hospitals were reported by Raman *et al*. (2001) and Shobiri and Nazari (2006) which revealed that 25% and 21% of neonates were LBW babies respectively. Percentage LBW in female neonates was slightly higher than males neonates (12% vs 13% respectively, Table 4). Comparison of the two groups (male and female neonates, Table 5) indicated that male neonates showed significantly higher height, weight, head and chest circumferences than females. Similar findings were also reported by Som *et al*. (2004) from India, Kato, (2004) from Japan and Moore *et al*., (2004) from Australia, Their finding indicated that male neonates were heavier than female neonates.

An attempt was made to investigate the relationship between anthropometric measurements, fundal height and haemoglobin status of pregnant women and birth weight of neonates. As a first exercise to find out association with birth weight and nutritional status of pregnant women, birth weight of neonates was classified into two categories LBW and NBW and subjected to student's t-test and results are presented in Table 6. As shown in the Table pregnant women who gave birth to LBW babies were significantly lower in height, weight, fundal height and haemoglobin level than women who gave birth to neonates with normal birth weight. It was also observed that pregnant women who gave birth to normal neonates had significantly higher consumption of energy and nutrients than pregnant women who gave birth to neonates with LBW babies. Similar results are reported by Rao *et al*. (2007) from India and Al-Shosan (2007) from Saudi Arabia.

It was interesting to analyze the results of different categories of height, weight, fundal height, haemoglobin level, energy and nutrient intake of pregnant women with reference to variations in birth weight of neonates. The data was subjected to one-way ANOVA and the findings are presented in Table 7. It is clear from Table that the taller pregnant women (more than 160 cm) gave birth to significantly heavier babies (3.1 kg) than shorter women. Pregnant women with weight less than 50 kg gave birth

Table 7: Nutritional status (level) of pregnant women vs. Birth weight of neonates (n = 500)

Parameters	Mean birth weight	F-value	p-value
Height (cm)			
<150.0	2.8[a]		
150.0-160.0	2.9[a]	13.6	0.001
>160.0	3.1[b]		
Weight (kg)			
<50.0	2.3[a]		
50.0-54.9	2.5[b]	61.6	0.001
55.0-59.9	2.8[c]		
60.0-64.9	3.0[d]		
Fundal height (cm)			
28.0-30.0	2.5[a]		
31.0-33.0	2.8[b]	24.3	0.001
34.0-36.0	3.0[c]		
Hemoglobin (g/dl)			
<9.0	2.7[a]		
9.0-9.9	2.7[a]		
10.0-10.9	2.8[a]	17.8	0.001
≥11.0	3.1[b]		
Energy intake (kcal)			
>1500.0	2.3[a]		
1500.0-1999.9	3.0[b]		
2000.0-2499.9	3.2[c]	177.1	0.001
≥2500.0	3.5[d]		
Protein intake (g)			
<40.0	2.2[a]		
40.0-49.9	2.5[b]		
50.0-59.0	3.0[c]	154.5	0.001
≥60.0	3.0[c]		
Calcium intake (mg)			
<800.0	2.8[a]		
800.0-1200.0	3.1[b]	26.0	0.001
>1200.0	3.2[b]		
Magnesium intake (mg)			
<280.0	2.7[a]		
280.0-320.0	2.8[a]	78.2	0.001
>320.0	3.0[b]		
Iron intake (mg)			
<19.0	2.8[a]		
19.0-29.0	3.1[b]	37.6	0.001
>29.0	3.2[b]		
Zinc intake (mg)			
<9.0	2.7[a]		
9.0-12.0	3.2[b]	47.6	0.001
>12.0	3.2[b]		

