Original Article

DIET HISTORY AND BIRTH WEIGHT RELATIONSHIP AMONG SAUDI PREGNANT WOMEN

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ABSTRACT

Objective: The aim of this study was to see the relationship between food intake pattern and its effect on birth weight.

Subjects and Methods: 1771 Saudi pregnant women who were admitted for delivery at the government maternity hospitals in Riyadh city of Saudi Arabia who gave birth to singleton live-born babies were interviewed immediately after delivery.

Results: During the pregnancy the average energy and protein intakes were 1815.7±624Cal. and 86±30.9g, respectively. Intakes of vitamins A and B12 supply 90% and 92% of RDA for each nutrient, respectively. The intake of 94%, 91% and 90% of women were below 85% of RDA for folate, iron and vitamin B1, respectively.

Conclusions: Mothers of heavier infants have significantly higher average intake of most nutrients. Intake level of individual nutrients correlates significantly with NAR index which parallel the findings for individual nutrient intakes and was the only variable in the regression equation calculated.

KEY WORDS: Pregnancy, Maternal nutrition, Birth weight.

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INTRODUCTION

Pregnancy is a natural phenomenon during which women encounter a wide range of internal physical and emotional changes. Quantification of the impact of nutrition on human reproductive performance is important to planners and to justify investment in maternal nutrition programs. This impact should reside in the current pregnancy for intervention to be effective.[1] Pregnancy and the outcome growth are affected by maternal and various environmental and demographic factors.[2] Growth in the intrauterine phase is dependent upon genetic factors and environmental support. Placental factors include vascular abnormalities, placental hormones and hypoxia. Chromosomal abnormalities or syndromes within the fetus itself influence fetal growt.[3] Because birth weight is often used as an indicator of the successful outcome of pregnancy, studies have attempted to explain variability in birth weight attributable to these factors.[4-8] The positive relationship between maternal nutrition and birth weight has been reported under acute starvation[9-11] but less clear with moderate levels of malnutrition.[12-14] In general, some studies have included dietary factors[4,15] and / or examine overall dietary quality as an independent variabl.[16] Assessment of dietary intake during pregnancy is important because it is well established that both nutrient deficiencies and excesses can have adverse effects on pregnancy outcome.[17]

Among groups of pregnant women in Saudi Arabia, deficiency of Vitamin D, nutrition knowledge and food habits has been studied.[18-21] The effect on birth weight in

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relation to other factors was also investigated.[22] However, literature on the nutritional status of Saudi pregnant women is scarce, and the relationship between maternal nutrition and the birth weight of infants demand further attention. This study was designed to measure the dietary intake and nutrition adequacy of Saudi women throughout pregnancy and to relate the birth weight of infant born to these nutritional factors.

SUBJECTS AND METHODS

A total of 1771 Saudi pregnant women were interviewed soon after delivery for their food intake during the current pregnancy. The data were collected 24 hours after delivery from women delivered at the government maternity hospitals in Riyadh city. A structured food frequency recall questionnaire was used in which most common food items were included. Additional items of food were also incorporated according to the mother's consumption. The foods were grouped into exchange lists, their nutrient content analyzed and food scores calculated with a maximum score of 25 for each of the food groups. All figures were compared to the Recommended Dietary Allowances (RDAs) for pregnant women.[23] The data was then used to estimate intake levels of energy, twelve nutrients and five food groups, and to calculate a nutrient adequacy ratio index (NAR). Nutrients estimated were protein, vitamin A, vitamin C, vitamin B1, vitamin B2, vitamin B6, vitamin B12, calcium, phosphorus, Iron and folate. The food groups were milk, fruit, vegetable, cereal and meat group. The NAR index for each pregnant women was obtained by converting intake to percentage of RDA for 12 nutrients, truncating amounts over 100% so that excessive amounts of some nutrients would not affect the index, and then averaging the percentages, a procedure similar to that used by Philipps and Johnson.[15] Data on neonatal outcome was obtained from the babies' medical records for singleton live-born babies.

To relate infant birth weight to food intake and nutrition adequacy of expecting mother, pregnant women under study were grouped according to their intake above and below the RDA level for each nutrient. The resulting average birth weight was then calculated. Average intake from each nutrient and food group was also determined for the mothers having babies with weight below and above 2500g.

