PRENATAL DIET, NUTRIENT INTAKE AND PREGNANCY OUTCOME IN URBAN ECUADORIAN PRIMIPARAS

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SUMMARY

A nutritional survey was conducted in an urban public maternity hospital, Hospital Gineco-Obstétrico Isidro Ayora (HGOIA), located in Quito, Ecuador. Seventy-four primiparas in the third trimester of pregnancy were recruited to assess the influence of sociedemographic factors on food patterns and nutrient intake, and the interrelationship between prenatal nutrient intake, maternal weight gain and pregnancy outcome. Results of the regression analysis indicated that maternal education was the factor most strongly associated with nutrient intake, followed by monthly *per capita* income. Maternal nutrient intake was next analyzed and compared with the WHO (1974,1985) and NRC (1980) recommended daily allowances. Results also indicated the average daily intake of energy, protein, phosphorus, vitamins C and A, thiamine, riboflavin, and niacin met or exceeded the recommended daily allowances. Dietary calcium and iron intake, however, were below recommendations. Sodium and fat intake were both relatively high. Higher dietary fat intake was associated with increased birth weight, while lower protein intake was associated with increased risk of delivering a low-birth weight baby. Maternal weight gain during the third trimester predicted baby birth weight and height but not head circumference.

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INTRODUCTION

The relationship between maternal nutritional status and pregnancy outcome is well documented. In particular, nutrient deficiencies and insufficiencies have been correlated with suboptimal pregnancy outcome measures including low pregnancy weight gain (1, 2), pregnancy-induced hypertension (3-5), maternal anemia and postpartum hemorrhage (6,7), perinatal death (8), prematurity, low-birth weight, intrauterine growth retardation (1,2,7,9), and infectious disease (10,11). Undernutrition or malnutrition is regarded as one of the most significant public health problems in the Republic of Ecuador (7, 12-14). Poor preconception and prenatal nutritional status have been linked with the high incidence of maternal and perinatal mortality observed in urban and rural Ecuadorian populations (7, 12, 15). However, this hypothesized relationship has not been documented as yet, since little information exists on the specific prenatal dietary habits and nutritional status of pregnant Ecuadorian women, except for a recent study of serum iron values (16) and anecdotal observations (17). Unfortunately, although knowledge of specific social and demographic factors is crucial for effective nutrition and health program planning, almost nothing is known about the role of these (i. e., maternal income, education, occupation, etc.) in affecting prenatal nutritional status and/or pregnancy outcome in Ecuadorian women.

Thus, the overall objective of this study was to investigate the dietary habits, nutritional status, and pregnancy outcome of primiparas at an urban public maternity hospital in Quito, Ecuador in an attempt to identify the interrelationaship of social and nutritional factors in influencing maternal and perinatal pregnancy outcomes. Specific objectives were to: 1) quantify maternal intake of 14 major nutrients and compare these with the WHO (1974, 1985) and NRC (1980) RDA's for pregnant women; 2) to assess the relatinship of maternal sociodemographic factors with food patterns and nutrient intake; 3) ascertain the relationship between nutrient exposure and maternal weight gain patterns; 4) investigate the relationship between maternal weight gain patterns and pregnancy outcome, and 5) assess the relationship of nutrient status to maternal and perinatal pregnancy otucome measures.

MATERIAL AND METHODS

Study Site and Subject Selection

The study was conducted at the Hospital Gineco-Obstétrico Isidro Ayora (HGOIA), a large, full-service public maternity hospital in Quito operated by the Ministerio de Salud Pública (MSP). Primiparas in their third trimester of pregnancy were recruited from the HGOIA prenatal clinic during a 6-month period (July 1987-December 1987). The first interview time period (28-32 weeks) was chosen because we were interested in the effect of third-trimester nutriture on pregnancy outcome and because the subjects were also being evaluated to determine whether the "roll-over test", a non-invasive procedure could accurately predict the future development of pregnancy-induced hypertension (18). All patients who met the above criteria, who were free of any

serious underlying medical disorder (e.g., hypertension, diabetes, renal disease), and who agreed to participate were entered into the study (n=78). All subjects received normal prenatal care according to the MSP-HGOIA protocol (19). Seventy-four subjects (95%) completed the study while four subjects were excluded for non-compliance with the study protocol, e. g. failure to continue prenatal care al HGOIA.