Note: Different superscript indicate significant difference at 5% level as shown by post hoc Bonferroni

to neonates with 2.3 kg, while subjects with more than 65 kg gave birth to heavier neonates (3.3 kg). Studies conducted by Fawzi *et al.* (1997) from North Africa and Parvathi and Khyrunnisa Begum from India (2007) reported maternal height and weight at 6 and 9 month of pregnancy was positively associated with mean birth weight and length of neonates ($p<0.001$) and their finding supported present findings. Higher level of fundal height in pregnant women (28-36 cm) at the end of the third trimester, showed significant increase in birth weight of neonates born to them. Shobiri and Nazari (2006), Parvathi and Khyrunnisa Begum (2007) reported similar results. It is revealed from the Table 7 pregnant women with haemoglobin more than 11 g/dl, which is considered as normal level gave birth to neonates with normal weight, while pregnant women with lower haemoglobin level (<11 g/dl), who were considered as anaemic gave birth to low birth weight babies. Shoberi *et al.* (2006) in their study also indicated the importance of normal haemoglobin level on pregnancy outcome and their results was agree with current findings. Their finding showed normal concentration of haemoglobin have a significant influence on birth weight. Effect of different level of haemoglobin also reported by Rosenberg *et al.* (2004) from China, their finding also showed that both mild and moderate anaemia (95 = Hb<120 g/L and Hb <95 g/L respectively) were significantly associated with lower birth weight.

Maternal nutrition has been recognized for its important in the course and outcome of pregnancy. Young (1976) has suggested that nutritional factors may account for 60% of the observed variations in birth weight. Variations in the energy intake of pregnant women showed significant influence on birth weight of babies. It is evident from the Table 7, pregnant women who consumed <1500 kcal per day (<59%RDA) gave birth to neonates with LBW (2.3 kg), while pregnant women with ≥2500 kcal per day (≥96% RDA) of energy per day gave birth to neonates with NBW (3.5 kg). Pregnant women with protein intake <40 g per day (<49% RDA) gave birth weight to neonates LBW (2.2 kg) while pregnant women with higher intake of protein (≥60 g/day or 73%RDA) gave birth to neonates with NBW (3.3 kg). Similar results with regard to protein and energy intake were reported by Al-Shosan (2007) and Rao *et al.* (2007). The finding showed high intake of calcium, magnesium, iron and zinc significantly influenced the birth weight of babies. As it clear from the Table 7 pregnant women with higher intake of minerals gave birth to neonates with normal weight, while pregnant women with lower intake gave birth to neonates low birth weight. It may be stated from this finding that different levels of nutritional status of pregnant women significantly influenced the birth weight of neonates.

It was interesting to find out which nutritional factors were very important in influencing birth weight of neonates. The binary logistic regression was carried out to find out the possible factors associated with birth weight (results are presented in Table 8). Weight, fundal height of pregnant women along with energy and protein intake could be considered as primary predictor factors for birth weight. In a study conducted by Rao *et al.* (2007) in the rural areas of district Ambala, Haryana, energy intake and mother's weight were best predicting factors for birth weight where as in Saudi Arabia Al-Shosan (2007) reported that caloric intake was the best indicator for birth weight. Moore *et al.* (2004) in South Australia reported caloric deficit in the third trimester and low maternal anthropometric measurements are associated

Table 8: Summary of results of binary logistic regression

Variables (pregnant women)	B	SE	Wald	Sig	95.0% C.I. for EXP(B) Lower	Upper
Weight (kg)	0.079	0.035	4.937	0.026	1.009	1.159
Fundal height (cm)	0.079	0.075	10.008	0.002	1.095	1.472
Energy (kcal/day)	0.005	0.001	29.104	0.001	1.003	1.007
Protein (g/day)	0.058	0.027	4.655	0.031	1.005	1.118

a Variable(s) entered on step 1: Height, Weight, Fundal height, Hemoglobin, Energy intake, Protein intake, Calcium intake, Magnesium intake, Iron intake, Zinc intake

with high percentage of LBW. The findings reported by Rao *et al.* (2007); Al-Shosan (2007) and Moore *et al.* (2004) are similar with present findings.

