

Nutrient Intakes of Pregnant Women in Comparison to the Reference Intake

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Abstract: Pregnant women with poor nutritional status have an increased risk of birth outcomes. Nutritional assessment is an effective method of preventing potential complications in pregnant women. To assess and compare the dietary intake of nutrients and energy in pregnant women from antenatal care units of Peshawar. A Cross sectional study was carried out in Lady Reading hospital (Govt) and Alkhidmat (Private) hospital Peshawar for a period of three months. A total of 198 Pregnant Women (PW), 66 from each trimester were selected. The sub groups of PW in each trimester were ≤ 18 (n = 12), 19-30 (n = 151) and ≥ 31 (n = 35) years. Data about the socioeconomic status, educational status and food intake were collected by structured questionnaire. Nutrients were calculated using food composition tables. Percent adequacy for each nutrient was calculated. The nutrients were calculated from actual ingredients used for dish preparation and the quantity of food consumed by the pregnant women. The energy and protein intake of all PW were higher than RDA except belonging to 1st trimester. Intake level of Fe, Ca, Zn were below except age group ≥ 31 yrs (2nd trimester) in which Fe intake was 5.1%, The Mg and P intakes were higher except age group ≤ 18 (1st trimester) which was -11%. Intake of vitamin B12 and folate were below while intake of vitamin C was above the RDA except for age group ≤ 18 years (2nd and 3rd trimesters) which were -12.7 and -28.4%, respectively. Micronutrients were deficient in the diet of PW from both low and high income groups when compared with Recommended Dietary Allowances (RDA).

Key words: Dietary intake, nutrient intake, assessment, pregnant women

INTRODUCTION

Pregnancy is a critical period during which good maternal nutrition is a key factor influencing the health of both child and mother (Kaiser and Allen, 2002). Therefore, nutritional status assessment and counseling are considered as an integral component of preconception and prenatal care.

In Pakistan, the status of maternal health is poor. An estimated 30,000 women die each year due to pregnancy related complications and recent estimates show about 500/100,000 live birth. But in reality it may be higher because of under registration of deaths and absence of the causes of death information (WHO, 2007).

The nutritional and demographic surveys, conducted during last few years, indicate extremely poor state of female and child nutrition. National nutrition survey 2002-03 reported a high prevalence of malnutrition in pregnant women with specific deficiencies of protein, energy, iron, iodine and zinc in the diet of pregnant women (National Nutrition Survey, 2002-2003).

Dietary intake patterns and socio economic variables are well known indicators for assessing the nutritional status of a society. The present study was designed to assess and compare the dietary intake of the pregnant women visiting two antenatal care units in district Peshawar.

MATERIALS AND METHODS

This was a cross sectional study conducted in Lady Reading hospital and Alkhidmat hospital Peshawar. The antenatal care units of these hospitals were well equipped with health care facilities.

A random sample of 198 pregnant women (66 from each trimester) was selected. The age of pregnant women was in the range of 18-35 years.

Socio economic status of the women was calculated on the monthly income of the household. Families with a monthly income of Rs<5000 and >5000 Rs were categorized into low and middle income groups respectively.

Data were collected by structured questionnaire which contained information regarding the present age, age at marriage, number of children, educational level, socioeconomic status and number of pregnancies.

Diet survey was conducted by 24 h dietary recall method. This method of dietary assessment was considered to be a good representation of the dietary intake of the large number of Pregnant Women (PW) who participated in this epidemiological study. Subsequently the individual consumption of nutrients like energy, protein, iron, calcium, Mg, P, folate, vitC, Vit. B12 were calculated by using food composition table.

Table 1: Number of pregnant women by their age

Age range (yrs)	Numbers (%)
≤18	12 (6%)
19-30	151 (76%)
≥31	35 (18%)
18-35	198

Table 2: Distribution of pregnant women by educational level, family occupation

	Groups*	Numbers (%)
Educational level	0	87 (44%)
	1	26 (14%)
	2	45 (22%)
	3	22 (11%)
	4	18 (09%)
	Total	198
	Groups**	Numbers (%)
Family occupation	A	51 (25%)
	B	41 (20%)
	C	35 (17%)
	D	71 (35%)
		Total

*Group 0 = No education, Group 1 = Primary, Group 2 = Secondary School Certification (SSC), Group 3 = Higher secondary school certification, Group 4 = Graduation, Group** A = Agricultural workers and labors, Group B = Production and service workers, Group C = Professional and technical administrative workers, Group D = Shopkeeper, drivers

Energy was calculated from protein, fat and carbohydrate using the AtVater Method 4 and is given as:

$$\text{Energy (Kcal)} = \text{Protein} \times 4 + \text{Carbohydrate} \times 4 + \text{Fat} \times 9$$

The adequacy of nutrient intake (% RDA) was calculated by dividing the estimated nutrient intake by Recommended Daily Allowance (RDA) appropriate for that person's age and multiplied by 100 as described (Thimmayamma *et al.*, 1982). Further the nutrients intakes of subjects from low and high-income groups were analyzed for comparison using the student's T-test.

