FOOD AND NUTRIENT INTAKE DURING PREGNANCY IN RELATION TO MATERNAL CHARACTERISTICS SELECTED MICRONUTRIENT DEFICIENCY AMONG RURAL PREGNANCY WOMEN

Ms. G.K.GOMATHI
Assistant Professor & Head, Department of Nutrition and Dietetics,
Sengamala Thayaar Educational Trust Women's College,
Mannargudi – 614 001, Thiruvarur district, Tamil Nadu, India.
(*Affiliated to Bharathidasan University, Tiruchirappalli, Tamil Nadu, India).*

ABSTRACT
The nutritional status of an individual is usually a result of multiple factors that interact with each other at different levels. Recognizing the role of diet at the onset of many diseases and assessing the nutritional status of an individual, family and community are important for public health. We used cluster analysis to analyze how the intake of food and nutrients during pregnancy co-varies with lifestyle, clinical and demographic factors in 300 women who participated in this study. A food frequency questionnaire was administered in pregnancy people clinical appearance of face, hair, eye, mouth, nail, skin and the reported food and nutrient intakes were related to maternal characteristics such as age, anthropomentric and selected biochemicals for rural residence. Five lifestyle-diet clusters were identified like Daily, weekly, monthly and occasionally higher age were related to one another and associated with a diet rich in cereals and cereal product, pulses and legumes, roots and tubers, green leafy vegetables and other vegetables. Perceptions of rural foods as healthy, coupled with key structural barriers such as food costs were identified. Maternal morbidity influenced food consumption, as women reported reducing food intake early in pregnancy in response to illness episodes. Nutrition- specific and nutrition-sensitive interventions could improve access and availability of acceptable foods for supporting increased dietary intake during pregnancy.
Keywords: Diet, diet survey, nutritional assessment, Zinc, iron, pregnancy

INTRODUCTION
Maternal nutrition during pregnancy and lactation is important since inadequate amounts of essential nutrients can adversely affect both mother and child. During pregnancy, the development of maternal tissues, fetal growth and breast milk production increase nutritional requirements. While several observational studies have suggested that an adequate intake of micronutrients prevent several adverse pregnancy outcomes, apart from the preventive effect of folic acid supplementation on neural tube defects, randomized controlled studies of such factors are largely lacking (Ramakrishnan et al., 2012). Although multiple observational studies have suggested that a mixed diet that is rich in fruits and vegetables and that contains fish decreases the risk of preterm delivery (Englund-Ögge et al., 2014) and gestational diabetes (Karamanos et al., 2013) and is optimal with respect to maternal weight gain and fetal growth (Hillesund et al., 2014), the dietary pattern is interlinked with many other lifestyle factors, including smoking, body mass index (BMI), education, age, and urban versus rural residency (Jonsson et al., 2016).

The nutritional status of an individual is usually a result of multiple factors that interact with each other at different levels. The consumption of adequate amount of food both in terms of quantity and quality is one of the key determinants, which has a significant impact on the nutritional status (Park, 2009). Furthermore, the eating pattern of an individual is a crucial factor that dictates the occurrence of a disease, especially some chronic conditions

such as coronary heart disease, hypertension, stroke, diabetes mellitus, and cancer. In addition, adverse outcomes such as low birth weight, malnutrition, disability, poor quality of life, and mortality are also related to poor eating pattern, in both developed and developing countries. Recognizing the role of diet at onset of many diseases, and assessing nutritional status of an individual, family and community are important for public health (Herder and Demmig-Adams, 2004; Price, 2005).

Severe maternal zinc deficiency has a devastating effect on pregnancy outcome. Studies of experimental animals and humans show that maternal zinc deficiency can cause infertility, prolonged labor, intrauterine growth retardation, teratogenesis, or embryonic or fetal death. Although the teratogenic effects of zinc deficiency in the developing fetus are well documented, much less attention has been given to the impact on maternal function and health. The purpose of this review was to 1) compare the maternal response to varying degrees of zinc deficiency during pregnancy, 2) describe the physiologic adjustments that occur in zinc metabolism to support maternal and fetal needs, and 3) describe conditions that may override these physiologic adjustments and put the health of the mother and fetus at risk.