To conclude, maternal nutritional status influenced birth weight of neonates. Adequate nutrient intake especially dietary energy, protein, calcium intake are important for pregnancy outcome. Weight, fundal height and energy and protein intake of pregnant women could be considered as predictor factors for birth weight. The findings of the study indicate that male neonates were heavier, taller and their head and chest circumferences were higher than female neonates. Further studies with large sample size may have to be conducted to throw light on various aspects of nutritional factors and their association with birth weight of neonates.

The limitation of the present study was that haemoglobin measurements could have been done by investigator and sample size at higher number (i.e., 658 pregnant women) could have been taken to cover 10% of the respective population.

It may be recommended from the present study that the government and non government agencies should focus on the effective implementation of program to improve the dietary intake of pregnant women to optimize their health and that of to improve the health condition of neonates.

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REFERENCES

Al-Shosan, A., 2007. Diet history and birth weight relationship among Saudi pregnant women. Pak. J. Med. Sci., 23: 176-181.

Bang, S.W. and S.S. Lee, 2009. The factors affecting pregnancy outcomes in the second trimester pregnant women. Nutr. Res. Prac., 3: 134-140.

Chaturvedi, S., U. Kapil, T. Bahanthi, N. Gnansekara and R.M. Pandey, 1994. Nutritional status of married adolescent girl in rural Rajasthan. Ind. J. Pediat., 61: 695-701.

Fawzi, W.W., M.R. Forman, A. Levy, B.I. Graubard, L. Naggan and H.W. Berendes, 1997. Maternal anthropometry and infant feeding practices in Israel in relation to growth in infancy: The North African infant feeding study. Am. J. Clin. Nutr., 65: 1731-1737.

Freisling, H., I. Elmadfa and T. Gall, 2006. The effect of socioeconomic status on dietary intake, physical activity and Body Mass Index in Austrian pregnant women. J. Hum. Nutr. Diet., 19: 437-445.

ICMR, 1998. Nutrient requirements and recommended dietary allowances for Indians. Indian Council of Medical Research.

Jackson, A.A. and S.M. Robinson, 2001. Dietary guideline for pregnancy. Public. Health. Nutr., 10: 623-630.

Jelliffee, D.B., 1966. The assessment of the nutritional status of community. World Health Organization.

Kapil, U., 2009. Multiple micronutrient supplements will not reduce incidence of low birth weight. Ind. J. Com. Med., 34: 85-86.

Kapil, U., P. Pthak, M. Tandon, C. Sing, R. Pradhan and S.N. Dwivedi, 1999. Micronutrient deficiency disorders amongst pregnant women in three urban slum communities of Delhi. Ind. Pediatr., 36: 983-989.

Kato, N., 2004. Reference birth weight range for multiple birth neonates in Japan. BMC. Preg. Childbirth., 4: 2.

Kharade, P.P. and U. Antony, 2002. Nutritional status and outcome of pregnancy in young and older mothers in Mumbai. Ind. J. Nutr. Diete., 39: 26-30.

Kramer, M.S., 2003. Maternal nutrition and adverse pregnancy outcome: An overview. J. Nutr., 133: 1592S-1596S.

Laria, B.A., A.M. Siega-Riz, C. Gunderson and N. Dole, 2006. Psychosocial factors and socioeconomic indicators are associated with household food insecurity among pregnant women. J. Nutr., 136: 177-182.

Mirdula, A., C.P. Mishra and A. Chakaraverty, 2003. Dietary intake of expectant mother's. Ind. J. Nutr. Diet., 40: 24.

Moore, V.M., M.J. Davies, K.J. Willson, A. Worsley and J.S. Robinson, 2004. Dietary composition of pregnant women is related to size of the baby at birth. J. Nutr., 134: 1820-1826.

Nahar, S., C.G.N. Mascie-Taylor and H. Ara Begum, 2007. Maternal anthropometry as a predictor of birth weight. Pub. Health. Nutr., 10: 965-970.