RESULTS

Subjects of the study: A total of 198 individuals participated in the study. Age variation among study participants is given in Table 1. The highest percentage of pregnant women was the one from the age group 19-30 yrs (76%) followed by the age group ≥31 yrs (18%).

Educational level and socio economic status: Educational status of women was poor, as 44% of women were illiterate (Table 2). Mostly pregnant women belonged to low socio-economic status. It was suggested that low socio economic status negatively influence the dietary intake and nutritional well being of the pregnant women and therefore, malnutrition is a common feature among low income rural pregnant women.

Nutrients intake: Table shows the mean (SD) nutrients intake, their RDA, % intake over (+) or below (-) the RDAs and the frequency distribution according to % RDA. The RDAs were adapted from the WHO/FAO/IAEA recommendations.

Nutrient intake in first trimester: The mean intake of nutrients by pregnant women in first trimester is presented in Table 3. The highest energy intake was observed in ≤18 year, which was 2795±946 kcal. The mean protein intakes in PW were 69±10 g (≤18 yrs), 70.5±20.5 g (19-30 yrs) and 70.1±21.8 g (≥31 yrs). The mean iron intake in the PW of ≤18, 19-30 and ≥31 years were 22±8, 21.1±5.6 and 24.3±11.9 mg/day. The mean calcium intakes in PW were 397±135, 436±192 and 570±320 mg/day, respectively. The intake of zinc was 6.4±0.9, 7.2±2.3 and 7.8±2.3 mg/day, respectively. The intakes of Magnesium were 627±354, 547±133 and 597±144 mg/day, respectively. The intake of phosphorus by the PW was 1106±254, 1098±324 and 1250±509. The intake of folate was 195±154, 217±123 and 229±176 µg/day, respectively. The intake of vitamin C was 188±141, 130.8±106.6 and 196.1±97.6 mg/day, respectively. Intakes of vitamin B12 were 0.5±0.4, 0.7±0.6 and 0.5±0.4 mg/day, respectively.

Percent distribution of Pregnant Women (PW) according to % RDA for different nutrients in first trimester: Table 4 shows the percent distribution of PW belonging to first trimester according to % RDA. The highest % of PW for energy and protein intake was mostly found in the range of ≥100% of RDA except that the highest percentage of PW for protein intake was found in age group ≤18 yrs (i.e. among the range of 76-99%). The highest percentages of PW for most of the minerals were found to be below 76% of RDA. The % of PW for iron intake was higher as in 50-75% RDA (age group 19-30 and ≥31 yrs) while the highest frequency of group ≤18 yrs was found in the range of 76-99% RDA. Frequency of PW for the intakes of calcium and zinc were found to be higher in <76% of RDA while the frequency for the magnesium and phosphorus intake were mostly in ≥100%. The highest % of PW for folate and vitamin B12 intake was higher in ≤50% of RDA, however the % for vitamin C intake was found to be higher in ≥100% of RDA.

Nutrients intake in second trimester: Table 5 shows the mean energy intake of the PW was 2900±271, 2829±554 and 2855±489 kcal/day, respectively. The mean intakes of protein in PW of the second trimester were 91.7±18.9, 76.4±20.7 and 77.1±21.2 g/day, respectively. The mean iron intakes in the PW of the three age groups were 21.6±4.2, 24.6±6.5 and 28.4±9.6 mg/day,

Table 3: Nutrient intake level of pregnant women in first trimester in comparison with reference intake

