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KENNETH G. SWANBERG AND ELIZABETH SHIPLEY*

THE NUTRITIONAL STATUS OF THE RURAL FAMILY IN EAST CUNDINAMARCA, COLOMBIA

The extent to which malnutrition is a consequence of low incomes and can be alleviated by raising incomes is critical in the formulation of national nutrition policy. To the extent that the nutritional quality is related to income, it may be expected to be improved by measures that will foster increased food production, higher incomes for the poor, more efficient distribution systems for foods and foodstuffs, and more nutritious, inexpensive foods. If income is not a determinant of the quality of the diet, these measures may have no effect on nutrition, although some will, of course, raise the level of living in terms of non-food items.

The studies reported on here were designed to test the relationship between income and nutrition of persons of all ages, and of preschool children, in two rural areas of Colombia.

MALNUTRITION IN COLOMBIA

Nutritional studies in Colombia have shown that the majority of the population consumes a diet deficient in all of the required nutrients with the exception of iron and vitamin C; and a high incidence of dental caries, anemia, and certain vitamin deficiencies (especially vitamin A and the vitamin B complex) have been identified. These studies have also shown a high prevalence of protein-calorie malnutrition in the infant population, possibly causing retardation of growth and mental development, along with a chronic state of undernutrition in the adult population, which could lead to decreased labor productivity (4, p. 6; 5, p. 41). These same nutritional studies have attributed the nutritional problems encountered within the country to the following factors: (1) low incomes; (2) inadequate supply of nutritious foods; (3) food habits based on ignorance and misbeliefs; (4) lack of education; and (5) unsanitary health conditions.

As a result of these findings, various governmental agencies have begun working on the design and implementation of action programs aimed at elimination of those factors which cause malnutrition. As a part of this effort, the Rural Development Project of East Cundinamarca (Caqueza Project), which is managed by the Colombian Agricultural Institute (ICA) and located in Caqueza, carried

* Kenneth G. Swanberg is Agricultural Economist, Technical Advisor to the Colombian Agricultural Institute, and staff member of the International Development Research Center. Elizabeth Shipley is Dietician and member of the Peace Corps, assigned to the Colombian Agricultural Institute (ICA) Caqueza Rural Development Project.

out a study of the nutritional status of the rural farm families within the region in August 1973. The region contains two distinct ecological zones: one below 2,200 meters and the other above 2,200 meters. The low-altitude zone has a warm temperate climate and small farms on which corn is the principal crop. The highland zone has a cold temperate climate, farms are larger, and potatoes are the principal crop. The low-altitude zone will be referred to as the *corn zone* throughout this paper, and the high-altitude zone as the *potato zone*.

The home economics program within ICA has traditionally based its nutrition work on the generalization that the entire Colombian population consumes an inadequate diet with a variety of nutritional problems. The nutrition programs presently being pursued are based on country-wide recommendations. However, since the nutritional status of a population is dependent upon a variety of factors that vary not only within a country, but sometimes within the same region, a nutrition problem that is found in one community may not exist in another. Moreover, the cause of such problems may differ between two communities due to social, economic, or geographic differences, and thus their solution will require distinct methodologies. Because most ICA nutrition programs have ignored the local state of nutrition or its causes within the particular region where a program is to be applied, past programs have done little to improve the nutritional status of the community.

HYPOTHESES AND OBJECTIVES

The following hypotheses were tested in the nutrition investigation:

1. The state of nutrition of an individual or population is highly correlated with the level of income. Consequently, the nutrient intake in the higher-income potato zone should be more nearly adequate than that of the lower-income corn zone.
2. The consumption of protein and calories is more highly correlated with income than is the consumption of vitamins and minerals, which is related more to food practices.

In order to examine these hypotheses, the following specific research objectives were elaborated:

1. To obtain the level of per capita food consumption and thus calculate the nutrient intake of the rural family in the two ecological zones found within the project area.
2. To determine the nutritional adequacy of the diet consumed by the rural population in each zone by means of the percentage relationship between nutrients consumed and nutrients required.
3. To determine nutrient intake and adequacy levels in the preschool population in each zone.
4. To take height-weight measurements of the preschool children to determine nutritional status according to the Rueda-Williamson scale designed specifically for Colombia.
5. To correlate socioeconomic information with the consumption and health status data in order to establish cause and effect relationships.
6. To develop a system of identification that relates nutritional deficiency patterns to ecological and socioeconomic characteristics of the population.

