FOOD CONSUMPTION AND DIETARY ADEQUACY ACCORDING TO INCOME IN 1,200 FAMILIES, MANAUS, AMAZONAS, BRAZIL, 1973–1974[1]

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SUMMARY

Data from a household expenditure survey of 1,200 Manaus families performed by the Amazonas State Government in 1973-74 are analyzed by income group. The per cent frequency of families buying different foods and the daily *per capita* consumption of each were calculated. The daily *per capita* intakes of energy, protein, vitamin A, thiamine, riboflavin, nicotinic acid, ascorbic acid, calcium, phosphorus, iron and zinc were estimated and their adequacy evaluated. In contrast to the south and northeast of Brazil, the main bulk of the diet was derived from cereals and fish. The quantities of eggs, meats, fruit and vegetables consumed per person, increaded 50 - 100o/o as income improved, whereas fish consumption decreased 30o/o. The nutrients quantitatively most deficient were zinc, vitamin A, calcium, thiamine and riboflavin, with 60 - 80o/o of low and middle income families not achieving safe levels of intake for zinc and vitamin A. The beneficial effect of income on the adequacy of calcium, thiamine and riboflavin intake was quantitative. For zinc and vitamin A, increased income was associated with a qualitative improvement in the diet, principally due to the increased consumption of meat and liver. These results are discussed in relation to existing clinical evidence of deficiency states in the region.

INTRODUCTION

In the last decade the Brazilian Government has undertaken an aggressive program to occupy productively its scarcely populated Amazon Region. The population has consequently grown rapidly, associated with intense internal migration from the rural areas to the major urban centers.

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1 This study is part of a thesis by the author, entitled "Studies on Zinc Nutrition in the Amazon Valley", approved for the degree of Doctor of Philosophy by the University of London, 1980. Dr. Shrimpton's address is: Instituto Nacional de Pesquisas da Amazonia, Caixa Postal 478, 69000 Manaus, AM, Brazil.

Since becoming a free trade zone in 1967, Manaus, capital of the State of Amazonas, centrally situated in the Amazon Basin, has become one of the fastest growing cities in Brazil.

Data on the nutritional situation of the inhabitants of the Amazon Region is limited. A previous study of the effect of income and geographic region on the nutritional value of diets in Brazil did not include the north of Brazil (1). In 1973-4 a household expenditure survey was performed in Manaus by the Amazonas State Government. The purpose of this study was to analyze the data obtained, in order to establish the dietary pattern and evaluate dietary adequacy according to family income in these urban Amazonian families.

MATERIAL AND METHODS

The Survey Population

Situated 1,500 km inland, central in the Amazon Basin, Manaus is a seagoing port and capital of the State of Amazonas. Stradling the equator, the State enjoys a tropical rain forest climate with an eight-month rainy season, a drier season from August to November, and an annual mean temperature of around 26-27°C in the shade. In 1975 the State population was estimated to be 1.1 million with 36°/o living in Manaus. The survey sample was randomly selected from the register of customers of the electricity company of Manaus. This sample was divided into three groups: low income – those families whose monthly earnings amounted to less than 2.2, minimum salaries[2]; middle income – families earning more than 2.2, but less than 5.2 minimum salaries; and high-income families – those earning more than 5.2 minimum salaries. The Brazilian Food and Nutrition Institute (INAN) has adopted two minimum salaries as a family poverty line, and estimates that 40°/o of Brazilian families are in this category considered to be nutritionally at risk (2). Forty per cent of Manaus families probably had low family incomes, whilst medium and high–income families each represented 30°/o[3]. The survey population sample had 3.9°/o of families in the low-income group, 43.3°/o in the medium-income group and 52.8°/o in the high-income group.

Data Collection

The survey was performed by the Amazonas State Government in collaboration with the Fundação Getúlio Vargas, Rio de Janeiro, using standardized FAO household expenditure survey techniques (3). One hundred families a month were interviewed during 12 months, com-

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2 A minimum salary is the legal minimum wage as incorporated into the labor laws in the 1940's. Originally this supplied the basic food, rent and the clothing requirements of a Brazilian worker. Its value has been eroded with time and in 1973-4 was roughly equivalent to US$ 50.00 per month.