Data coding was carried out using commercial Dbase IV and the subsequent analyses were performed by the use of SPSS/PC+ statistical package.

RESULTS

The average of daily intakes, intake as a percentage of the RDA and the percentage of women with intake below 85% of the RDA for energy and selected nutrients are presented in Table-I. Average energy and protein intake were 1815.7±624 Cal and 86±30.9g which provided around 65.7% and 96.0% of the recommended levels of each respectively. Pregnant women had an intake levels that supply 90.5% and 92% of RDA for vitamins A and B12 respectively. Folate, Iron and vitamin B1 intakes were below 85% of RDA for 94%, 91% and 89.6% of women respectively. The average intake was less than the RDA for zinc followed by magnesium, and meet the recommended for niacin. The average NAR index was 69.17% of total RDA for the 12 nutrients included. Average score of intake of food groups and the percentage of women with intake below 85% of the RDA exchange for each group are shown in Table-II. The consumption of milk, meat, and vegetable groups fill below 85% of the RDA for 85.7%, 79.4%, and 53.3% of the pregnant women respectively, and meet the recommended exchanges among 81.8% and 84.2% women for fruit and cereal groups respectively. The NAR index parallel the findings for individual nutrient intakes.

Table-III presents the average of infant birth weight for women with intake below and above RDA levels for each nutrient. Average birth weight was slightly higher among mothers with intake above 85% of the recommended, compared to those with less intake. The birth

Table-I: Average daily intakes; the average intake as a percentage of the RDA and the percentage of women with intake below 85% of the RDA for energy and selected nutrients.

Nutrient	*Mean ± SD*	*RDA*	*intakeof RDA*[a]	*% below 85% RDA*[b]
Calorie (Cal)	1815.74 ± 624.06	2700	65.70 ± 19.58	54.5%
Protein (g)	85.99 ± 30.90	60	96.03 ± 11.04	9.8%
Vitamin A (Mg RE)	1034.96 ± 480.02	800	90.45 ± 18.19	29.3%
Vitamin C (mg)	75.87 ± 43.07	70	82.40 ± 22.92	40.5%
Folate (Mg)	77.75 ± 26.74	400	19.43 ± 6.69	94.0%
Vitamin B1 (mg)	71.00 ± 0.27	1.5	46.84 ± 17.48	89.6%
Vitamin B2 (mg)	1.77 ± 0.80	1.6	86.79 ± 19.33	29.5%
Vitamin B6 (mg)	1.27 ± 0.51	2.2	56.85 ± 21.41	72.4%
Vitamin B12 (Mg)	3.12 ± 1.58	2.2	91.97 ± 16.83	19.3%
Calcium (mg)	897.17 ± 450.68	1200	68.46 ± 25.10	72.2%
Phosphorus (mg)	1253.32 ± 467.96	1200	87.63 ± 17.73	37.9%
Iron (mg)	11.22 ± 4.19	30	37.37 ± 13.97	91.1%
Magnesium (mg)	246.33 ± 97.74	320		
Zinc (mg)	6.49 ± 2.79	15		
Niacin (mg NE)	17.81 ± 7.85	17		
Carbohydrate (g)	250.92 ± 101.04			
Total Fat (g)	43.49 ± 18.37			
Cholesterol (mg)	286.01 ± 151.92			
NAR index	69.17 ± 13.70			

[a] The average of intake among pregnents as a percentage of RDA for each nutrient.
[b] The percentage with intakes below 85% of the RDA.

weight difference was significant with higher intake of vitamin A, vitamin C, phosphorus ($P \leq 0.001$), vitamin B2 ($P \leq 0.05$), and was insignificant in respect to energy and other nutrients including protein intake. Means of intake for mothers with birth weight below and above 2500g for nutrient and food groups are presented in Table-IV and Table-V respectively. Mothers with infant weight over 2500g show a significant higher intake of energy and nutrients, except Niacin. Their RNA index was 69.50±13.47% which is significantly higher than that for those with smaller infant weight, 65.34±15.72.

DISCUSSION

In a simple correlation test, intake level of individual nutrients correlates significantly with overall adequacy measured by RNA index ($P \leq 0.001$). Both show no correlation with the resulting birth weight of infants. In multiple regression stepwise method, to predict birth weight, the total R^2 was 0.069, with RNA index being the only variable in the equation.