Data Collection and Analysis

All subjects were interviewed with a structured 3-part instrument, on two occasions, during the third trimester. The first interview occurred between 28 and 32 weeks of pregnancy and the second, four weeks later, between weeks 32 and 36. Interviews were conducted in the HGOIA prenatal clinics by three investigators (MMW, AL, MN) during regularly scheduled patient visits. The first portion of the interview included questions on patient sociodemographic characteristics and physical activity patterns. The second portion of the interview collected information on smoking and drinking patterns, use of prescription or over-the-counter medications, and intake of vitamin-mineral preparations and/or other dietary supplements. The third portion of the interview was a dietary recall which elicited information on foods and quantity consumed, methods of preparation, and eating patterns during the prior 24-hour period. The trained investigators used a variety of standard Ecuadorian plates, bowls, cups and other utensils as well as three-dimensional figures of certain food items (e.g., steak, hamburger, poultry, fish, seafood, cheeses) to determine food quantities and serving sizes. Each patient was also asked about types and quantity of individual ingredients, salt and other condiments used in all recipes. Food intake, frequency and portion sizes were then entered onto a standard form during the interview, and later coded for data entry and analysis. dietary intake of calories, protein, fat, carbohydrates, calcium, phosphorus, iron, ascorbic acid, vitamin A, riboflavin, niacin, thiamine, sodium and fiber were analyzed using a computerized version of the 1965 Tabla de Composición de Alimentos Ecuatorianos (TCAE) (20) developed by the primary author for use in the research population. Other nutrients of possible interest were not analyzed since, with the exception of sodium, they are not contained in the TCAE. Partial sodium consumption of subjects was measured by asking each individual about the amount of table salt added to each recipe or dish during preparation and/or consumption.

In addition, medical, obstetrical and maternal anthropometric data were recorded for each subject al each regular prenatal visit. These included weight, height, blood pressure, uterine fundal height, and serum and urinary biochemical analyses. Maternal and perinatal pregnancy outcome were recorded at delivery and included pregnacy weight gain, blood pressure patterns and pregnancy-induced hypertension devolopment, gestation length, birth weight, height, head circumference, one- and five-minute Apgar scores, and presence/absence of fetal anomalies. These data, where available, were compared with those of Vasconez and colleagues (21) who conducted an analysis of the anthropometric characteristics of over 4.000 newborns at the HGOIA site.

Three analytic models employing correlational and multiple regression methods were used to address the study's basic objectives: Model #1 ascer-

tained the relatinship between sociodemographic variables (maternal age, ethnic status, marital status, education, monthly *per capita* income, and maternal occupation and nutrient intake. model #2 assessed the relationship between nutrient intake and pregnancy outcome (including pregnancy weight gain patterns). Model #3 investigated the relationship between pregnancy weight gain patterns and measures of pregnancy outcome. The multiple regression method utilized was the inital forced entry of all variables, with backward elimination of all non-significant ($P > 0.05$) variables.

RESULTS

Subject Sociodemographic Characteristics

The mean maternal age of the sample was 20.8 years (range 15-44); almost 30% of the subjects were adolescents. Most subjects were of mestizo ethnic background (95%) and the majority were legally married (67.6%) by the time of the first interview. The major occupation of most women was that of housewife (56.8%) although 17.6% of the subjects also reported having a dual occupational status of housewife/student or housewife/white collar worker. Subjects were fairly well educated: 53% (n=39) had completed at least 10 years of formal schooling; 36% had completed at least ono year of college or technical school. Only one-fourth of subjects had a primary school education or less. Mean maternal *per capita* income was $9,000 sucres/month. None of the subjects reported drinking, smoking, or drug use during pregnancy. The results of repeated medical examinations appeared to confirm the absence of these behaviors in the subjects.