Nutrients	≤18 yrs (n = 4) % of RDA			19-30 yrs (n = 53) % of RDA			≥31 yrs (n = 9) % of RDA		
	AI	RI (a)	RV	AI	RI (a)	RV	AI	RI (a)	RV
Protein (g)	69±10	71	-3.0	70.5±20.5	71	-0.7	70.1±21.8	71	-1.3
Energy (kcal)	2795±946	2500	9.1	2489±624	2500	-0.4	2710±685	2500	8.0
Iron (mg)	22±8	27	-18.5	21.1±5.6	27	-21.8	24.3±11.9	27	-10.1
Calcium (mg)	397±135	1300	-69.0	436±192	1000	-56.0	570±320	1000	-43.0
Zinc (mg)	6.4±0.9	13	-51.9	7.2±2.3	11	-33.9	7.8±2.3	11	-29.4
Mg (mg)	627±354	400	56.8	547±133	350	56.0	597±144	360	66.0
Phosphorus (mg)	1106±254	1250	-11.0	1098±324	700	57.0	1250±509	700	79.0
Folate (µg)	195±154	600	-68.0	217±123	600	-64.0	229±176	600	-62.0
Vit. C (mg)	188±141	80	135.0	130.8±106.6	85	53.8	196.1±97.6	85	130.7
Vit. B12 (mg)	0.5±0.4	2.6	-82.5	0.7±0.6	2.6	-74.3	0.5±0.4	2.6	-79.9

AI = Actual Intake, RI (a) = Reference Intake (a), RV = % More or less (-) over reference value

Table 4: Percent distribution of pregnant women according to % RDA for nutrients in first trimester

Nutrients	≤18 yrs (n = 4) % of RDA				19-30 yrs (n = 53) % of RDA				≥31 yrs (n = 9) % of RDA			
	≤50%	50-75%	76-99%	≥100%	≤50%	50-75%	76-99%	≥100%	≤50%	50-75%	76-99%	≥100%
Energy	-	25	-	75	2	19	32	47	-	22	11	67
Protein	-	-	75	25	2	23	23	53	-	22	22	56
Fe	25	-	50	25	4	51	26	19	11	44	22	22
Ca	75	25	-	-	79	19	-	2	67	11	11	11
Zn	25	75	-	-	25	43	25	8	22	33	33	11
Mg	-	25	-	75	-	2	6	92	-	-	-	100
P	-	-	25	75	-	6	23	72	-	-	11	89
Folate	75	25	-	-	75	21	4	-	67	22	-	11
Vit. C	-	25	-	75	-	32	23	45	-	22	-	78
Vit. B12	100	-	-	-	87	13	4	-	100	-	-	-

Table 5: Nutrient intake level of pregnant women in second trimester in comparison with reference intake

Nutrients	≤18 yrs (n = 4) % of RDA			19-30 yrs (n = 49) % of RDA			≥31 yrs (n = 13) % of RDA		
	AI	RI (a)	RV	AI	RI (a)	RV	AI	RI (a)	RV
Protein (g)	91.7±18.9	71	29.2	76.4±20.7	71	7.6	77.1±21.2	71	8.6
Energy (kcal)	2900±271	2500	16.0	2829±554	2500	13.0	2855±489	2500	14.0
Iron (mg)	21.6±4.2	27	-20.0	24.6±6.5	27	-9.0	28.4±9.6	27	5.1
Calcium (mg)	668±214	1300	-49.0	525±225	1000	-45.0	573±231	1000	-43.0
Zinc (mg)	8.3±1.3	13	-36.5	7.2±2.1	11	-34.2	7.8±3.0	11	-28.7
Mg (mg)	612±179	400	53.0	652±102	350	86.0	659±109	360	83.0
Phosphorus (mg)	1441±281	1250	15.0	1425±403	700	103.0	1441±418	700	106.0
Folate (µg)	286±63	600	-52.0	249±132	600	-59.0	308±137	600	-49.0
Vit. C (mg)	69.9±40.9	80	-12.7	173.4±126.8	85	104.0	193.6±138.8	85	127.7
Vit. B12 (mg)	1.03±0.46	2.6	-60.5	0.7±0.6	2.6	-72.9	0.57±0.59	2.6	-77.8

AI = Actual Intake, RI = Reference Intake (a), RV = % More or less (-) over reference value

respectively. The mean calcium intakes were 668±214, 525±225 and 573±231 mg/day, respectively. The mean zinc intakes were 8.3±1.3, 7.2±2.1 and 7.8±3.0 mg/day, respectively. The intakes of Mg were 612±179, 652±102 and 659±109 mg/day, respectively. The intakes of Phosphorus were 1441±281, 1425±403 and 1441±418 mg/day, respectively.

