Micronutrients Dietary Intakes of Pregnant Sudanese Women

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Abstract: Nutritional imbalance could cause detrimental effects to the pregnant woman by influencing pregnancy outcome and impair breast milk composition. Fetal growth and development are strongly linked with maternal supply of essential nutrients but how the nutritional status of the mother influences her health, and that of the fetus is still not clear. <u>Purpose</u>: This study was conducted to determine micronutrient intake of pregnant Sudanese women in their third trimester. Focus was on micronutrients vitamins A, B1, B2, B6 folate, vitamin C, and minerals; sodium, potassium, calcium, magnesium, phosphorus, iron and zinc. <u>Methods</u>: Dietary intake of pregnant women (n=81) in their third trimester attending Omdurman Maternity Hospital, Khartoum State assessed by 3-days 24-hour dietary recall sheet. Diets consumed converted to nutrients using Nutri-survey software package. Database modified from other food composition tables. RDA values based on FAO/WHO/UNU reference values. <u>Results</u>: Most of the pregnant mothers were from middle economic class and educated. Eighty-eight percent (88%) of the babies were normal whereas 12% had LBW. Results of the mean intakes of 13 nutrients (68.4%) for all subjects were below RDA, The minimum intake recorded for vitamin A, which is <20% than RDA. Income and mothers education positively correlated with most of the nutrients. Age correlated very significantly with protein intake (r=0.77, P=0.00). <u>Conclusion</u>: All subjects were at high risk of anaemia, VAD and zinc deficiency. Micronutrients status of the pregnant mothers is mainly influenced by dietary intake. Iron and zinc supplements, good nutrition, nutrition education and counseling are crucial for maternal and newborn health.

Keywords: Micronutrients, Pregnancy, Sudan, dietary intake.

1. Introduction

Pregnancy associated with physiologic changes that result in increased plasma volume and red cells and increased concentration of circulating nutrients binding proteins and micronutrients. [1]. Requirements for many micronutrients increase during pregnancy. Deficiencies can exist because of inadequate intake, losses or malabsorption associated with diseases. Lack of knowledge about adequate prenatal nutrition or dietary taboos associate with pregnancy [2] in addition it has great consequences for both mothers and infants [1].

Review of studies on dietary intake assessment indicates that recording nutrients intake and food habits among pregnant and lactating women and their consequences for the mothers and newborns. Nutrition during pregnancy is related and varies according to socioeconomic, cultural, and demographic factors [3-5].

In Africa, undernutrition causes maternal and infant deaths and illness. That is due insufficient food intake, high energy expenditure, micronutrients' deficit diets and the demands of pregnancy and lactation [6]. The most common micronutrients' deficiencies in pregnancy are those of vitamin A, iron, and zinc.

Vitamin A deficiency in pregnancy associated with night blindness [7,8]. Increased risk of maternal mortality [9], premature birth, intrauterine growth retardation, low birth weight [10] and antepartum haemorrhage due to abruptio placentae [11].

Iron deficiency is the most common haematological problem in pregnancy. The term "physiologic anaemia of pregnancy" is a dilution process secondary to an increase in blood volume [12]. However, nutritional deficiencies, haemolysis and other disorders can cause a significant anaemia that can affect both mother and fetus. Rush (2000) noted that anaemia in pregnancy and pregnancy-induced hypertension commonly found in developing countries and assumed to contribute significantly to maternal mortality and morbidity [13].

Mild zinc deficiency noticed in pregnant women associated with abnormal taste acuity, prolonged gestation, slowed labor, atonic bleeding and increased risk to the fetus that was reduced by zinc supplementation [14]. Zinc deficiency also related to a factor responsible for intrauterine growth retardation and poor uterine contractility [15,16].

In Sudan, information about nutritional status of pregnant women is limited. Only one clinically based study [17] has been carried out in 2000. Another study was conducted to determine the daily intake of essential micro- and macronutrients in Sudanese women. This study focused on dietary fat and essential fatty acids and comparison between dietary intakes of internally displaced with those of the nondisplaced population [18]. Therefore, the aim of this study is to provide a baseline data for the intake of essential nutrients with a random sample of pregnant mothers in their third trimester attending Omdurman Maternity Hospital, Khartoum State.

2. Methods

Participants in this study were 148 subjects; 83 pregnant mothers (15 to 41years) in their third trimester of pregnancy and 65 newborn babies of the studied mothers. This study conducted in Omdurman Maternity Hospital - Omdurman Province, Khartoum State. Eighty-three pregnant women who reported to hospital at the time of data collection were asked to join the study.