THE SURVEY

The nutrition investigation carried out by the Caqueza Project was realized with a random sample of 128 families from the corn zone and 131 families from the potato zone. The samples were drawn from the municipalities of Caqueza, Chipaque, Fosca, and Ubaque, which are representative of the two zones for which the Caqueza Project has influence. The variance used in calculating sample sizes was determined on the basis of a pilot investigation carried out in the area of Ríonegro Sur, in the municipality of Caqueza. The samples were statistically significant at the 95 percent level, accepting a 7 percent error on the average value.

The Survey Questionnaire

A variety of information can be used in the assessment of the nutritional status of a community (3, p. 2; 17, p. 467; 22, p. 563). When the group to be investigated is large and dispersed it is not always possible to evaluate every biological factor that is related to the nutritional status of a community. Hence the investigator has to collect the most pertinent information, depending upon the specific use for which the data are intended and the amount of resources available (16, p. 8; 17, p. 472).

In consideration of this resource allocation problem, the project chose to employ a survey questionnaire to elicit dietary information, height-weight measurements of preschool age children, socioeconomic data, and food practices of the family. With this information, the project expected to obtain an adequate evaluation of the nutritional status of the rural family with a minimum of disturbance to the families investigated, and a minimum of cost in personnel time. The specific method employed for obtaining food consumption information was the 24-hour recall survey. Height and weight measurements were taken of all children less than six years of age in each family studied.

General Characteristics of the Surveyed Families

A total of 259 families was investigated, but some had to be eliminated in the analysis due to obvious errors in the information collected. Consequently, the analysis of data is based on 1,540 people distributed among 242 families, 119 families in the corn zone, with an average family size of 6 persons, and 123 in the potato zone, with 7 persons per family. Children under 16 represented 58 percent of the total population in the potato zone and 54 percent in the corn zone. Table 1 shows the population distribution (both numbers and percentages) in the two zones by age groups.

TABLE 1.—POPULATION DISTRIBUTION BY AGE IN THE TWO ZONES

Age group	Corn zone		Potato zone	
	Number	Percentage	Number	Percentage
Less than 1	11	2	15	2
1 through 5	111	15	143	18
6 through 15	268	37	311	38
16 through 19	54	8	58	7
Over 19	281	39	288	35

TABLE 2.—DIET COMPOSITION FOR ALL MEMBERS OF THE FAMILY

Product	Corn zone		Potato zone	
	Calories	Protein (grams)	Calories	Protein (grams)
Milk and derivatives	82	4.7	135	7.9
Meat	75	4.0	103	5.7
Eggs	11	0.9	10	0.8
Legumes	124	8.7	91	6.5
Vegetables	9	0.4	16	0.7
Fruit	3	—	1	—
Corn and derivatives	216	6.9	251	7.9
Rice	157	4.0	181	4.6
Other cereals and derivatives	134	3.8	182	5.1
Potatoes	218	4.6	269	5.6
Other roots and tubers	191	1.1	217	1.3
Sugar and sweets ^a	255	1.3	253	1.4
Oils and fats	34	—	33	—
Miscellaneous	—	—	11	0.3
Total	1,509	40.4	1,753	47.8
Starchy-staple ratio	.61		.63	
Animal-protein ratio		.24		.30

^a Includes panela and chocolate.

Average Consumption of Nutrients

The basic information on the amount of each food that was consumed by the family as a whole and by preschoolers in particular was recorded in common household measures. These values were converted to net weight in grams of the edible portion according to the Colombian Food Composition Table (6). Once the net weight of each food was obtained, the foods were coded and the nutritional content calculated to obtain the daily average per capita food consumption for each family in the investigation and for the preschool group. The data were then pooled and the average family consumption value calculated for each zone.

Composition of the Diet

Major foods in the diet of all members of the family and of preschoolers, by zone, are shown in Tables 2 and 3.¹

The starchy-staple ratio for family diets is slightly higher in the potato zone (0.63) than in the corn zone (0.61) despite greater expenditure for food.² This partly results from a greater own consumption of potatoes, but the percent of

¹ The total values from these tables differ slightly from the earlier reported average consumption levels due to the method used for determining the "average diet." The frequency of consumption of each product was recorded and each product was ranked accordingly. Selection of the products to be included in the "average diet" was then made according to the frequency ranking until the sum of the average product consumption levels reached the average expenditure level for each group. This group of products with their average consumption levels did not calculate out to be equal to the average protein and nutrient intake levels.