Intake of folate was 286±63, 249±132 and 308±137 µg/day, respectively. Data on vitamin C intakes showed an adequacy of vitamin C intake in two age groups only. The vitamin C intake was 69.9±40.9, 173.4±126.8 and 193.6±138.8 mg/day, respectively. The data showed that

intakes of vitamin B12 were 1.03±0.46, 0.7±0.6 and 0.57±0.59 mg/day, respectively.

Percent distribution of Pregnant Women (PW) according to % RDA for different nutrients in second trimester: Table 6 shows the percent (%) distribution of PW belonging to second trimester. The % of PW for energy and protein intake was found to be higher in the range of ≥100% of RDA.

The % number of PW for the iron intake was higher in 76-99% of RDA for age group 19-30, while the percentage of PW of age group ≤18 yrs was almost

Table 6: Percent distribution of Pregnant Women (PW) according to% RDA for nutrients in second trimester

Nutrients	≤18 yrs (n = 4) % of RDA				19-30 yrs (n = 49) % of RDA				≥31 yrs (n = 13) % of RDA			
	≤50%	50-75%	76-99%	≥100%	≤50%	50-75%	76-99%	≥100%	≤50%	50-75%	76-99%	≥100%
Energy	-	-	-	100	-	6	16	78	-	8	15	77
Protein	-	-	-	100	-	8	45	47	-	-	46	54
Fe	-	50	50	-	6	16	43	35	-	8	46	46
Ca	50	25	25	-	63	22	12	2	69	22	8	8
Zinc	-	50	50	-	18	59	18	4	15	62	15	8
Mg	-	-	25	75	-	-	-	100	-	-	-	100
P	-	-	-	100	-	2	6	92	-	-	-	100
Folate	75	25	-	-	67	22	10	-	46	46	8	-
Vit. C	25	-	50	25	2	14	16	67	-	-	31	69
Vit. B12	75	25	-	-	78	14	8	-	92	-	8	-

Table 7: Nutrient intake level of pregnant women in third trimester in comparison with reference intake

Nutrients	≤18 yrs (n = 3) % of RDA			19-30 yrs (n = 55) % of RDA			≥31 yrs (n = 8) % of RDA		
	AI	RI (a)	RV	AI	RI (a)	RV	AI	RI (a)	RV
Protein (g)	66.3±17	71	-6.6	73.0±20.8	71	2.9	76.7±12.0	71	8.0
Energy (kcal)	2506±246	2500	0.3	2788±599	2500	12.0	2800±390	2500	12.0
Iron (mg)	24.0±3.9	27	-10.8	23.9±7.07	27	-11.5	22.4±5.7	27	-17.1
Calcium (mg)	513±291	1300	-60.0	549±185	1000	-45.0	579±134	1000	-42.0
Zinc (mg)	6.3±3.1	13	-51.2	7.1±2.1	11	-35.4	7.0±1.5	11	-38.0
Mg (mg)	642±142	400	61.0	615±159	350	76.0	597±183	360	66.0
Phosphorus (mg)	1476±533	1250	18.0	1443±390	700	106.0	1289±207	700	84.0
Folate (µg)	216±78	600	-64.0	259±154	600	-57.0	274±59	600	-54.0
Vit. C (mg)	57.4±10.9	80	-28.4	125.4±116.6	85	47.6	86.9±24.3	85	2.2
Vit. B12 (mg)	0.9±0.7	2.6	-64.1	0.5±0.4	2.6	-81.9	0.7±0.5	2.6	-70.9

AI = Actual Intake, RI (a) = Reference Intake (a), RV = % More or less (-) over reference value

same for 50-75 and 76-99% of the RDA. However, the frequency (% number of PW) of ≥31 yrs was same for 76-99 and ≥100% of the RDA. Frequency of PW for the intakes of calcium and zinc were found to be higher below 76% of the RDA. The highest % of PW for magnesium and phosphorus were mostly found in ≥100%.

Percentage of PW for the intakes of folate and vitamin B12 was higher in ≤50% of RDA. The highest % number of PW for vitamin C intake was found to be in ≥100% of RDA (for age group 19-30 and ≥31 yrs) while the higher frequency (%) for age group ≤18 yrs was found in ≤50% RDA.