Zinc plays an important role in many biological functions including protein synthesis, cellular division and nucleic acid metabolism (King and Cousins, 2006). Although severe zinc deficiency is relatively rare in human populations, mild to moderate depletion appears to be quite prevalent. Zinc intake data suggest that the risk of deficiencies is high. Using a model that related reported zinc intakes of pregnant women to the recommended intake, Caulfield estimated that 82% of the pregnant women worldwide have inadequate zinc intakes (Caulfield et al., 1998).

Despite evidence supporting the importance of maternal nutrition, various studies reveal that few women follow adequate diets. In addition, there is a lack of up-to-date data on the discrepancies between nutritional intake during pregnancy and lactation and the dietary advice provided to pregnant women from high income countries. A study conducted in during the first trimester of pregnancy showed intakes of cereals, legumes, fruit and vegetables under the recommended range.

The objectives of our study are as follows: (1) To assess Food Consumption Pattern; (2) to analyze the Clinical Assessment of the Subjects; (3) to examine Mean Anthropometric Measurement of the Selected Subjects and (4) to analyze Biochemical analysis of the selected subjects during pregnancy and post-partum in a sample of healthy pregnant women.

MATERIALS AND METHODS

Study design: A population-based cross-sectional study adopting the multi-stage stratified random sampling procedure has been planned to carry out in selected rural areas of panchayat village.

Number of Subject: An approximate sample size of 300 pregnant women is estimated.

Consent: For proper consent, The Research and Development Advisory Committee of the STET College will be contacted for the study and Written informed consent will be obtained from all the subjects all after prior approval from College R & D committee.

Selection Criteria: The study will be carried out amongst pregnant women belonging to selected rural communities of Panchayat village in and around area of Pattukkottai. A total of

500 pregnant women in II and III trimester attending the Antenatal Clinic, Rural Primary Health Training Center, will be studied. All consecutive pregnant women attending the clinic will be enrolled for the study. All the clinical examination and biochemical estimations to be undertaken will be explained to them prior study.

The pregnant women will be contacted and data collected using well developed structured questionnaire that inquires about their age, gestational age, socio-economic status, other socio-demographic parameters and details pertaining to study etc.

Assessment of Anemia: Anemia will be assessed by assessing the clinical signs, pallor of tongue and pallor of conjunctiva. The hemoglobin levels were estimated using the Sahli's method. Anemic subjects will be classified according to the methods of WHO classification. Hemoglobin levels more than 11g/dl were classified as non-anemic.

Assessment of Zinc: This is the simplest way of assessing zinc status but the factors that can cause inaccuracies are high. They include diurnal variations, fluctuations after meals, increased levels after fasting, stress, pregnancy, certain malignancies, renal failure, low albumin concentrations etc.

The clinical manifestations in severe cases of zinc deficiency will be assessed for bullous-pustular dermatitis, alopecia, diarrhea, emotional disorder, weight loss, intercurrent infections, hypogonadism in males; it is fatal if unrecognized and untreated. A moderate deficiency of zinc is characterized by growth retardation and delayed puberty in adolescents, hypogonadism in males, rough skin, poor appetite, mental lethargy, delayed wound healing, taste abnormalities and abnormal dark adaptation.

Analysis of the 250µL (minimum) blood sample is done by atomic absorption spectroscopy. Serum samples were diluted 5-fold with deionized water and introduced into nebulizer burner system by the injection method. In view of viscosity of diluted serum, 3% (v/v) Glycerin was added to the standard solutions for matching the surface tension between samples and calibrators for Zn to determine their levels at wave length 213.9, 324.8 nm respectively. A concentration below 7 µmol/L (46µg/dl) is indicative of a decided deficiency.

RESULTS AND DISCUSSION

A total of 300 women returned the questionnaire completed at different weeks gestation (85.5% of the original sample, many of these had already been lost because of miscarriage), of these, subjects had sufficient dietary data available.