Maternal Nutrient Intake

The results of the two 24-hour dietary recalls for 14 nutrients are presented in Table 1. The correlations between levels of nutrient intake for the first and the second visit were high for the majority of nutrients. In addition, there were no significant changes in mean intake of subjects between the first and second visits with respect to the majority of nutrients analyzed (Table 2: paired t-test).

Dietary Energy Intake

The mean energy intake of 2663.6 kcal was 110% of the NRC (22) RDA or 104% of the WHO (23) recommendations (Table 2). Carbohydrates were the major energy source (59%) in the diet. As Table 2 shows, subjects consumed an average of 386.5 grams of carbohydrate/day, mainly derived from rice, potatoes, tubers, fruits, vegetables, and grains. Fats accounted for the second largest energy source in the diet (i. e., 27% of total kilocalories) or a mean intake of 85 grams/day (Table 2). Meat and other animal products such as milk and cheese contributed a large proportion of the dietary fat component. Another significant source were the added saturated animal and non-animal fats and oils (i. e., pork, beef, palm, coconut), commonly used in frying and baking, followed by soy and other non-saturated oils. Combined animal and

TABLE 1

THIRD TRIMESTER NUTRIENT INTAKE IN ECUADORIAN PRIMIPARAS (n = 74)

Nutrient	Visit I Mean	Visit I (SD)	Visit II Mean	Visit II (SD)	Pearson's r	p[1]	Mean diff.	p[2]
Energy (kcal)	2,660.7	(1,096.1)	2,666.5	(1,070.9)	0.552	0.001	-5.82	0.964
Pretein (g)	101.6	(65.8)	91.8	(38.5)	0.432	0.001	9.82	0.204
Fat (g)	83.4	(51.6)	86.5	(47.5)	0.192	0.134	-3.09	0.701
Carbohydr. (g)	379.0	(167.3)	394.0	(188.4)	0.558	0.001	-14.99	0.485
Calcium (mg)	933.7	(475.2)	923.3	(562.4)	0.370	0.003	10.39	0.889
Phosyph. (mg)	1,446.6	(543.0)	1,475.3	(584.1)	0.575	0.001	-8.87	0.894
Iron (mg)	19.1	(9.8)	17.8	(0.9)	0.468	0.001	1.26	0.279
Vit A. (μg RE)	1,046.9	(28.5)	1,039.9	(24.7)	0.134	0.236	7.01	0.804
Thiamine (mg)	1.9	(0.9)	1.9	(0.1)	0.556	0.001	0.02	0.799
Ribofl. (mg)	1.9	(0.8)	1.8	(0.8)	0.652	0.001	0.05	0.519
Niacin (mg)	22.5	(9.1)	22.9	(8.8)	0.345	0.006	-0.42	0.746
Vit. C (mg)	233.0	(177.5)	202.2	(155.2)	0.246	0.054	30.85	0.241
Sodium (mg)	3,499.6	(1,480.7)	3,491.1	(1,278.8)	0.326	0.010	8.48	0.967
Fiber (g)	9.9	(8.4)	12.1	(12.7)	0.096	0.454	-2.20	0.241

1 Two-tailed p for correlation coefficient.
2 Two-tailed p for individual change (paired t-test).

TABLE 2

COMPARISON OF MEAN NUTRIENT INTAKE WITH RDA's FOR ADULT PREGNANT WOMEN [1,2,3]