An appropriate eating pattern is essential throughout the childbearing years and during pregnancy to ensure a healthy pregnancy and baby.[24] In a country such as Saudi Arabia where food is easily available, nutritional status of women during the course of pregnancy is expected to be compatible to those in other societies with similar standards of living. In this study the averages of intake of Saudi pregnant women for energy and selected nutrients were compared to the recommended daily allowance.

Pregnant women in this study found to consume on average 65.7±20% of the recommended calories which left more than 54.5% of them below two third of RDA level. Almost all pregnant women included had a level of intake far below the recommended from

Table-II: Scores of intake of food groups and the percentage of women with intake < 85 % of the RDA exchanges.

Food groups	*Mean+SD*[a]	*RDA Exchange*	*% women below 85 % of RDA*
Milk	15.92 ± 6.95	4-5	85.7
Fruit	23.26 ± 4.23	2-3	18.2
Vegetable	21.11 ± 2.51	2-3	53.3
Cereal	23.62 ± 3.67	4-6	15.8
Meat	19.24 ± 6.15	7-8	79.4

[a] Maximum score is 25.

Table-III: means of birth weight for women with itake < and ≥RDA levels for each nutrient.

Nutrient	*Birth Weight Mean ± SD*		
	Group 1[a]	*Group 2*[b]	*P Value*
Calorie	3194.83 ± 595.21	3227.14 ± 521.22	0.22
Protein	3181.42 ± 615.30	3212.56 ± 557.00	0.48
Vitamin A	3151.23 ± 609.62	3233.71 ± 540.67	0.001
Vitamin C	3163.82 ± 599.59	3240.67 ± 534.42	0.001
Folate	3209.53 ± 562.84		
Vitamin B1	3207.63 ± 566.61	3250.63 ± 474.98	0.50
Vitamin B2	3164.90 ± 599.98	3228.24 ± 545.68	0.02
Vitamin B6	3204.00 ± 574.57	3224.04 ± 531.11	0.50
Vitamin B12	3177.60 ± 581.79	3217.16 ± 558.15	0.24
Calcium	3209.38 ± 580.06	3209.91 ± 516.04	
Phosphorus	3162.86 ± 598.21	3238.01 ± 538.41	0.003
Iron	3209.19 ± 564.54	3246.87 ± 330.38	0.78

[a] Birth weight for group of mothers with intake < 85% of the RDA.

[B] Birth weight for group of mothers with intake ≥ 85% of the RDA.

folate, iron and vitamin B1. Meat, milk and vegetable groups were below the consumption level expected.

In interpreting the insufficient intake observed, certain factors are worth mentioning. First, this study was carried out at government hospitals in which a larger percentage of deliveries are that for women of low and middle socioeconomic levels. Second, the RNA index value obtained parallel the findings for individual nutrient intakes which may support its use as a better overall measure to test the adequacy of mother's diet. In this regard, the quality of the mother's diet expressed as NAR index determined by this study is somewhat comparable to that of American women, 74.7±12.8.[17]

Birth weight was slightly affected by level of intake of most nutrients and food groups (Tables III-V). Higher intake and higher RNA index, on average, resulted on heavier babies and smaller babies were born to mothers who had less intake of nutrients and food groups during pregnancy. However, Hutcheon, et al [25] related higher birth weights to increased maternal age, pre-pregancy body mass index, weight gain during pregnancy and carbohydrate intake. Such relative adequacy of nutrients and food choice of food groups as found in this study did not, on average, determine (insignificant figures) the positive effect on birth ≥ weight. The absence of a meaningfull positive correlation between either individual nutrients

Table IV: Means of intake for mothers with birth weight < and ≥2500g for selected nutrients.

