

## Vitamin A status of pregnant women assessed by a biochemical indicator and a simplified food frequency questionnaire

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**SUMMARY.** The aim of this study was to compare plasma concentrations of vitamin A in 710 women after delivery, with a simplified Food Frequency Questionnaire (FFQ). Vitamin A was determined in plasma, by HPLC. The FFQ included 55 foods, and was based on the typical diet of the low socioeconomic families in the Southeast of Brazil. For calculation purposes, first were identified all potential sources of retinol and carotenoids; the portion sizes being assigned to each food item on the basis of a previous study in the same area. Daily, weekly and monthly frequencies of consumption of foods with high, moderate and low concentrations of vitamin A were grouped according to the IVACG recommendations (1) in usual pattern of food consumption (UPF) scores. Pregnant women were allocated by these scores in 3 different categories (high, moderate and low) according to their risk of developing vitamin A deficiency. The categories of risk were based on the safe level of vitamin A intake of 800 RE/day (5600 RE/week) (7) and the basal requirement of 370 RE/day for pregnant women (8). 1.3% of the women had plasma concentrations of vitamin A  $\leq 0.70\mu\text{mol/l}$ , 10.2% between  $0.71-1.05\mu\text{mol/l}$  and 88.5%  $> 1.05\mu\text{mol/l}$ . According to the score categories, 49.5% of the women were at low risk for vitamin A deficiency, and 50.5% were at moderate risk. There was a weak statistically significant correlation between the plasma concentrations of vitamin A and the score categories ( $r = 0.11$ ;  $p = 0.005$ ). Our results indicate that the FFQ does not provide a very precise information on vitamin A status, probably because of the day to day variation in vitamin A intake, and the insensitivity of plasma concentrations to consumption of vitamin A. However, by using a simple score based on the FFQ, we were able to predict that the majority of the mothers were not at high risk for vitamin A deficiency.

**Key words:** Vitamin A, plasma, food frequency questionnaire.

**RESUMEN.** Evaluación del estado nutricional de vitamina A en mujeres gestantes utilizando indicador bioquímico y cuestionario simplificado de frecuencia alimentaria. El objetivo principal de este estudio fue comparar las concentraciones plasmáticas de vitamina A de 710 mujeres parturientas con los escores encontrados por medio del Cuestionario Simplificado de Frecuencia Alimentaria (CSFA). La vitamina A en el plasma fue determinada por HPLC. El CSFA fue elaborado a partir de la dieta típica de familias de bajo nivel socio-económico del Sur-este de Brasil e incluyó 55 ítems de alimentos. Para fines de cálculo, en primer lugar se identificaron todas las fuentes potenciales de retinol y carotenoides; seguidamente fueron determinados los tamaños de las porciones para cada alimento teniendo como base un estudio anterior en la misma región. Las frecuencias de consumo diario, semanal y mensual con altas, moderadas y bajas concentraciones de vitamina A se agruparon de acuerdo a las recomendaciones del IVACG, (1) en escores de patrón usual de consumo (PUC). Según los escores obtenidos, las gestantes fueron clasificadas en tres diferentes categorías (alto, moderado y bajo) de acuerdo al riesgo de desarrollar deficiencia de vitamina A. Para establecer las categorías de riesgo se utilizó la ingesta diaria de 800 ER/día (5600 ER/semana) recomendada (7) y la necesidad basal de 370 ER/día para mujeres gestantes (8). 1.3% de las mujeres tuvieron concentración de vitamina A  $\leq 0.70\mu\text{mol/l}$ , 10.2% entre  $0.71$  y  $1.05\mu\text{mol/l}$  y 88.5%  $> 1.05\mu\text{mol/l}$ . De acuerdo a las categorías de los escores, 49.5% de las mujeres estaban en bajo riesgo de deficiencia de vitamina A y 50.5% en riesgo moderado. Se encontró una débil correlación estadísticamente significativa entre las concentraciones de plasma y los escores de categorización ( $r=0.11$ ;  $p=0.005$ ). Nuestros resultados indican que el Cuestionario Simplificado de Frecuencia Alimentaria no ofrece información muy precisas en relación al estado nutricional de vitamina A, probablemente debido a la variabilidad del consumo diario de vitamina A y a la falta de sensibilidad de las concentraciones plasmáticas en relación al consumo. Usando un simple escore a través del CSFA, es posible predecir que la mayoría de las madres no estaban en alto riesgo de deficiencia de vitamina A. **Palabras clave:** Vitamina A, plasma, Cuestionario de Frecuencia Alimentaria.

## INTRODUCTION

An important focus of attention in Public Health has been micronutrient deficiency in pregnancy, because of the enhanced needs and enhanced vulnerability of pregnant women to the effects of micronutrient deficiency or imbalance.