Nutrient	Current study mean intake of subjects	(SD)	US RDA[1]	% of US RDA	WHO RDA[2,3]	% of WHO RDA
Energy (kcal)	2,663.60	(954.7)	2,400.00	(111%)	2,550.00	(104%)
Pretein (g)	96.73	(44.7)	74.00	(131%)	47.25	(204%)
Fat (g)	84.98	(38.3)				
Carbohydr. (g)	386.50	(157.1)				
Calcium (mg)	928.50	(430.1)	1,200.00	(77%)	1.0-1.2g	(77-92%)
Phosyph. (mg)	1,471.38	(500.2)	1,200.00	(123%)		
Iron (mg)	18.49	(7.3)	30-60	(31-62%)	14-28	(66-132%)
Thiamine (mg)	1.96	(25.5)	1.50	(131%)	1.00	(196%)
Riboflavin (mg)	1.91	(0.8)	1.60	(119%)	1.50	(127%)
Niacin (mg)	22.76	(0.8)	16.00	(142%)	16.80	(135%)
Ascorbic acid (mg)	217.63	(7.3)	80.00	(272%)	30.00	(725%)
Vitamin A (μg RE)	1,043.45	(131.5)	1,000.00	(104%)	750.00	(139%)
Sodium (mg)	3.495.30	(1,125.1)				
Fiber (g)	11.01	(8.0)				

1 *Recommended Dietary Allowances,* NRC (1980) (22).
2 *Energy and Protein Requirements,* WHO (1985) (23).
3 *handbook on Human Nutritional Requirementes,* WHO (1974) (24).

plant protein intake accounted for only 14% of the third trimester dietary energy sources but total mean daily protein intakes (96.7 g) exceeded both the NRC and WHO RDA's (22,23) for pregnant adult women as is noted in Table 2.

Dietary Mineral Intake

Average daily calcium intake of 928.5 mg in the sample was about 77% of the NRC (22) and between 77-92% of the WHO (24) RDA for adult pregnant women (Table 2). The primary source of calcium in the diet was fluid milk (i. e., primarily as "café en leche") and other dairy products such as chesse and yoghurt. As the same Table indicates, mean phosphorus intake was 1,471. 4 mg/day or about 123% of the NRC (22) recommended daily allowance of 1,200 mg for adult pregnant women. Dietary iron intake averaged 18.5 mg/day as is depicted in Table 2 The NRC RDA (22) recommends increasing iron supplementation by 30-60 mg/day in women with inadequate pre-pregnancy iron stores, while the WHO (24) recommends from 14-28 mg elemental iron/ day during pregnancy. Dietary iron was derived fron a mixed diet of animal and vegetable sources and (inconsistently) from prenatal iron supplements.

There is no RDA for sodium, but the NRC (22) suggests that average daily intake for pregnant women should be an additional 69 mg/day of sodium over normal non-pregnant intake. Average daily sodium consumption of the pregnant subjects was almost 3,500 mg. Nevertherless, since the Tabla de Composición de Alimentos Ecuatorianos (20) does not list sodium content in foods, this figure is an underestimation of the true sodium consumption of the subjects as we were only able to calculate the sodium added as salt during cooking or at the table was considered.

Dietary Vitamin Intake

The dietary vitamin C content of the subjects diets was high, most of which came from the frequent consumption of a variety of fresh fruits, particularly tangerines, and fruit juices. In fact, the majority of subjects drank one to two 6-8 ounce glasses of juice per day during the third trimester. As table 2 shows, mean vitamin C intake was 217.6 mg/day or about 2.7 times the recommended U. S. RDA (22). In addition, average daily vitamin A intake was also above recommendations (i. e., 1,043.45, μg Re) as indicated in the same Table. other major sources of vitamins C and A were fresh salads incorporating fresh raw and slightly cooked vegetables, e. g., carrots, green beans, green peppers, tomatoes, potatoes, and green scallions. The average daily dietary intake of the B-vitamins thiamine, riboflavin and niacin met or exceeded the NRC (22) and WHO (24) RDA's for pregnant adults, as also shown in Table 2.

Soups were another significant source of both fat- and water-soluble vitamins as well as calories, protein, fats and carbohydrates. However, tha Ecuadorian food composition table listed the nutrient values for only two of the 20+ cooked soups consumed by subjects in this survey. Thus, the true content of the amounts of vitamin C and other heat-labile vitamins affected by prolonged cooking times and frequent reheating in many of the soups was probably overestimated, since a number of the recipes contained the fresh rather than coked values for some of the ingredients (i. e., tomatoes, scallions).