2.1 Dietary Intake

Only eighty-one mothers completed 24-hour dietary recall for three days. Average daily intake was calculated. Thirty five 35 local recipes were designed according to average amounts used by different Sudanese cooking methods. Using Nutri-survey program (www. nutrisurvey. De) [19], BLSWe diets consumed were converted to nutrients, updated 1999, version BLS II.3). The BLS based on several national and international food tables. Database modified from other food composition tables [20-25]. RDA values based on reference values according to FAO/WHO/UNU (2004)a and FAO/WHO/UNU(2004)b [26, 27].

Ethics: Research proposal was approved by Faculty of Education Postgraduate Board. Letter postgraduate faculty board faculty of education and university of Khartoum faculty board, permission was taken from Maternity Hospital authority. Verbal consent and was taken from each pregnant lady before delivery to participate in the study to allow blood sample collection.

2.2 Statistical Analysis

The statistical software SPSS (version 16) used for data analysis. Descriptive results expressed as frequencies and percentages. Results expressed as mean \pm Standard deviation (mean \pm SD). Statistical significance taken as p < 0.05. Categorical data statistics, also interpreted using Pearson Chi-Square Tests. Spearman's rank correlation tests done to examine partial correlations.

Dietary intake adequacy was classified using RDA s cut of points .into: adequate (>80 % RDA), (80-50 % RDA) inadequate, and very inadequate (<50% RDA).

3. Results

Amount of micronutrients daily intakes of the pregnant mothers and their statistical analysis as the percentage of recommended dietary allowances(RDA) presented in Table 1. Daily mean intakes of vitamin B2, vitamin C, sodium and potassium were above RDA.

Riboflavin (B2) 1.40 mg/day (100.07±6.17 %RDA); Vitamin C 63.08 mg/day (114.69±7.85% RDA); Sodium 3061.04 mg/day (127.54±6.11% RDA); Potassium 2032.68 mg/day (101.63±3.66% RDA)

Thiamine(B1), magnesium mg/day and zinc were >85 % RDA. Vitamins A, B6, folate, phosphorus and iron were below 50 % RDA. Adequacy of micronutrients daily intake in relation to RDA revealed in Table 2. The greatest inadequacy found in vitamin A, folic acid and phosphorus; 100%, 100% and 90%, respectively. Sodium and potassium have recorded the highest adequacy of intake.

Table 3 shows one sample t-test statistics for micronutrients daily intake. Results show that intake of vitamins A, B1, B6, folate, calcium, phosphorus, iron and zinc were significantly lower than RDA whereas potassium was significantly higher than RDA.

Partial correlations (2-tailed) at 95% level of confidence interval was performed to study the relationship between micronutrients dietary intake and socioeconomic factors.

Partial correlations found between maternal dietary intake of studied mothers and income, education and family size. There was an overall pattern of positive correlations between dietary intake and socioeconomic factors. Results showed a positive correlation between income and fathers' education and 12 nutrients (80%). Mothers' education also correlated positively with 11 nutrients (73.3%).

Family size correlated negatively with all nutrients except for vitamin C. The correlation was significant for vitamin A (r=-0.23, P=0.04), vitamin B2 (r=-0.29, P=0.01), folate (r=-0.22, P=0.05) but the correlation with calcium was not significant (r=-0.21, P=0.06).

Age correlated positively but insignificantly with vitamin A, vitamin B2, vitamin B6 and zinc. However, it was negatively correlated with vitamin B1, vitamin C, calcium and iron.

	1	6		
Nutrient	Amount of Intake	Mean ± SE %RDA (amount) All subjects (n = 81)	RDA ^{a/b} Pregnant 3 rd Trimester ^{WHO}	
Vitamin A µg	134.39	16.80±3.32	800	
Thiamine(B1) mg	1.24	88.60±3.46	1.4	
Riboflavin (B2) mg	1.40	100.07±6.17	1.4	
Vitamin B6 mg	0.94	49.61±2.05	1.9	
Folate µg/da	180.09	30.01±1.41	600	
Vitamin C mg	63.08	114.69±7.85	55	
Sodium mg	3061.04	127.54±6.11	2400	
Potassium mg	2032.68	101.63±3.66	2000	
Calcium mg	692.53	57.71±2.51	1200	
Magnesium mg	207.60	94 37+3 63	220	

Table 1: Nutrients intake as percentages of recommended dietary allowances (RDA)

International Journal of Science and Research (IJSR) ISSN (Online): 2319-7064 Index Copernicus Value (2013): 6.14 | Impact Factor (2013): 4.438

Phosphorus mg	1013.71	28.96±0.91	3500
Iron mg	11.39	42.17±1.53	27
Zinc mg	9.91	90.12±3.00	11

Table 2: Distribution of studied pregnant women according to risk of inadequacy of micronutrients intake