3 Author's estimate.

mencing in September, 1973. The amounts of food bought by each family during a one-month period were recorded. The age, sex, weight and height of all members of the family and presence of visitors were also recorded, together with meal presence during the month period. The survey data were coded, tabulated, stored and analyzed in the Amazonas State Government Computer Center (PRODAM), in Manaus.

Estimation of Food Frequency, Food Intake and Nutrition Adequacy

The percentage of families that bought each individual food in the survey month was calculated by income group. Only those foods consumed at a rate of one or more grams *per capita,* per day, were considered for the analysis. A standard 10o/o was deducted from all food quantities reported as bought by the family, in allowance for possible preparation and plate waste. The rest was considered to be that consumed by the family and was divided by the number of members in order to obtain the food intake *per capita.* Since the correction for meal presence affected the total number of consumers by less than 3o/o, no correction was made for absence of members of the family or presence of visitors during meals.

In absence of local food analysis data, literature values were used to calculate the *per capita,* per day intakes of energy, protein, vitamin A (retinol equivalents), thiamine, riboflavin, nicotinic acid, ascorbic acid, calcium (3, 4) and zinc (4, 5), by family income group. No allowance was made for any possible cooking losses of nutrients.

The adequacy of energy and nutrient intake *per capita* was evaluated by comparison with international recommended intakes of energy, protein (6), retinol, thiamine, riboflavin, nicotinic acid (7), ascorbic acid, vitamin D, iron (8), and calcium (9) and American recommendation for zinc and phosphorus (10), by income group.

Since recommended nutrient intakes are in excess of nutrient requirements, the percentage of families with dietary intakes *per capita,* less than an assumed safe level (70o/o of the recommended dietary intake), were also calculated by income group.

In order to evaluate the qualitative effects of income from its quantitative effects on nutrient adequacy of family diets and facilitate comparison with other studies, the *per capita* nutrient to energy ratios were calculated and compared with the ratios of recommended nutrient intake *per capita* to recommended energy intake *per capita* for each income group. The per cent distribution of energy and nutrient intakes by food group was also calculated for the different income groups.

RESULTS

The frequency of families purchasing each food during the one-month survey period, at the three levels of family income, is shown in Table 1. Higher income families less frequently bought rice and jaraqui, but more frequently bought potatoes, vegetables, fruits, fresh meat, tucunaré and milk powder than poorer families.

TABLE 1

PER CENT PREVALENCE OF FOOD ITEMS IN THE MONTHLY FOOD BASKET OF 1,200 MANAUS FAMILIES, BY INCOME GROUP 1973–1974

Foods	Family income groups			
	Low	Medium	High	All
Cereals & derivatives				
Bread (ordinary, white)	98	97	98	98
Pasta	81	82	78	80
Rice (ordinary, polished)	79	77	48	67
Cream crackers	20	19	20	24
Wheat flour	21	21	39	29
Roots, tubers & derivatives				
Potato *(Solanum tuberosum)*	38	50	75	62
Fermented cassava flour *(Manihot esculenta crantz)*	57	56	53	60
Nonfermented cassava flour *(Manihot dulcis)*	40	44	34	39
Sugar & sweets				
Sugar (non refined)	91	74	61	68
Sugar (refined)	16	24	38	31
Guava jam	27	32	53	42
Pulses & nuts				
Dried kidney beans *(Phaseolus vulgaris)*	60	70	65	67
Vegetables				
Onion *(Allium cepa)*	91	96	96	96
Garlic *(Allium sativum)*	84	78	89	85
Bouquet garni *(Allium schoenoprasum)*	73	83	85	83
Tomato *(Lycopersicum esculentum)*	70	68	58	63
Collard *(Brassica oleracea)*	44	55	62	58
Green peppers *(Capsicum annum)*	30	50	62	55
String beans *(Vigna unguiculata)*	21	26	43	34
Sea cucumber *(Cucumis anguna)*	22	26	44	33
Pumpkin *(Cucurbita pepo)*	30	31	35	32
Cucumber *(Cucumis sativus)*	11	23	36	28
Okra *(Hibiscus esculentus)*	13	16	21	23
Fruits				
Banana maçã *(Musa sapientum)*	78	76	78	77
Lime *(Citrus limon)*	43	56	60	58
Banana prata *(Musa sapientum)*	19	28	33	30
Papaya *(Carica papaya)*	10	23	36	29
Orange *(Citrus aurantium)*	8	20	38	28
Meats				
Salted beef	42	43	56	48
Chicken	41	52	68	59

Table 1 (Cont.)