Among all micronutrient deficiencies, vitamin A has been one of the most important public health problems, affecting a large percentage of pregnant women and children in developing countries.

Biochemical assessment of vitamin A status is expensive and difficult to perform at community level. Clinical examination requires specialized and well trained personnel, and may not give very good information in some environments. As an option to overcome these problems, we decided to utilise the IVACG guidelines (1) for the development of a simplified dietary approach for assessing the 24-h and habitual intake of food sources of vitamin A by young children.

A study carried out in São Paulo, Brazil, adapted the IVACG guidelines to a population of pregnant women (2). Based on the results of this study, we decided to compare plasma concentrations of vitamin A in 710 women after delivery with a simplified FFQ to evaluate vitamin A deficiency risk.

## MATERIALS AND METHODS

The women included in this study were participants in a large case-control study in Brazil. Details of this population are given elsewhere (3). Blood samples and FFQs were available in 710 pregnant women between March 1991 and January 1992. Women were selected from 4 hospitals in Campinas city, São Paulo state, 12-72 hours after delivery. None of them received vitamin A supplements during pregnancy.

Women's blood sample was taken by Becton Dickinson vacutainer tubes. Vitamin A was determined in plasma, in duplicate, by high performance liquid chromatography (HPLC).

An interviewer-administered FFQ was utilised, considering the high percentage of illiteracy. The FFQ included 55 foods, and was based on the typical diet of the low socioeconomic families in the Southeast of Brazil (4). For calculation purposes, first were identified all potential sources of retinol and carotenoids; the portion sizes being assigned to each food item on the basis of a previous study in the same area (2). The FFQ included the foods that provide a minimum of 5% of the total average of retinol equivalents (RE) recommended for this population, which in quantitative terms, represents a value of 40 µg of RE for a small portion.

To classify the foods on high, moderate and low concentrations of RE we used two selection criterias: the first one was based on a previous study of vitamin A content in

regional foods (5), and the second was based on the food composition table of McCance & Widdowson's (6).

Daily, weekly and monthly frequencies of consumption of foods with high, moderate and low concentrations of vitamin A were grouped according to the IVACG recommendations (1), in usual pattern of food consumption (UPF) scores, according to the average frequency they consumed each food in the 9 months of pregnancy. Women were allocated by these scores in 3 different categories (high, moderate and low) according to their risk of developing vitamin A deficiency. The categories of risk were based on the RDA safe level of vitamin A intake of 800 RE/day (5600 RE/week) (7), and the basal requirement of 370 RE/day for pregnant women (8). The cut-off points for the high, moderate and low categories of risk for vitamin A deficiency, based on scores, were  $\leq 3/5$  of the RDA recommendation (score = 480) in the low category, between  $3/5$  of the RDA recommendation and  $3/5$  of the basal requirement for vitamin A (score = 220) in the moderate category, and  $\leq 3/5$  of the basal requirement in the high category (1).

Univariate analyses were used in EPI-INFO to identify the women that ingested foods with high, moderate and low concentrations of vitamin A, based on the food composition table of McCance & Widdowson's (6), and to identify possible differences between the plasma levels of vitamin A and the FFQ scores as indicators of vitamin A deficiency. The correlation between the plasma levels of vitamin A and the FFQ scores were assessed in the SPSS Statistical Software, utilising the Spearman correlation coefficient.

Informed written consent was obtained from all subjects and the protocol was approved by the ethical committee of the four hospitals in Campinas.

## RESULTS

According to Table 1, the mean level of vitamin A in plasma was  $1.71 \mu\text{mol/l}$  ( $SD = 0.59$ ); the mean value for the FFQ score was  $484.31$  ( $SD = 117.88$ ).

Six hundred and twenty eight (628) women had plasma levels of vitamin A  $> 1.05 \mu\text{mol/l}$ , and almost half of them (315) had low risk for vitamin A deficiency, according to the score categories. Seventy three women had plasma levels of vitamin A between  $0.71$ - $1.05 \mu\text{mol/l}$  (marginal levels of vitamin A) and 43 of them had moderate risk for vitamin A deficiency, by the score categories. Only nine women had concentrations of vitamin A  $\leq 0.70 \mu\text{mol/l}$  (deficient levels), none of them had high risk, by the score categories. There was no statistically significant difference between the biochemical indicator of vitamin A deficiency, and the FFQ scores ( $p = 0.19$ ) (Table 2).

Figure 1 shows the distribution of the plasma levels of vitamin A and the FFQ scores. There was a weak statistically significant correlation between the plasma levels of vitamin A and the FFQ score categories ( $r = 0.11$ ;  $p = 0.005$ ).