	Adequacy of Intake %				
Nutrient	Adequate	Inadequate	ate Very Inadequate		
Vitamin A µg	4.9	4.9	90.1		
Thiamine(B1) mg	58	29.6	12.3		
Riboflavin (B2) mg	61.7	22.2	16		
Vitamin B6 mg	6.2	44.4	49.4		
Folate µg	-	6.2	93.8		
Vitamin C mg	64.2	22.2	13.6		
Sodium mg	80.2	16	3.7		
Potassium mg	72.8	22.2	4.9		
Calcium mg	16	45.7	38.3		
Magnesium mg	63	25.9	11.1		
Phosphorus mg	-	-	100		
Iron mg	1.2	27.2	71.6		
Zinc mg	64.2	30.9	4.9		

*Adequate Intake(>80 % RDA);Inadequate (50-80 % RDA);Very Inadequate(<50 % RDA)

4. Discussion

Daily mean intakes of vitamin B2, vitamin C, sodium and potassium were above RDA. Thiamine (B1), magnesium and zinc intakes were >85% RDA. Vitamins A, B6, folate, phosphorus and iron were below 50 % RDA. In our study results showed that dietary intake of vitamins A, B1, B6, folate, calcium, phosphorus, iron and zinc were

significantly lower than RDA whereas potassium was significantly higher than RDA.

In Africa, recent surveys of pregnant and lactating women indicate that several micronutrients deficiencies are common, especially, iron, zinc, iodine, vitamin A, folic acid, and riboflavin. Low intakes of calcium and vitamin E also found [6]. Similar studies reported that a high prevalence of multiple deficiencies can account for by low dietary intakes and reduced bioavailability of micronutrients. Decreased consumption of animal products and fortified foods also contributes to multiple deficiencies [28].

Vitamin A was the minimum nutrient taken. These results might give the indication to unbalanced diets and hence poor dietary intake of vitamin A sources that might be due either to economic or educational factors. These can be explained by poor intakes of liver and other animal sources in addition to dairy products and egg; these are all expensive food that cannot afford to all low or moderate income families. In addition to poor knowledge and education about cheap vegetable sources that are available and affordable. Our results are lower than a similar study [17]. These variations attributed to that Al Khalifa

One-Sample Test						
	Test Value = 100					
Nutrient	t	df	Sig. (2- tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Vitamin A µg	-25.079-	80	.000	-83.20173-	-89.8041-	-76.5994-
Thiamine(B1) mg	-3.290-	80	.001	-11.39579-	-18.2879-	-4.5037-
Riboflavin (B2) mg	.011	80	.991	.07012	-12.2089-	12.3491
Vitamin B6 mg	-24.638-	80	.000	-50.38765-	-54.4575-	-46.3178-
Folate µg	-49.492-	80	.000	-69.98519-	-72.7993-	-67.1711-
Vitamin C mg	1.871	80	.065	14.68627	9311-	30.3037
Sodium mg	4.506	80	.000	27.54333	15.3790	39.7077
Potassium mg	.447	80	.656	1.63395	-5.6485-	8.9164
Calcium mg	-16.859-	80	.000	-42.28938-	-47.2813-	-37.2975-
Magnesium mg	-1.552-	80	.125	-5.63447-	-12.8583-	1.5894
Phosphorus mg	-77.668-	80	.000	-71.03679-	-72.8569-	-69.2166-
Iron mg	-37.676-	80	.000	-57.83062-	-60.8852-	-54.7760-
Zinc mg	-1.840E3	80	.000	-98.64198-	-98.7486-	-98.5353-

Table 3: One sample t-test of micronutrients intake of pregnant mother

study conducted earlier, and that new recommendation developed. The present study supports other studies [8, 39, 30]. They found out that VAD occurs when the intake of dairy products and carotene-rich vegetables and fruit is limited and, rarely, with malabsorption syndrome.

Our results were favorable regarding vitamin C intake that was above 100 % RDA in the two groups. However adequacy was 60% in the diet group and 62.7% in the iron group. Dietary intake of vitamin C satisfies more than RDA for pregnancy. Vitamin C in serum progressively decreases 50 % during pregnancy [31]. Partly, because of the extra uptake by the fetus and serum ascorbate concentrations have been weakly positively associated with gestational duration. Results in this study were similar to another study in Sudan [17].

Thiamine dietary allowances are 12 % higher in early pregnancy and remain constant throughout [32]. Vitamin B_1 Intakes in this study were similar to another study [17].

Subjects in this study have recorded higher intakes of vitamin B2 than reported by others [17,18]. Dietary Allowances 7 % higher might attribute to increased

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maternal and fetal tissue synthesis and a small increase in energy utilization [33].