Foods	Family income groups			
	Low	Medium	High	All
Rump beef	25	29	44	36
Beef liver	11	14	27	21
Eggs				
"Farm" eggs	48	49	50	50
Ordinary eggs	35	39	44	42
Fish				
Tambaqui *(Colossoma macroponum)*	64	75	72	73
Jaraqui *(Prochilodus insignis* sp)	49	51	29	40
Sardinha *(Triportheus elogantus* spp)	16	22	23	22
Tucunaré *(Chicla ocellaris* spp)	8	15	29	22
Pacú *(Mylossoma* spp)	21	24	19	22
Milk & derivatives				
Milk powder	52	61	70	65
Condensed milk	33	38	45	41
Fats & oils				
Cottonseed oil	87	81	77	80
Butter (national)	43	67	53	58
Butter (local)	43	22	35	29
Drinks				
Guarana soft drink	64	74	80	76
Grape or orange soft drink	30	32	22	27
Miscellaneous				
Salt (national)	100	99	98	98
Coffee powder	97	98	96	97
Black pepper	87	84	86	85
Coloral *(Bixa orellana)* powder	92	88	80	84
Vinegar	65	73	85	79

The quantities of food bought *per capita* are expressed by food group in Table 2. For all income groups the main bulk of the diet was derived from cereals, cereal derivatives and fish. The quantities of eggs, meats, fruits and vegetables consumed *per capita* increased 50 to 100o/o with income, whereas fish consumption decreased 30o/o.

The *per capita* intakes of energy and the 10 nutrients studied, together with their per cent adequacies in the different income groups, are shown in Table 3. In the survey sample as a whole, *per capita* intakes of zinc, thiamine, and riboflavin were below recommended levels. In the low and medium income families, vitamin A and calcium intakes were also below

TABLE 2

FOOD CONSUMPTION BY FOOD GROUP AND INCOME IN 1,200 FAMILIES OF MANAUS, 1973–1974

(g/capita/day)

Food groups	Family income		
	Low	Medium	High
Cereals and derivatives	203	211	239
Roots and tubers	85	83	90
Sugar and preserves	60	59	66
Pulses and nuts	30	28	33
Vegetables	38	39	70
Fruits	76	75	121
Meats	87	81	126
Eggs	12	13	22
Fish	151	139	105
Milk (fresh & reconstituted powder)	85	92	119
Condensed milk (reconstituted)	3	3	6
Cheese	0	1	3
Cream	0	1	1
Oils and fats	23	22	27
Miscellaneous (condiments + drinks)	87	104	165

recommendations. The effect of income was most apparent for vitamin A and ascorbic acid, although intakes of the latter were adequate at all levels of income.

Forty to 50o/o of the high-income families and 60 to 80o/o of the low and middle-income families did not achieve the safe level of intake *per capita* for zinc and vitamin A. Family intakes of thiamine, riboflavin, calcium and energy were also frequently below the safe level (20-40o/o of low and middle-income families) with vitamin A and calcium showing the most consistent effect of income on the percentage of families achieving safe levels of nutrient intake (Figure 1).