National Institute of Nutrition, 2009. Pre-Conference Workshop on Assessment of Nutritional Status and Dissemination of New RDA for Indian. 41st National Conference Nutrition Society of India.

Panwar, B. and D. Punia, 1998. Nutrient intake of rural pregnant women of Haryana state, Northern India: Relationship between income and education. Int. J. Food. Sci. Nutr., 49: 391-395.

Parvathi, M. and Khyrunnisa Begum, 2007. Dietary intakes, anthropometric measurements and pregnancy outcome among women from low income family. Ind. J. Nutr. Diet., 44: 484-491.

Pathak, P., U. Kapil, S.K. Kapoor, S.N. Dwivedi and R. Singh, 2003. Magnitude of zinc deficiency among nulliparous nonpregnant women in rural community of Haryana state, India. Food. Nutr. Bull., 24: 368-371.

Raman, G.C.T.R., V. Primala, W.C.M. Bhalla, S.L.V. Venkateshwar and A. Iyengar, 2001. A correlative study of maternal haemoglobin and birth weight, M.J.A.F., I 57: 110-113.

Rao, S., C.S. Yajnik, A. Kanade, C.H. Fall, B.M. Margetts, A.A. Jackson, R. Shier, S. Joshi, S. Rega, H. Lubree and B. Desai, 2001. Intake of micronutrient-rich foods in rural Indian mothers is associated with the size of their babies at birth: Pune maternal nutrition study. J. Nutr., 131: 1217-24.

Rao, B.T., A.K. Aggarwal and R. Kumar, 2007. Dietary intake in third trimester of pregnancy and prevalence of LBW: A community-based study in a rural area of Haryana. Ind. J. Com. Med., 32: 272-276.

Rosenberg, A.G., R.J. Wood, X. Wang, H. Xing, C. Chen, D. Chen, W. Guang, A. Huang, L. Wang and X. Xu, 2004. Preconception haemoglobin and ferritin concentrations are associated with pregnancy outcome in a prospective cohort of Chinese women. J. Nutr., 134: 2586-2591.

Sachdev, H.P., 2001. Low Birth Weight in South Asia. Int. J. Diab. Dev. Countries, 21: 13-33.

Singh, M., S. Jain and M. Choudhary, 2009. Dietary adequacy of pregnant women of four district of Rajasthan. J. Hum. Ecol., 25: 161-165.

Shihareni, D. and U.K. Lakshmi, 2001. Effect of supplementation of Cynodon dactylon (Arugampul) juice/powder on anaemic pregnant women. Ind. J. Nutr. Dietet., 38: 281-291.

Shobiri, F. and M. Nazari, 2006. Symphsis-Fundal height and abdominal circumference measurements as indicators for low birth weight. Mal. J. Nutr., 12: 79-86.

Shoberi, F., Khyrunnisa Begum and M. Nazari, 2006. A prospective study of maternal haemoglobin status of Indian women during pregnancy and pregnancy outcome. Nutr. Res., 26: 209-213.

Som, S., M. Pal, D.K. Adak, A.K. Gharami, S. Bharati and P. Bharati, 2004. Effect of socio-economic and biological variables on birth weight in Madhya Pradesh, India. Mal. J. Nutr., 10: 159-171.

Thimmayamma, B.V.S. and R. Pravathi, 1996. Dietary assessment as part of nutritional status. In: Bamji M.S., Rao, N.P., Reddy, V. (Eds.), Textbook of Human Nutrition. Oxford and IBH Publishing Co. Pvt. Ltd., pp: 125-135.

WHO/UNICEF/UNO, 1998. IDA: Prevention, assessment and control. Report of a WHO/UNICEF/UNO Consultation. Geneva, World Health Organization. Geneva.

Young, M., 1976. The accumulation of protein by the fetus. In: Beard R.W. and Nathanielse, P.W. (Eds.) Fetal physiology and medicine: The Basis of Pernatology., London, pp: 60-78.