Maternal and Perinatal Pregnancy Outcome

Most subjects gained between 0.2 and o.4 kg a week during the third trimester. Data on total pregnancy weight gain was unavailable, due to the fact that most women did not come to HGOIA for the first prenatal visit until the second trimester, and most did not know their pre-pregnancy weight. We also observed a relatively high incidence of pregnancy-induced hypertension in the sample (37.6%, n=28), but this is consistent with previous figures at HGOIA in Ecuadorian primiparas (25, 26). Nevertheless, no subjects developed eclampsia, and no maternal deaths were recorded. Table 3 describes the data for measures of perinatal otucome, including mean gestation length (39 weeks) and incidence of prematurity (11.1%), mean birth weight (2,952 g) and incidence of low-birth weight (8.1%), average baby height (48.26 centimeters), average head circumference (34.86 cm) and other related data. One neonatal death occurred within two bours of birth as a result of multiple congenital abnormalities. Table 3 also indicates that the perinatal characteristics of the sample were similar to those reported previously at the HGOIA site by Vasconez *et al.* in 1984 (21) for a large sample of women of mixed parity (n= 4, 197).

TABLE 3

COMPARISON OF THE PERINATAL CHARACTERISTICS OF BABIES BORN TO HGOIA PRENATAL PATIENTS

Perinatal characteristic	Current study	Vasconez *et al.* (21)
Gestation length (wk)	39.07 (SD 1.75)	38.96
Premature births (<37 wk)	11.10 % (n=7)	8.40 % (n=352)
Mean birth weight (g)	2,952.34 (SD 355.8)	3,052.00 (SD 399.0)
Low birth weight (<2,500 g)	8.10 % (n=6)	
Mean baby length (cm)	48.26 (SD 3.99)	48.40 (SD 2.0)
Mean bead circumference (cm)	34.86 (SD 3.42)	33.80 (SD 1.1)

Maternal Sociodemographic Factors and Nutrient Intake

The results of the multiple regression analysis revealed the presence of several relationships between maternal sociedemographic variables and nutrient intake. Maternal educational level had the strongest correlation with the intake of calories, fats, carbohydrates, calcium, and iron compared to the other maternal variables (Table 4). This relationship was independent of the effects of other maternal sociodemographic variables, including monthly *per capita* income, maternal age, marital status, and occupation. As Table 4 also indicates, monthly *per capita* income was the next factor most strongly associated with nutrient intake. Specifically, higher *per capita* income was significantly associated with decreased intake of calories, carbohydrates, and iron.

TABLE 4

ASSOCIATION OF MATERNAL SOCIODEMOGRAPHIC FACTORS WITH MEAN NUTRIET INTAKE[1]

Nutrient	Family income	Education
Calories	-0.24 (P = 0.042)	0.34 (P = 0.003)
Fat		0.24 (P = 0.037)
Carbohydrates	-0.25 (P = 0.033)	0.28 (P = 0.018)
Calcium		0.27 (P = 0.019)
Iron	-0.27 (P = 0.019)	0.31 (P = 0.007)

1 Values expressed as partial correlation coefficients.

Maternal Nutrient Intake and Pregnancy Outcome

As Table 5 indicates, women who had higher fat intakes were significantly more likly to have babies with higher birth weights, independent of gestation length (P = 0.009), while those with lower dietary protein intakes during the third trimester were more likely to deliver low-birth weight infants (≤ 2,500 g). Higher maternal riboflavin and niacin consumption was also correlated with delivering higher birth-weight infants. It was also found that increased calcium consumption was associated with significantly shortened gestation length (P < 0.02), although not with the risk of premature delivery (< 37 weeks). The only nutrient observed to be associated with average weekly maternal weight gain was riboflavin (P < 0.04).