For the whole survey population the only nutrients that had inadequate nutrient to energy ratios were thiamine, riboflavin and zinc, while in low and middle-income families, calcium and to a greater extent vitamin A, were also inadequate (Table 4). The clearest effects of income were seen for vitamin A, vitamin C and zinc, although vitamin C to energy ratios were adequate in all income groups. The distribution of energy and nutrients by food group (Figure 2) showed that cereals were the main source of energy, iron and thiamine; fish, the main source of protein, phosphorus and nicotinic acid; meats, the main source of zinc; milk and derivatives, the main source of calcium and riboflavin, and fruits and

TABLE 3

PER CAPITA ENERGY AND NUTRIENT INTAKE AND PER CENT ADEQUACY*, BY INCOME GROUPS IN 1,200 MANAUS FAMILIES, 1973–1974

Dietary components	Family income groups							
	All		Low		Medium		High	
Energy (MJ)[a]	9.5	(99)	8.8	(93)	8.8	(92)	10.2	(106)
Protein (g)[a]	89	(212)	85	(204)	83	(201)	93	(222)
Retinol equivalent (mcg)[b]	636	(99)	332	(57)	448	(71)	814	(127)
Thiamine (mg)[b]	0.75	(87)	0.71	(79)	0.69	(77)	0.78	(87)
Riboflavin (mg)[b]	1.05	(87)	0.92	(77)	0.93	(77)	1.15	(96)
Nicotinic acid (mg)[d]	23	(154)	23	(158)	23	(155)	23	(151)
Ascorbic acid (mg)[c]	56	(207)	38	(141)	42	(155)	69	(256)
Calcium (mg)[d]	567	(103)	478	(86)	506	(92)	623	(113)
Phosphorus (mg)[e]	1,142	(208)	1,070	(194)	1,063	(193)	1,213	(221)
Iron (mg)[c]	17.9	(169)	16.6	(160)	16.3	(154)	19.2	(178)
Zinc (mg)[e]	8.8	(63)	7.3	(53)	7.7	(56)	10.5	(75)

* Recommendations:

a World Health Organization, 1973.
b World Health Organization, 1967.
c World Health Organization, 1970.
d World Health Organization, 1962.
e Food and Nutrition Board, 1974.