Nutrients intake in third trimester: Table 7 shows the mean nutrient intake Pregnant Women (PW) in their third trimester. The mean intakes of energy by the PW were 2506±246, 2788±599 and 2800±390 kcal/day, respectively. The mean protein intakes in PW 66.3±17, 73.0±20.8 and 76.7±12.0 g/day, respectively. The mean iron intakes in the three age groups were 24.0±3.9, 23.9±7.0 and 22.4±5.7 mg/day, respectively. The calcium intakes were 513±291, 549±185 and 579±134 mg/day, respectively. The intakes of Zn were 6.3±3.1, 7.1±2.1 and 7.0±1.5 mg/day, respectively. The intake of Mg was 642±142, 615±159 and 597±183 mg/day, respectively. The intakes of phosphorus were 1476±533, 1443±390 and 1289±207 mg/day, respectively.

Intakes of folate were 216±78, 259±154 and 274±59 µg/day, respectively. The intakes of vitamin C were 57.4±10.9, 125.4±116.6 and 86.9±24.3 mg/day, respectively. Intakes of vitamin B12 were 0.9±0.7, 0.5±0.4 and 0.7±0.5, mg/day respectively.

Percent distribution of Pregnant Women (PW) according to % RDA for nutrients belonging to third trimester: Table 8 shows the percent distribution of PW belonging to third trimester according to % RDA for nutrients. The highest percentage (%) of PW for energy and protein intake was found to be in the range of ≥100% of RDA.

The frequency (%number of PW) for iron intake was higher (≥100% of RDA) for age group 19-30, while the frequency of PW of age group ≤18 yrs was evenly distributed among 50-75%, 76-99% and in ≥100% RDA. Similarly % of age group ≥31 yrs was higher (50-75% of RDA). The percentage of PW for the intakes of calcium and zinc were found to be higher below 76% of RDA. However, highest frequencies of PW for magnesium and phosphorus were mostly found in ≥100%.

The percent distribution of the respondents for the intakes of folate and vitamin B12 showed the highest % in ≤50% of RDA. The highest % of the participants for vitamin C intake was found to be in ≥100% of RDA (age group 19-30), while the highest frequency for age group ≤18 yrs was found in 50-75% and evenly distributed among 76-99% and in ≥100% RDA for the age group of ≥31 yrs.

Table 8: Percent distribution of Pregnant Women (PW) according to % RDA for nutrients in third trimester

Nutrients	≤18 yrs (n = 3) % of RDA				19-30 yrs (n = 55) % of RDA				≥31 yrs (n = 8) % of RDA			
	<50%	50-75%	76-99%	≥100%	<50%	50-75%	76-99%	≥100%	<50%	50-75%	76-99%	≥100%
Energy	-	-	33	67	2	5	24	69	-	-	25	75
Protein	-	33	-	67	2	15	33	51	-	-	25	75
Fe	-	33	33	33	5	31	25	38	-	50	25	25
Ca	67	-	33	-	53	40	7	-	50	50	-	-
Zinc	33	67	-	-	29	45	20	5	25	75	-	-
Mg	-	-	-	100	-	2	4	95	-	13	-	88
P	-	-	-	100	-	-	5	95	-	-	-	100
Folate	67	33	-	-	56	33	11	-	63	38	-	-
Vit. C	-	67	33	-	15	18	16	51	-	-	50	50
Vit. B12	67	33	-	-	96	4	-	-	88	12	-	-

Table 9: Average nutrient intake of pregnant women in low and high socio economic status groups

Nutrients	LIG (n = 68)	RI	HIG (n = 131)
Calories (k cal)	2654.0	2500.0	2737.0
Protein (g)	66.0	71.0	77.0
Iron (mg)	23.0	27.0	24.0
Calcium (mg)	522.0	1100.0	481.0
Zinc (mg)	6.3	11.0	7.7
Magnesium (mg)	606.0	370.0	608.0
Phosphorus (mg)	1247.0	884.0	1330.0
Folate (µg)	242.0	600.0	253.0
Vitamin C (mg)	143.0	81.0	144.0
Vitamin B12 (mg)	0.4	2.6	0.7

n = number of respondents, LIG = Low Income Group (n = 68), RI = Recommended Intake, HIG = High Income Group (n = 131)

Nutrients intakes of low and high income groups:

Table 9 shows the nutrient intake of subjects from both low and high income groups. It is evident from the data that the intake of most of the nutrients was higher in subjects of high income group as compared to those of low income group. There was no significant (p<0.005) difference in the intakes of nutrients between subjects from low and high income groups.