TABLE 5

ASSOCIATION OF MATERNAL NUTRIENT INTAKE WITH PREGNANCY OUTCOME MEASURES[1]

Nutrient	Average weekly wt. gain[2]	Gestation length	Birth weight[2]	Low birth weight[2] (≤ 2,500 g)
Protein (g)				-0.30 (P = 0.037)
Fat (g)			0.30 (P = 0.09)	
Calcium (mg)		-0.29 (P = 0.013)		
Thiamine (mg)			-0.29 (P = 0.049)	
Riboflavin (mg)	0.41 (P = 0.036)		0.34 (P = 0.017)	
Niacin (mg)			0.36 (P = 0.013)	

1 Values expressed as partial correlation coefficients.
2 Delivery week as covariate.

Maternal Weight Gain and Pregnancy Outcome

Increased average maternal weekly weight gain was significantly associated with increased baby birth weight and length ($P < 0.04$), although there was no apparent correlation between average weekly weight gain in the third trimester and baby gead circumference (Table 6).

TABLE 6

ASSOCIATION BETWEEN AVERAGE MATERNAL WEEKLY WEIGHT GAIN AND BABY ANTHROPOMETRIC MEASURES

Baby weight	Baby height	Baby head circumference
0.3114 (P = 0.031)	0.3105 (P = 0.032)	0.2013 (P = 01.170)

DISCUSSION

This study is the first to report on the dietary habits and nutrient intake of pregnant urban Ecuadorian women and the relationship of the latter with pregnancy outcome. Our results indicate that, based on their nutrient intake and weight gain patterns, this group of public hospital primiparas was relatively well nourished during the third trimester of pregnancy, at least for the nutrients analyzed. Although it is recognized that population-specific dietary recommendations are more appropriate for assessing the nutritional status of Andean area polations, such as our group of pregnant subjects, these are not yet available. Thus, this conclusion is based on comparisons with the NRC (22) and WHO/FAO (23, 24) RDA's.

As a group, the 74 subjects had diets which met or exceeded both the US (22) and WHO (23, 24) RDA's for energy, protein and six other major nutrients. The high carbohydrate intake observed in the current study is similar to data reported for Ecuadorian (12, 27) and other rural and urban Andean non-pregnant populations (28, 29). The quality of the mixed protein diet seemed adequate to meet the needs of pregnancy. The high fat content of the diet, however, especially the proportion contributed by saturated fats would appear to be greater than desirable (30, 31); this may be a contributing factor to the high population incidence of PIH.

The dietary intake of most of the minerals analyzed was sufficient to meet the needs of pregnancy, with a couple of exceptions. For example, although the reported calcium intake of our pregnant subjects was 500-600 mg/day mre than that reported for most Andean (non-pregnant) populations (29, 32, 33), it still provided only one-half to three-fourths of the calcium NRC (22) RDA for pregnant adolescents and adults. Since a large proportion of babies in Ecuador are born to adolescent mothers, the low dietary calcium intake may represent a considerable risk, as girls in this age group require increased calcium intake

(as well as other micro- and macronutrients) to support their physical growth and development, in addition to that of the the growing fetus (34).

We had assumed *a priori* that calcium intake would be even lower than what we observed, as there is a common but as yet unproven popular belief that many Andean populations, including those in Ecuador, do not consume many dairy products due to a high incidence of adult primary lactase deficiency. Based on the results of the current data, however, it appears that this condition may be less common than previously suggested. On the other hand, it is also possible that the higher than expected consumption of dairy products could be due to a progessive adaptation to lactose during pregnancy, as Villar and colleagues (35) have found recently in Guatemalan women.

The finding that over 25% of the pregnant subjects had low calcium intakes (i. e., below 500 mg/day) is important, since low prenatal calcium intake has been strongly linked to poor pregnancy outcome, especially increased risk for pregnancy-induced hypertension (PIH) in diverse populations, including Andean Ecuador (25), Colombia (3, 5), Ethiopia (36) and India (37). On the other hand, calcium supplementation in these calcium-deficient populations has been shown to attenuate late pregnancy blood pressure and/or to decrease PIH risk (4, 25, 38). The epidemiologic and clinical evidence indicates that the incidence of PIH in Ecuador is elevated compared to many other populations (15, 39), reanging from to 13-36% depending upon the characteristics of the group investigated (25, 38, 40-45). In the present study, subjects who developed PIH, on the average, consumed about 100 grams less per day dietary calcium, compared to subjects who did not develop PIH, although this difference was not statistically significant. These subjects also tended to consume several hundred more milligrams sodium per day (from table salt ingestion) and more saturated dietary fat. Both calcium and sodium have been linked with increased blood pressure (31).