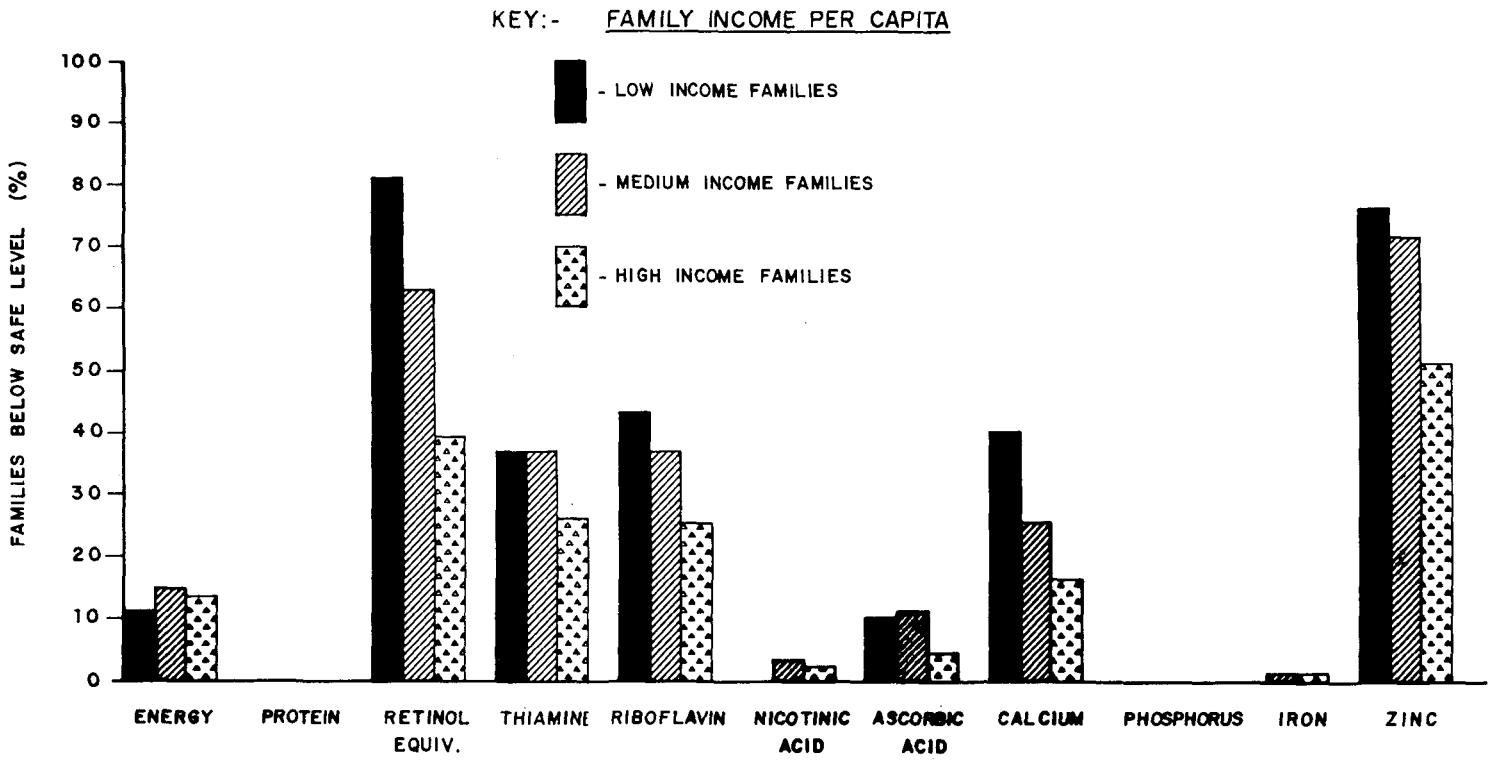

FIGURE 1

Percentage of 1,200 families consuming less than the safe intake level of energy and 10 nutrients, by income, in Manaus 1973-1974

TABLE 4

PER CAPITA NUTRIENT TO ENERGY RATIOS OF FAMILY DIETS, IN COMPARISON (%) WITH *PER CAPITA* RECOMMENDED NUTRIENT TO ENERGY RATIOS*, BY INCOME IN 1,200 MANAUS FAMILIES, 1973–1974

Nutrients per MJ	Family income groups			
	All	Low	Medium	High
Protein(g)[a]	9.4 (214)	9.7 (219)	9.4 (218)	9.1 (210)
Retinol (mcg)[b]	66.9 (100)	37.7 (56)	50.91 (77)	79.8 (120)
Thiamine (mg)[b]	0.07 (76)	0.07 (75)	0.07 (76)	0.07 (77)
Riboflavin (mg)[b]	0.11 (88)	0.10 (78)	0.10 (79)	0.11 (89)
Nicotinic acid (mg)[b]	2.4 (154)	2.6 (167)	2.6 (166)	2.2 (140)
Ascorbic acid (mg)[c]	6.0 (212)	4.3 (149)	4.8 (169)	6.9 (248)
Calcium (mg)[d]	59.5 (103)	54.7 (93)	57.6 (99)	61.0 (107)
Phosphorus (mg)[e]	120.2 (209)	121.6 (207)	120.8 (209)	118.9 (209)
Iron (mg)[c]	1.9 (240)	1.9 (241)	1.9 (236)	1.9 (239)
Zinc (mg)[e]	0.9 (62)	0.8 (54)	0.9 (62)	1.0 (69)

* Recommendations:
- a World Health Organization, 1973.
- b World Health Organization, 1967.
- c World Health Organization, 1970.
- d World Health Organization, 1962.
- e Food and Nutrition Board, 1974.

vegetables, the main source of vitamins A and C. The effects of income on these distributions were most apparent for meat and fish, the former increasing and the latter decreasing their contributions to total energy, protein, zinc, riboflavin and nicotinic acid, with increasing income. Fruits also increased their contribution to total dietary vitamin C with increasing income.