The most frequently ingested foods with high, moderate and low concentrations of vitamin A are presented in Figure 2. The staple diet of the Brazilian pregnant women in this region is given in Figure 3.

**TABLE 1**  
Mean and standard deviation (SD) of plasma levels of vitamin A (umol/l) and FFQ scores

	Mean and SD	Range
Vitamin A in plasma (ug/dl)	1.71 (SD =0.59)	0.28-3.95
FFQ scores	484.31 (SD=117.88)	255-998

**TABLE 2**

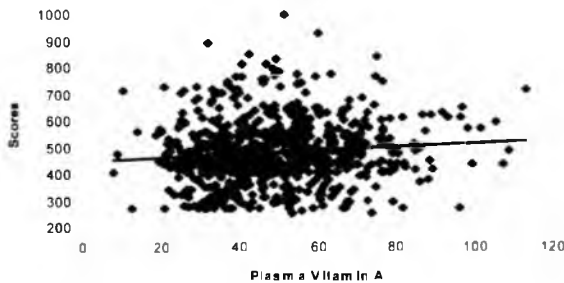
Categories of risk for vitamin A deficiency based on plasma levels of vitamin A and FFQ scores

	≤0.70 umol/l	0.71-1.05 umol/l	>1.05 umol/l	Total
High (score ≤220)	—	—	—	
Moderate (score 221-480)	3	43	313	359
Low (score ≥481)	6	30	315	351
Total	9	73	628	710

p=0.19

**FIGURE 1**

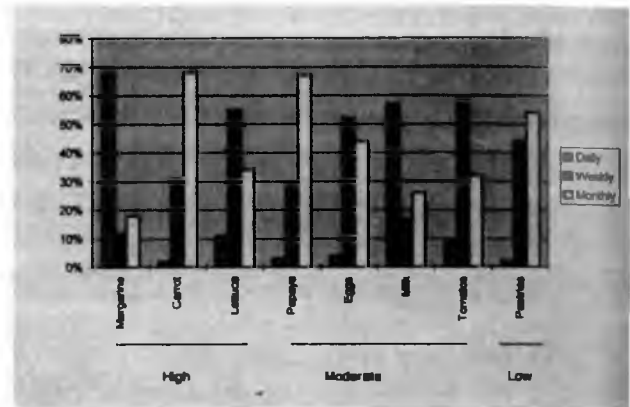
Distribution of plasma levels of vitamin A versus FFQ scores



r = 0.11, p = 0.005

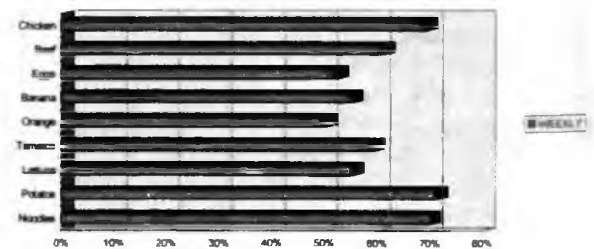
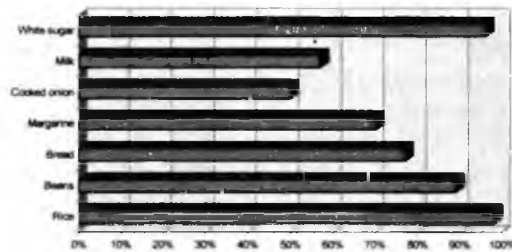
**FIGURE 2**

Foods with high, moderate and low concentration of vitamin A, most frequently ingested by the population



**FIGURE 3**

Staple diet of the Brazilian pregnant women in the region



**DISCUSSION**

There were very few studies in the literature comparing the intake of vitamin A, as reported on a food frequency questionnaire with the corresponding biochemical indicator of vitamin A status. In countries where vitamin A deficiency is not a public health problem, plasma carotenoids showed a higher statistically significant correlation with dietary questionnaires (although weak), than plasma levels of retinol

(11-15). However, in populations where vitamin A deficiency was prevalent, plasma retinol was associated with a poor dietary intake of vitamin A (16).

Despite all the ease of the administration of the FFQ, we were aware of its limitations such as under or overestimation of the frequency of food intake (9). The diet of the pregnant women included in this study was similar to those obtained in ENDEF (4,10), a large national study that assessed the most common type of foods purchased per family in several Brazilian regions and large cities.

Our results indicate that the FFQ does not provide a very precise information on vitamin A status, probably because of the day to day variation in vitamin A intake, and the insensitivity of plasma concentrations to consumption of vitamin A. However, by using a simple score based on the FFQ, we were able to predict that the majority of the mothers were not at high risk for vitamin A deficiency.

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