We would like to note that it is possible that the level of calcium intake in our subjects was somewhat overstimated, since the grater part of this mineral in the diet came from the consumption of milk. Our preliminary analyses of random milk samples from several different commercial establishments in Quito indicate that adulteration with water may be a common practice among some "lecheros" in the area.

Previous reports have suggested that the prevalence of iron-deficiency anemia is high in the Ecuadorian population, with women of reproductive age and children at greater risk (7, 12, 44). We observed a mean daily intake of only 18 mg in our pregnant subjects, which is below the US (22) 30-60 mg or WHO (24) 14-18 mg RDA's. It is possible that iron absorption in the subjects was enhanced due to their high ascorbic acid intake. Nevertheless, since the available evidence (7, 12) also suggests that Ecuadorian women have deficient stores prior to conception, it is unlikely that given the level of the observed intake, the effects of enhanced absorption would be sufficient to meet the increased maternal and fetal physiological requirements associated with late gestation. The combined deficient pre-pregnancy and prenatal iron exposure have important consequences for maternal and perinatal outcome. Indeed, a recent study conducted at the HGOIA site by Calle *et al.* (16), reported that over 68% of pregnant subjects (n=84) were found to be deficient in serum iron. Furthermore, 45% were diagnosed as having iron-deficiency anemia (i. e., hemoglobin less than 12.3 g/dl) at the time of delivery. Thus, the evidence from

our dietary intake study combined with biochemical evidence of Calle (16) and others (7, 12), suggest that the high incidence of iron deficiency may be a significant factor in the high incidence of infant anemia and postpartum hemorrhage notified in Ecuador (7, 12, 15).

The present study did find a relationship between maternal nutritional exposure and pregnancy outcome, although the mechanism for some of the specific observed associations is unclear. One would hypothesize that the relationship between specific nutrients and perinatal outcome measures would be more or less reflected in prenatal weight gain patterns. We found that maternal weight gain as well as nutrient intake were correlated with measures of birth outcome (e.g., infant birth weight). However, no single nutrient was observed to affect both maternal weight gain patterns and measures of pregnancy outcome with the exception of riboflavin, which was associated with average maternal weekly weight gain and baby birth weight. Thus, as previous studies (1, 45-48) have indicated, the interrelationship between prenatal nutriture, weight gain patterns and pregnancy outcome, is not a simple one, and is influenced by a multitude of factors related to stage of gestation, nutrient absorption and bioavilability, and individual differences.

Potential confounding influences in any population include factors affecting nutrient absorption and utilization, interactions among nutrients, and infection and disease (6). In particular, our Ecuadorian population has a high incidence of gastrointestinal disorders and infections associated with food- and water-borne microorganisms. Other possible confounders in our sample may also include young maternal age (49, 50), low pre-pregnancy weight and stature (51, 52) and the physiologic effects of residence at a high altitude on the mother and fetus (53-56). Such factors need to be taken into consideration with respect to the interpretation of the current study's findings.

The observed relationships between sociodemographic factors and nutrient content of the maternal diet were interesting. Previous studies have shown that maternal education and *per capita* income have a significant effect on maternal-child nutrient intake patterns (57, 58). Nevertheless, although we had expected that better educated subjects would consume better-quality foods with higher nutrient density, the strength of this relationship over that of income with increased caloric, fat, carbohydrate, calcium and iron intake, was somewhat surprising. It may have been influenced by the fact that the majority of subjects were reasonably well educated and, at the time of the survey, a large proportion of the sample (i. e., almost 20%), were students enrolled in higher technical or university programs, and were attending the HGOIA public maternity hospital since they met the low income eligibility criteria for prenatal care.