DISCUSSION

The State of Amazonas is self sufficient in only two food items, fish and cassava, while food imports account for a third of the total value of State imports (11). Cereal consumption was higher than one would have expected in the Amazon, since it is not a cereal-producing region. Wheat imports into the State of Amazonas have increased five-fold since wheat prices were subsidized by the Federal Government a decade ago. The Manaus food consumption data were different to values reported for other cities in Brazil (12). The *per capita* fruit, vegetable and kidney bean consumption in Manaus was half of that reported for cities in the south of Brazil. As such foods are all imported into Manaus, greatly increasing their cost, they are consumed more commonly and in greater amounts by

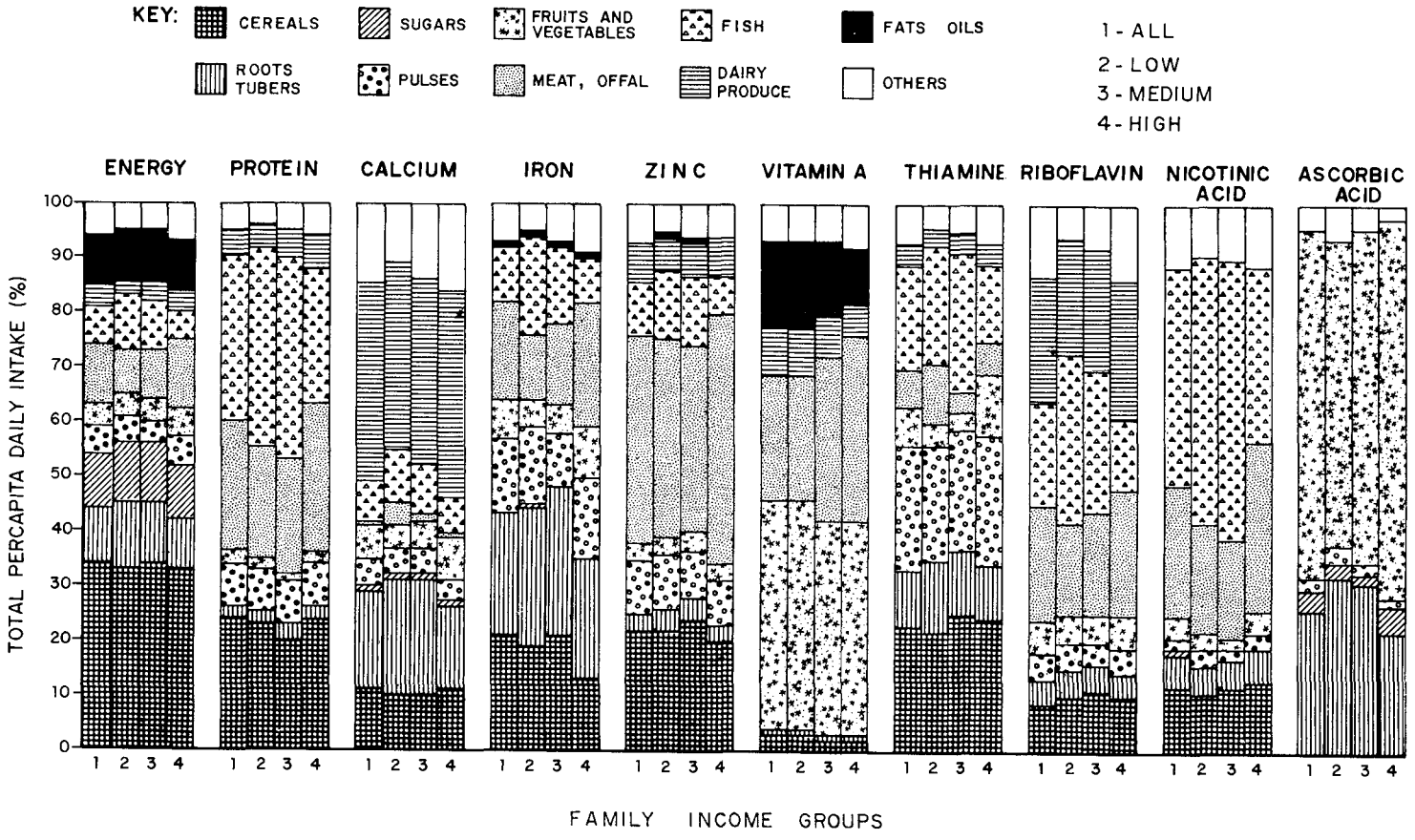

FIGURE 2

The per cent distribution of daily *per capita* consumption of energy and 9 nutrients by food group and family income, in 1,200 Manaus families, 1974—1974