Our results showed dietary intake of vitamin B_6 was very inadequate in \geq 90% of the subjects. Deficiency of this vitamin rarely occurs. The FAO/WHO (1974) [34] has not recommended additional requirements for pregnant women. But the IOM (1990) has on assumption that the vitamin not stored to any great extent, and there is an increased need in the latter half of pregnancy. Thus, the IOM recommended that the RDA should be elevated by 46 % to ensure sufficiency throughout pregnancy.

Mean intake of folic acid was very low intake and very inadequate for pregnancy requirements [35]. A very similar result was obtained by another [17]. The intake of folic acid was 100% adequate for subjects who took fefol supplements whereas 100% inadequate among those who did not use supplements.

Folic acid is needed to maintain maternal stores and to meet the needs of supplementation. A study conducted on folate bioavailability and health documented that insufficient folate status might attribute to risk of developing various medical conditions throughout the individual's life. Such as certain congenital malformation and poor pregnancy outcomes to cardiovascular disease, some malignancies, and neurological dysfunction of the elderly [36].

Calcium mean intake was slightly higher than 50% RDA (57.71% RDA). This might attribute to the high cost of calcium rich dietary sources, e.g., milk and milk products. In addition to this is groundnuts and arugula that contain 75 mg and 165 mg Ca per 100 gram, respectively. Low intakes of calcium have also been documented in Sudan many parts of Africa[37,38] and other developing countries in Asia, the Caribbean and Central/South America[40]. Higher intakes were found in another study but still less than recommended allowances [17]. However one study reported variations in calcium intake among countries, with very low intake in India 250 mg/day \pm 49 to high intakes in Caucasian women in Canada 1256 ± 577 mg/day. During the third trimester of pregnancy, 200 mg/day is considered the average increment rate. [39].

In our study iron intake was less than 50% RDA. Similar studies reported median dietary intakes of iron were below the recommended levels and suggested fortified foods as important sources of iron, folate, and vitamin C [40,41].

Regarding zinc, intake was also less than 50% RDA. Other studies reported similarly low intakes of zinc [18,40,42]. Micronutrients deficiencies thgim exist due to malabsorption or losses associated with disease or inadequate intakes detimiL .knowledge about adequate prenatal nutrition or dietary taboos associated with pregnancy with potential adverse consequences for both mothers and newborns [43].

Fetal supply substrate is a primary regulator of prenatal growth. Maternal nutrition influences the availability of nutrients for transfer to the fetus [44].

Apart from the dietary intake, nutrition is highly dependent on economic status, social and cultural environment, and maternal dietary habits [3,5,45,46].

There was an overall pattern of positive correlations between dietary intake and socioeconomic factors. Results showed a positive relationship between income and fathers' education and 12 nutrients (80%). Mothers' education also correlated positively with 11 nutrients (73.3%).

Family size correlated negatively with all nutrients except for vitamin C. The correlation was significant for vitamin A (r=-0.23, P=0.04), vitamin B2 (r=-0.29, P=0.01), folate (r=-0.22, P=0.05) but the correlation with calcium was not significant (r=-0.21, P=0.06).

Our findings were supported by other studies [17, 47]. They found that economic aspects and education levels a have a significant influence on the adequacy of the diet consumed. Ensuring proper food and improving the social and economic conditions will reduce the risk of anemia during pregnancy and its prenatal consequences.

Vitamin A intake positively and significantly correlated with age, family size, and mothers' education. Our findings show that iron and zinc both positively related to mothers and fathers education but, negatively correlated with family members, age, and fathers occupation. Iron-deficiency anemia (IDA) and vitamin A deficiency (VAD) share the same socio-economic risk factors and may occur simultaneously [48].

Martin et al., showed a positive impact from the social marketing campaign of eggs and dark green leafy vegetables on food consumption; an increase in the consumption of eggs and plant sources of vitamin A, and associated improvement in vitamin A status [43].

Pregnancy increases metabolic demand for high-quality nutrients. Careful food selection, make it possible to obtain most of the recommended levels of nutrients [3].

5. Conclusions

Dietary intake of vitamins A, B1, B6, folate, calcium, phosphorus, iron and zinc were significantly lower than RDA whereas potassium was significantly higher than RDA. Thiamine (B1), magnesium and zinc intakes were >85% RDA. Vitamins A, B6, folate, phosphorus and iron were below 50 % RDA. Pregnant mothers are at risk of multiple micronutrients deficiencies.

6. Acknowledgements

This work funded by a scholarship from the German DAAD Research Fund. This fund provided the real support that enabled the author to step over financial difficulties and finalize this research. This manuscript done for academic purposes

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