Dietary survey is a scientific assessment of eating pattern that could detect nutrient deficiency. There are many methods to do dietary surveys. Five lifestyle-diet clusters were identified like Daily, weekly, monthly and occasionally higher age were related to one another and associated with a diet rich in cereals and cereal product, pulses and legumes, roots and tubers, green leafy vegetables and other vegetables (Table 1). Perceptions of rural foods as healthy, coupled with key structural barriers such as food costs were identified. Maternal morbidity influenced food consumption, as women reported reducing food intake early in pregnancy in response to illness episodes. The food frequency questionnaire method helps in assessing meal patterns and dietary habits of people by identifying number of times a specific food item is consumed in a defined time-span (Tefft and Boniface, 2000; Anyzewska et al., 2013; Wang et al., 2013). However, most of these methods are tedious, difficult to execute, and have a poor acceptance rate by members of the community. To summarize, food

balance sheet method and inventory method are similar, and the only difference is the settings (food balance sheet - state/national level or inventory - institutional level) in which they are generally considered applicable. However, the other three methods are used at household level to assess the amount of food consumed/dietary patterns of members of a family in a specified period.

It is an essential feature of all nutritional surveys as the primary goal is to assess the health status of individuals or groups within a population in accordance with the type of food consumed. A food frequency questionnaire was administered in pregnancy people clinical appearance of face, hair, eye, mouth, nail, skin, and the reported food and nutrient intakes were related to maternal characteristics such as age, anthropomentric and selected biochemicals for rural residence (Table 2 & 3). The presence of two or more clinical signs of a specific nutritional deficiency increases the diagnostic significance (Park, 2009). It can be applied to a large group of the population. However, its limitation is that it cannot quantify the exact level of nutrient deficiency because most of these clinical signs for nutrient deficiency are nonspecific and require biochemical analysis to identify the nutritional status (Beghin et al., 1988; Malara et al., 2014).

The steady increase in the incidence of preterm birth during the past decade is troubling. Infants born preterm are at greater risk for mortality and a variety of health and developmental problems. Thus, if reflective of a true causal effect, a 14% reduction in preterm birth with zinc and iron supplementation, as estimated from these trials, would be of major public health importance. Several plausible explanations for the positive effect of zinc and iron on preterm births exist. Zinc deficiency alters circulating levels of a number of hormones associated with the onset of labour. For example, lower levels of serum progesterone and prolactin concentrations in zinc-deficient ewes were associated with preterm deliveries (Apgar, 1992). Zinc and iron supplementation may reduce the incidence or the severity of maternal infections that, in turn, lower the risk of preterm birth. It has been reported that iron supplementation interferes with zinc absorption in pregnancy (King et al., 2006; O'Brien et al., 2000). However, we did not observe substantial differences when the analysis was restricted only to those trials providing supplemental zinc alone vs. only those that provided zinc along with iron and other micronutrients.

Interactions between iron and zinc occur during gastrointestinal absorption (Table 4). The deleterious effect of supplemental iron on zinc absorption and a depression in plasma zinc concentrations were shown in studies of experimental animals and humans (Solomons, 1986; Solomons and Ruz, 1997). The mechanisms for this iron-zinc interaction probably involved a combination of intraluminal and intracellular effects (Solomons et al., 1983). Iron and zinc may compete in the absorption process by: 1) displacing one another on the molecule necessary for their uptake from the lumen into the intestinal cell, 2) competing for pathways through the mucosal cell into the blood stream, or 3) interacting with one another and a third substance to form an insoluble complex, impairing the absorption of both minerals. Studies evaluating the effect of iron fortification in infant formulas (Polberger et al., 1996) or weaning foods (Davidsson et al., 1995) fail to show an effect on zinc absorption. Possibly, the differences between the effects of food fortified with iron compared with supplemental iron are because of differences in the dose and form of iron given. The amount of iron provided by supplements is greater than that in one serving of fortified cereal or formula and is in a highly soluble form, ie, ferrous sulfate, enabling the iron to readily bind with ligands in the intestine.

Efforts to integrate salient terms and discourses identified in this study into programming strategies, for example, culturally appropriate social and behaviour change communications promoting increased consumption of leafy green vegetables and other local nutrient-rich produce during pregnancy, could help amplify gains in maternal nutrition achieved by the previously recommended market-level interventions. This study's identification of perceptions of and barriers to ideal pregnancy diets can be incorporated into social and behavioural communication strategies accompanying interventions for improving maternal diets and pregnancy outcomes.