the richer families. The kidney bean is the major protein source in the south and northeast of Brazil (13). In Manaus, fish was the main protein source and fish consumption was 10 times higher than reported for the south of Brazil. The Amazon has an abundant fish fauna with more than 2,000 different species, of which 40 are regularly sold in the Manaus markets. The two most popular fishes consumed by the survey population were tambaqui *(Colossoma macroponum)* and jaraqui *(Prochilodus insignis)*. Pirarucu *(Arapaima gigas)*, once the most consumed fish in the Amazon (14), had already become scarce.

Interpretation of the nutrient adequacy of the Manaus diets is restricted, on the one hand, by the absence of local food composition data, and on the other, by the validity of the recommended intakes employed to evaluate dietary adequacy. The possible deficiencies encountered in the Manaus diet of energy, zinc, thiamine, riboflavin, vitamin A and calcium, are all subject to these qualifications.

Energy intakes appeared satisfactory in the study population, with no families consuming less than the assumed safe intake level. It should be remembered, however, that the poorer segments of the Manaus population –those without access to electricity– were excluded from the survey. Protein deficiency has been considered to be rare in the Amazon region (15) and in this study, protein intake was found to be more than adequate. High fish consumption in the Manaus families was responsible for the high protein intake.

Diets heavily dependent on poultry and fish for animal protein have been incriminated as being potentially low in zinc (5). The zinc to energy ratios of the low and middle-income family diets in Manaus were 70% of values reported for Canada and Holland (16, 17), but similar to those reported for the United Kingdom (18, 19).

Both the Canadian recommended intakes (20) and the WHO requirements for zinc (21), are lower than the US recommendations used in this study, and nearer to the assumed safe level of intake. Even so, 70% of low and middle-income families in this survey did not achieve the safe level of intake. Neither Canadian nor WHO authorities considered endogenous zinc losses to be significant, although they are probably at least 2 mg a day, and did not take into consideration tropical sweat losses, which are higher than in temperate climates. Amazonian literature has many accounts of earth eating (22-25). The stature of children in the Western Amazon has been reported to be the lowest in Brazil (26), and persistent skin diseases, ulcers and poor wound healing have been reported as very frequent (23, 27). All of these conditions could be associated with a poor zinc status.

Clinical signs suggestive of vitamin A deficiency have commonly been reported in the Amazon (28) while blindness, usually associated with vitamin A deficiency in other regions, has not. Lowenstein commented on the lack of correlation between intake data and clinical data for vitamin A in the Amazon (29). Some of the local varieties of cassava flour contain carotenoids (30) but since the color of cassava flours consumed in this study was not recorded, no vitamin activity was accredited to them. Many Amazonian fruits are rich in carotenoids (31) and could provide a cheap vitamin A source if their supply to Manaus was better organized. In this study the qualitative dietary improvements in vitamin A

nutriture with income were not associated with increased consumption of these potentially cheap fruits, but with the increased consumption of relatively expensive liver, butter and margarine. The higher income families consumed a mean 1.5 g of liver *per capita* per day, but only a third of these families had bought liver in the previous month.

Beri-beri was common in the Amazon at the turn of the century (32) but since World War I, no cases have been recorded (11). Eggleton showed a correlation between the thiamine and the zinc content of foods (33) besides a reduced zinc content in hair, toenail and whole blood of beri-beri patients in China (34, 35). Clinical signs of riboflavin deficiency are common in the Amazon. The investigation of urinary or blood levels for either thiamine or riboflavin has not been reported.

The WHO recommendation used for calcium intake is based on balance data, and is much lower than the American recommendation, which is based on normal intakes in the United States. Requirements for calcium are not yet well established (36) and symptoms specific for calcium deficiency are not known (37). Evidence exists of adaptation to low calcium intakes, and positive balances have been observed in Peru on intakes similar to those observed in this study (38). Phosphorus intakes appear more than adequate in Manaus, as is usual elsewhere.