DISCUSSION

The overall per capital food availability of the basic food items has declined over the previous years. Food prices, poor income, nutrition education and degree of control of women over household resource allocation decisions all affect the level and quality of food intake (Bouis and Hunt, 1999).

It is evident from the data that energy intake of all the pregnant women PW were above the RDA except age group 19-30 yrs) in 1st trimester in which energy intake was -0.4%. The intake of protein of the subjects in the 1st trimester was below the RDA as compared to other pregnant women.

Deficiencies in micronutrients such as folate, iron and zinc and vitamins A, B6, B12, C, E and riboflavin are highly prevalent and may occur concurrently among pregnant women (Black *et al.*, 2008). Micronutrient deficiencies result from inadequate intake of meat, fruits and vegetables and infections can also be a cause.

Multiple micronutrient supplementation in pregnant women may be a promising strategy for reducing adverse pregnancy outcomes through improved

maternal nutritional and immune status (Allen, 2005; Bhutta *et al.*, 2008). The World Health Organization (WHO) currently recommends iron and folic acid supplementation to reduce the risk of iron deficiency anaemia among pregnant women. Since many developing countries already have systems in place for the delivery of iron and folic acid supplements, micronutrient supplements could be provided at little additional cost (Shrimpton *et al.*, 2002).

The National Nutrition Survey (NNS 2001-02) provided the first nationally representative survey of sub-clinical zinc deficiency in Pakistan and indicated that 41.4% of mother of children under 5 years and 37.1% preschool children had zinc levels of <60 µg/dl. In both cases (mothers and children) the prevalence of zinc deficiency is higher among rural than urban population.

The average intakes of some of the selected minerals Fe, Ca, Zn and vitamins were below the recommended levels. The mean magnesium and phosphorus intakes of most of the pregnant women were higher above the RDA.

There is an increased worldwide concern about prevalence of folic acid deficiency, especially in women of reproductive age and pregnant adolescents. Supplementation or food fortification programs can remove this situation (Garcia-Casal *et al.*, 2005).

Vitamin C was the only vitamin which seems to be adequately taken in by PW while vitamin B12 and folate intake were below the RDA level.

Conclusion and recommendations: This study shows that pregnant women should consume diet adequate in calories and essential micronutrients especially in iron, calcium, zinc, folate and vitamin B12. There is a need to assess the nutritional requirements and to design nutrition program at community level for the pregnant women.

REFERENCES

Allen, L.H., 2005. Multiple micronutrients in pregnancy and lactation. *Am. J. Clin. Nutr.*, 81: 1206-1212.
 Bhutta, Z.A., T. Ahmed, R.E. Black, S. Cousens, K. Dewey and E. Giugliani, 2008. Interventions for maternal and child undernutrition and survival. *Lancet*, 10: 417-440.

- Black, R.E., L.H. Allen, Z.A. Bhutta, L.E. Caulfield, M. Onis and M. Ezzati, 2008. Maternal and child undernutrition: Global and regional exposures and health consequences. *Lancet*, 10: 243-260.
- Bouis, H. and J. Hunt, 1999. Linking food and nutrition security: Past lessons and future opportunities. *Asia. Dev. Rev.*, 1: 168-213.
- Garcia-Casal, M.N., C. Osorio, M. Landaeta, I. Leets, P. Matus, F. Fazzino and E. Marcos, 2005. High prevalence of folic acid and vitamin B12 deficiencies in infants, children, adolescents and pregnant women in Venezuela. *Eur. J. Clin. Nutr.*, 9: 1064-1070.
- Kaiser, L.L. and L. Allen, 2002. Position of American Dietetic Association: Nutrition and lifestyle for a healthy pregnancy out come. *Am. J. Diet. Assoc.*, 10: 1479-1490.
- National Nutrition Survey, 2002-2003. Government of Pakistan. National Institute of Health, Islamabad, Pakistan.
- Shrimpton, R., R. Shrimpton and W. Schultink, 2002. Can supplements help meet the micronutrient needs of the developing world? *Proc. Nutr. Soc.*, 10: 223-229.
- Thimmayamma, B.V.S., P. Rau and R.K. Visweswara, 1982. Socio economic status, diet and nutrient adequacies of different population groups urban and rural Hyderabad. *Ind. J. Nutr. Dietet.*, 19: 173-183.
- WHO, UNICEF, UNFPA and the World Bank. Geneva. 2007. Estimation of Maternal Mortality. <http://ww.who.int/whosis/mme>.