Table 1. Food Consumption Pattern

S.No	Cereals & Cereal Product	Daily	Weekly		Monthly	Occasionally	Never
			Once	Twice			
1	Rice	100	-	-	-	-	-
2	Ragi	-	34	16	19	10	21
3	Rice Flour	-	22	23	26	29	-
4	Wheat Flour	44	18	26	12	-	-
5	Vermicelli	-	15	15	32	9	29
6	Semolina	-	25	3	28	39	5
	Pulses & Legumes						
7	Black gram dhal	85	-	65	-	-	-
8	Bengal gram dhal	-	19	18	20	37	6
9	Chick Peas	8	16	17	29	10	20
10	Green Peas	12	20	15	12	19	22
11	Beetroot	70	12	16	2	-	-
12	Carrot	65	10	25	-	-	-
	Roots & Tubers						
13	Beetroot	70	12	16	2	-	-
14	Carrot	65	10	25	-	-	-
15	Potato	5	39	15	19	22	-
16	Sweet Potato	-	-	-	40	46	14
17	Others	-	-	26	16	28	30
	Green Leafy Vegetables						
18	Amaranth	40	-	34	19	7	-
19	Curry Leaves	80	6	14	-	-	-
20	Mint Leaves	30	28	22	20	-	-
21	Fenugreek Leaves	-	-	-	-	56	44
22	Spinach	-	35	12	16	9	28
	Other Vegetables						
23	Beans	5	28	15	30	20	2
24	Pumpkin	7	27	16	30	14	6
25	Cabbage	-	29	9	26	28	8
26	Ladies Finger	38	10	19	20	10	3
27	Cauliflower	-	36	18	24	12	10
28	Mushroom	-	29	15	28	17	11

Table 2. Clinical Assessment of the Subjects

S.No	Clinical Appearance	Percentage of the subjects
1	General Appearance	
	Good	**80**
	Fair	**18**
	Poor	**2**
2	Face	
	Normal	**62**
	Bright	**31**
	Acne	**7**
3	Hair	
	Normal	**12**
	Hair Loss	**50**
	Thinning Hair	**38**
4	Eye	
	Normal	**79**
	Poor Night Vision	**21**
	Cloudy Cataract	**Nil**
5	Tongue	
	Normal	**76**
	Loss of Taste	**10**
	Burning	**14**
6	Mouth	
	Normal	**43**
	Dry	**32**
	Burning	**25**
7	Nail	
	Normal	**95**
	Brittle Nails	**2**
	Nail Discolouration	**3**
8	Skin	
	Itching	**3**
	Patches	**10**
	Dry Skin	**87**

Table 3. Mean Anthropometric Measurement of the Selected Subjects (N=300)

S.No	Anthropometric Measurements	Mean Value and Standard Value of the Selected Subjects
1.	Height(cm)	**154.32+ 8.38**
2.	Weight(kg)	**63.01+10.5**
3.	Body mass index(BMI)	**26.52+4.05**

Table 4. Biochemical analysis of the selected subjects

S.No	Biochemical Estimation	Mean Value and Standard Value of the Selected Subjects
1.	Haemoglobin	10.664 +_ 8.254
2.	Zinc	65.223+_15.22

ACKNOWLEDGEMENTS

I extend my acknowledgement for the financial assistance from the UGC-SERO, Hyderabad in the form of Minor Research Project and also I thank our Management to accomplish my research work.

References

[1] Anyzewska A, Wawrzyniak A, Wozniak A, Krotki M, Górnicka M. Nutritional assessment in Polish men with cardiovascular diseases. Rocz Panstw Zakl Hig 2013;64:211-5.

[2] Apgar J. Zinc and reproduction: an update. Journal of Nutritional Biochemistry. 1992;3:266–278.

[3] Beghin I, Cap M, Dujardin B. A Guide to Nutritional Assessment. Geneva: WHO Press; 1988.

[4] Caulfield LE, Zavaleta N, Shankar AH, Merialdi M. Potential contribution of maternal zinc supplementation during pregnancy to maternal and child survival. American Journal of Clinical Nutrition. 1998;68:499S–508S.