Since only 24o/o of the dietary energy was of animal origin, the lower value for iron availability was used, as recommended by the World Health Organization (8). Even so, the diet supplied sufficient iron, even in the lower income families. Anemia is and always has been an extremely common phenomenon in the Amazon (28), but a definitive study still remains to be done as to its exact causes.

Intakes of both nicotinic acid and vitamin C appeared to be sufficient, and deficiency symptoms have not been reported for either vitamin in the Amazon.

The food composition data used to calculate the nutrient intakes reported in this study need corroboration by analysis of local foods. Zinc intakes calculated using food composition tables have been found to agree with values obtained by analysis (29). The nutrient to energy ratios for calcium, phosphorus, iron, riboflavin, nicotinic acid and vitamin C reported in the present study were essentially similar to those notified previously for the rest of Brazil (1).

Unlike in this study, Jansen and coworkers (1) reported that income was more important in determining the quantity of food available than affecting the quality of the diet. Intakes of vitamin A and zinc, the nutrients most sensitive to income, cannot be compared, however, since the aforementioned study did not include zinc, and the food data analyzed excluded fresh vegetables and greens, important vitamin A sources.

As a result of the large fish intake, protein energy ratios in Manaus diets were 20-50o/o higher than those informed for the rest of Brazil. The basic diet encountered in Manaus families was heavily dependent of fish and bread. Consumption of vegetables and fruits, other than bananas, was very low. The consumption of fruits, vegetables and meats increased with income, while that of fish decreased. The most deficient nutrients encountered were zinc, vitamin A, calcium, thiamine and riboflavin. Income showed a beneficial effect on the adequacy of these nutrients, which for zinc and vitamin A was associated with a qualitative improve-

ment in the diet, mainly due to the increased consumption of meat and liver by the richer families.

In view of our findings, it would seem worthwhile conducting biochemical investigations of zinc and vitamin A nutrition in the Manaus population. The future development of the Manaus region will need a heavy investment in local agricultural production if the current nutritional situation is to be improved without resorting to food fortification for the micronutrients that appear to be deficient.

RESUMEN

CONSUMO ALIMENTARIO Y ADECUACION DE LA DIETA DE ACUERDO AL INGRESO DE 1,200 FAMILIAS DE MANAUS, AMAZONAS, BRASIL, EN 1973—1974

Se analizan, por grupos de ingreso, los datos de un estudio sobre gastos familiares de 1,200 familias de la ciudad de Manaus, Brasil, que el Gobierno del Estado del Amazonas llevó a cabo durante el período 1973-1974.

Se calculó la frecuencia porcentual de familias que compraban diversos alimentos, y el consumo diario *per capita* de cada una de ellas, estimándose, asimismo, las ingestas por persona, por día, de energía, proteína, vitamina A, tiamina, riboflavina, ácido nicotínico, ácido ascórbico, calcio, fósforo, hierro y zinc, juntamente con su adecuación.

En contraste con lo que acontece en el sur y nordeste del Brasil, se encontró que el principal elemento (en términos de cantidad) de la dieta habitual se derivaba de cereales y de pescado. La cantidad de huevos, carnes, frutas y vegetales consumidos por persona aumentó de 50 a 100o/o con el mejoramiento del ingreso; en cambio, el consumo de pescado decreció 30o/o.

Cuantitativamente, los nutrientes más deficientes fueron zinc, vitamina A, calcio, tiamina y riboflavina, habiéndose determinado que de 60 a 80o/o de las familias de bajo y mediano ingreso no alcanzaban niveles adecuados de ingesta de zinc y vitamina A. El efecto benéfico del ingreso sobre la adecuación de la ingesta de calcio, tiamina y riboflavina, fue de orden cuantitativo.

El mayor ingreso, en el caso del zinc y de vitamina A, se asoció a una mejora cualitativa de la dieta, debido principalmente al aumento en el consumo de carne e hígado.

Se comentan estos resultados en relación a la existencia de evidencia clínica de estados de deficiencia en la región.

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