Nutrient	*Intake (Mean ± SD)*		
	Group 1[a]	*Group 2*[b]	*P Value*
Calorie (Cal)	1692.28 ± 593.34	1826.51 ± 625.69	0.01
Protein (g)	79.69 ± 28.94	86.54 ± 31.01	0.01
Vitamin A (Mg RE)	895.93 ± 441.17	1047.09 ± 481.48	0.004
Vitamin C (mg)	69.36 ± 40.17	76.43 ± 43.27	0.05
Folate (Mg)	72.97 ± 27.66	78.16 ± 26.62	0.02
Vitamin B1 (mg)	0.64 ± 00.24	0.71 ± 0.27	0.00
Vitamin B2 (mg)	1.57 ± 00.69	1.79 ± 0.80	0.001
Vitamin B6 (mg)	1.17 ± 00.50	1.27 ± 0.51	0.02
Vitamin B12 (Mg)	2.80 ± 01.27	3.15 ± 1.60	0.01
Calcium (mg)	809.70 ± 413.75	905.89 ± 453.05	0.01
Phosphorus (mg)	1150.28 ± 443.13	1262.31 ± 469.11	0.003
Iron (mg)	10.27 ± 3.99	11.29 ± 4.20	0.001
Magnesium (mg)	225.12 ± 94.06	248.17 ± 97.86	0.001
Zinc (mg)	5.94 ± 02.45	6.53 ± 2.80	0.01
Niacin (mg NE)	16.95 ± 07.29	17.88 ± 7.89	0.17
Carbohydrate (g)	234.37 ± 93.10	252.36 ± 101.60	0.04
Total Fat (g)	39.68 ± 17.04	43.81 ± 18.45	0.003
Cholesterol (mg)	259.84 ± 143.54	288.29 ± 152.46	0.03
NAR index	65.34 ± 15.72	69.50 ± 13.47	0.002

[a] Mothers with newnate birth weight < 2500g.

[b] Mothers with newnate birth weight 2500g.

Table-V: means of intake for mothers with birth weight < and ≥ 2500 g for food groups.

Food groups	*Mean±SD*	*Intake score Mean±SD*		*P Value*
		Group 1[a]	*Group 2*[b]	
Milk	15.92 ± 6.95	14.80 ± 7.27	16.02 ± 6.92	0.04
Fruit & Veg	23.26 ± 4.23	22.56 ± 4.85	23.32 ± 4.17	0.04
Cereal	23.62 ± 3.67	23.26 ± 3.94	23.65 ± 3.65	0.21
Meat	19.24 ± 6.15	18.14 ± 6.48	19.33 ± 6.11	0.02

[a] Mothers with newnate birth weight <2500g.
[b] Mothers with newnate birth weight ≥2500g.

or food group intakes and birth weight indicate that birth weight was not determinal factor among mothers, regardless of their level of intake. The NAR index being the only variable in the regression equation calculated, support its use as a better determinant of birth weight. Studies investigating the association between women diet and the outcome of pregnancy, reported inconsistent results.[26] In their study, Seiler and Fox [27] found no significant correlation between dietary score and birth weight. This absence of clear relationship between birth weight and food intake during pregnancy on those studies could be due in part to the fact that most of the women of the studied populations were relatively well noriushed. In this study, the average intake was insufficient indicator of birth weight for both groups. Furthermore, the number of women included in this study, having an outcome with birth weight <2500g was 140 compared to 1631 women who gave birth weight ≥2500g. Although there is evidence for the importance of maternal nutrition as a determinant of the course and outcome of pregnancy, inconsistent results being reported from attempts to find direct correlation between diet and birth weight of infants.[1,17] There appears to be a minimal level of nutrients which must be available in order to obtain adequate birth weight. However, above this minimum level, pregnant women can adapt themselves to a wide variety of food intake, both in quantity and quality, without affecting birth weight.[28]

In conclusion, the observed low intake of energy may divert the use of sufficient ingested protein as a source of energy and in turn may make such diet inadequate even for protein. The amounts of iron and folate provided in the pregnant women's diet, could not meet the greatly increased requirements during this state of life. And even though those nutrients are widely supplemented for pregnant women around the country, the observed magnitude of their deficiency should raise a health concern and worth deeper investigation. In this respect, Turner, et al [29] concluded that the participants in their study did not consume adequate amounts of iron from food to meet the needs of pregnancy, and therefore iron supplementation is warranted in that population. The average diet (as revealed in this study) is deficient in important nutrients and the importance of micronutrients, specially of plant source, is to be addressed along with vitamin D and calcium which has been proven by others as deficient.[23,18]

The upraise for nutrition awareness programs among pregnant women is recommended. Food preferences should be encouraged to accommodate suitable sources in term of adequate energy and micronutrient intakes. The fact that the average of low birth weight rate is within an acceptable figure should not lead to overlooking of other less observed signs and effects of nutrient deficiencies. However, there could be other factors responsible for low birth weight in spite of maternal nutrition.

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