[5] Davidsson L, Almgren A, Sandström B, Hurrell RF. Zinc absorption in adult humans: the effect of iron fortification. Br J Nutr 1995; 74: 417–25.

[6] Englund-Ogge L., Brantsæter A.L., Sengpiel V., Haugen M., Birgisdottir B.E., Myhre R., Meltzer H.M., Jacobsson B., Brantsaeter A.L. Maternal dietary patterns and preterm delivery: Results from large prospective cohort study. BMJ. 2014;348:g1446.

[7] Herder R, Demmig-Adams B. The power of a balanced diet and lifestyle in preventing cardiovascular disease. Nutr Clin Care 2004;7:46-55

[8] Hillesund E.R., Bere E., Haugen M., Overby N.C. Development of a New Nordic Diet score and its association with gestational weight gain and fetal growth—A study performed in the Norwegian Mother and Child Cohort Study (MoBa) Public Health Nutr. 2014;17:1909–1918.

[9] Jonsson K., Barman M., Moberg S., Sjoberg A., Brekke H.K., Hesselmar B., Johansen S., Wold A.E., Sandberg A.S. Fat intake and breast milk fatty acid

composition in farming and nonfarming women and allergy development in the offspring. Pediatric Res. 2016;79:114–123.

[10] Karamanos B., Thanopoulou A., Anastasiou E., Assaad-Khalil S., Albache N., Bachaoui M., Slama C.B., El Ghomari H., Jotić A., The MGSD-GDM Study Group et al. Relation of the Mediterranean diet with the incidence of gestational diabetes. Eur. J. Clin. Nutr. 2013; 68:8–13.

[11] King JC, Cousins RJ. Zinc. In: Shils ME, Shike M, Ross AC, Caballero B, Cousins RJ, editors. Modern Nutrition in Health and Disease. 10. Philadelphia, PA: Lippincott Williams & Wilkins; 2006. pp. 271–285.

[12] Malara A, Sgro G, Caruso C, Ceravolo F, Curinga G, Renda GF, et al. Relationship between cognitive impairment and nutritional assessment on functional status in Calabrian long-term-care. Clin Interv Aging 2014; 9:105-10.

[13] O'Brien KO, Zavaleta N, Caulfield LE, Wen J, Abrams SA. Prenatal iron supplements impair zinc absorption in pregnant Peruvian women. Journal of Nutrition. 2000;130:2251–2255.

[14] Park K. Nutrition and health. In: Park K, editor. Textbook of Preventive and Social Medicine. 20 th ed. Jabalpur: Banarsidas Bhanot; 2009. p. 562-4.

[15] Polberger S, Fletcher MP, Graham TW, Vruwink K, Gershwin ME, Lonnerdal B. Effect of infant formula zinc and iron level on zinc absorption, zinc status, and immune function in infant rhesus monkeys. J Pediatr Gastroenterol Nutr 1996; 22 : 134 – 43.

[16] Price S. Understanding the importance to health of a balanced diet. Nurs Times 2005;101:30-1.

[17] Ramakrishnan U., Grant F., Goldenberg T., Zongrone A., Martorell R. Effect of Women's Nutrition before and during Early Pregnancy on Maternal and Infant Outcomes: A Systematic Review. Paediatr. Périnat. Epidemiol. 2012;26:285–301.

[18] Solomons NW, Ruz M. Zinc and iron interaction: concepts and perspectives in the developing world. Nutr Res 1997; 17:177–85.

[19] Solomons, NW, Pineda O, Viteri F, Sandstead HH. Studies on the bioavailability of zinc in humans: mechanism of the intestinal interaction of nonheme iron and zinc. J Nutr 1983; 113: 337 – 49.

[20] Solomons,NW. Competitive interaction of iron and zinc in the diet: consequences for human nutrition. J Nutr1986;116:927–35.

[21] Tefft ME, Boniface DR. Estimating food and nutrient intake from food frequency questionnaire data by reference to a standard weighed diet survey. J Hum Nutr Diet 2000; 13:219-24.

[22] Wang B, Yan X, Cai J, Wang Y, Liu P. Nutritional assessment with different tools in leukemia patients after hematopoietic stem cell transplantation. Chin J Cancer Res 2013; 25: 762-9.