The finding that monthly *per capita* income was less predictive of nutrient intake and, in fact, tended to be negatively associated with caloric, carbohydrate and iron intake was unexpected, since our *a priori* hypothesis was that this variable would be the most highly correlated with nutrient intake. We assumed that individuals with higher incomes are more likely to be able to afford more and better-quality food items. The explanation for this observed relationship is not clear. One possible reason, however, may be that higher-income women often have concerns about the effect of excess weight gain during pregnancy on prenatal and postnatal body image. Although we did not

query our subjects about their perceptions of ideal body image, anecdotal observations of higher income private prenatal patients in Quito suggests that this is often the case. In contrast, we have observed that many lower-income Ecuadorian women are often less concerned with a slender body image and, in fact, many view a more rounded body image as being positively correlated with fertility and health. As Leslie, Pelto and Rasmussen have suggested, cultural perceptions of body image on women's food intake patterns (59) as well as social pressures may play a greater role than previously thought, and warrant further study.

In conclusion, it appears that the overall diet of our pregnant third-trimester primiparas was generally well-balanced with adequate amounts of protein, energy and most other major nutrients. Nevertheless, the low dietary calcium and iron intakes remain a source of considerable concern, especially in populations such as HGOIA's where about a third of all prenatal women are young adolescents with special nutritional needs. Furthermore, the increased nutritional needs associated with higher altitude and chronic gastrointestinal infections, may also affect dietary adequacy during pregnancy.

A recent epidemiologic investigation of the nutritional status of Ecuadorian children (44) and our pilot study of the nutritional status of women of reproductive status in a rural, marginal population (27), indicate that the problem of adequate alimentation may be more severe in the rural areas of the country. Therefore, the results of the current study should not be generalized to areas other than the urban HGOIA catchment area.

Finally, the results of the study herein discussed, indicate that since maternal education was such a strong predictor of overall nutrient intake during pregnancy, in-house hospital or community prenatal nutrition education programs maybe a particularly cost-effective way to improve nutritional status and reduce the high incidence of poor pregnancy outcome in the population (60). In addition, our results further suggest that the current intensive nation-wide literacy program being conducted by the Ecuadorian Ministry of Education in both urban and rural areas, may have the added long-term benefit of not only augmenting the economic capacity of the country, but also of improving the nutritional an health status of pregnant women and their offspring through increasing the level of maternal education.

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RESUMEN

DIETA PRENATAL, INGESTA DE NUTRIENTES Y RESULTADOS PERINATALES EN PRIMIPARAS ECUATORIANAS DEL SECTOR URBANO

El presente estudio nutricional se llevó a cabo en el Hospital Gineco-Obstétrico "Isidro Ayora", del Ministerio de Salud Pública en Quito, Ecuador. Se valoró en 74 primigestas, durante el tercer trimestre de gestación, la influencia principalmente de factores sociodemográficos en los patrones de alimentación e ingesta de nutrientes; y la interrelación entre ingesta de nutrientes, peso materno ganado y resultados perinatales. El análisis de regresión demostró que la educación materna, seguida por el ingreso materno, fueron los factores más influyentes en la ingesta de nutrientes en general.

Se analizó esta última y se comparó con las recomendaciones diarias permitidas por la OMS (1974, 1985) y el NRC (1980), encontrándose que la ingesta de energía, proteínas, fósforo, vitaminas C y A, tiamina, riboflavina y niacina alcanzaban o excedían las cantidades recomendadas. No obstante, el nivel de consumo de hierro y calcio fueron inferiores a las recomendaciones. La ingesta de sodio y lípidos fue relativamente alta. Una mayor ingesta de lípidos se asoció con un mayor peso del recién nacido, mientras que una baja ingesta de proteínas de relacionó con peso bajo del recién nacido. La ganancia de peso materno durante el tercer trimestre predijo el peso y estatura del recién nacido, pero no su perímetro cefálico.

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