² Although farmers in both zones obtain a considerable part of their staple foodstuffs from their own production, they also obtain a part from the marketplace. They are by no means subsistence farmers. Farm families in the corn zone prefer to consume corn throughout the year. As their supplies of corn run out in August, therefore, farmers will sell early maturing legumes in order to buy corn.

TABLE 3.—DIET COMPOSITION OF PRESCHOOLERS

Product	Corn zone		Potato zone	
	Calories	Protein (grams)	Calories	Protein (grams)
Milk and derivatives	93	5.3	129	7.3
Meat	45	2.4	83	4.5
Eggs	13	1.0	25	2.0
Legumes	77	5.4	49	3.6
Vegetables	11	0.6	9	0.6
Fruit	6	—	7	0.1
Corn and derivatives	151	5.2	121	4.1
Rice	109	2.8	113	2.8
Other cereals and derivatives	137	3.9	130	3.7
Potatoes	158	3.3	185	3.9
Other roots and tubers	174	1.0	166	1.2
Sugar and sweets ^a	216	1.0	236	1.3
Oils and fats	35	—	—	—
Miscellaneous	—	—	—	—
Total	1,225	31.9	1,253	35.1
Starchy-staple ratio	.60		.57	
Animal-protein ratio			.27	
				.39

^a Includes panca and chocolate.

total calories coming from cereals is also higher than in the corn zone. Animal protein ratios, too, are higher in the potato zone, as would be expected because of the higher total expenditures.³ Starchy-staple ratios for preschool children are slightly lower than for the entire family, but the positions of the two zones are reversed.

On the other hand, animal protein ratios are markedly higher for the preschool groups than for the family groups, particularly in the potato zone. It is noteworthy that legumes contribute less protein than dairy products in all diets. Nevertheless, they are significant sources of protein even for preschoolers. The major source of proteins for all groups except preschoolers in the potato zone is the cereals. Preschoolers consume relatively greater quantities of milk,⁴ eggs, and fruits, and lesser quantities of legumes than the rest of the family.

NUTRITIONAL ADEQUACY OF THE DIET CONSUMED

The nutritional adequacy of the diet consumed was calculated as the percentage relationship between the actual nutrient consumption and the recommended dietary intake.

The recommended dietary intake per household was calculated for each zone

³ Protein adequacy is determined by the amino-acid composition of the protein rather than the source of the protein. If the protein ingested contains the required amino acids in adequate amounts so that the organism is able to meet its growth and maintenance requirements, it does not matter whether it comes from meat or corn and potatoes. Animal protein is more easily digested and contains most of the essential amino acids, but it is possible to meet protein requirements from vegetal sources if the diet contains a mixture of proteins which allows missing amino acids in one food to be supplied by another.

⁴ Milk consumption for the family groups in the corn and potato zones respectively are 112 grams and 144 grams, whereas for the preschool group consumption levels of milk are 155 grams and 210 grams respectively. The milk derivative *cuajada*, a cheese product, is part of the milk and derivatives consumption pattern in the family group.

TABLE 4.—RECOMMENDED ALLOWANCE, DAILY AVERAGE PER CAPITA CONSUMPTION, AND NUTRITIONAL ADEQUACY IN THE FAMILIES SURVEYED

Nutrient	Recommendation		Consumption		Adequacy ^a	
	Corn zone	Potato zone	Corn zone	Potato zone	Corn zone	Potato zone
Calories	2,145	2,176	1,486	1,734	69	80
Protein (g.)	57.9	57.8	40.2	48.4	69	84
Calcium (mg.)	680	696	436	572	64	82
Iron (mg.)	12.5	12.6	12.6	14.3	101	113
Vitamin A (IU)	4,183	4,179	1,172	1,677	28	40
Thiamin (mg.)	.90	.90	.98	1.12	109	124
Riboflavin (mg.)	1.31	1.32	.88	1.12	67	85
Niacin (mg.)	13.4	13.2	10.0	12.0	75	91
Vitamin C (mg.)	43	43	112	129	261	300

^a Consumption as a percent of recommendation.

on the basis of tables prepared by J. Ariza-Macias, Head of the Institute of National Nutrition, for the Colombian population (1, p. 258), adjusted for family size, age, sex, and annual mean temperature. The same calculations were made for the preschool group; values were the same for both zones.⁵ Table 4 shows the daily average per capita nutrient consumption of the families investigated in the two zones, and indicates the level of adequacy of this consumption in relation to the recommended daily allowance for the Colombian population.

Family Diets

Table 4 shows the nutritional quality of the diet consumed in the potato zone to be superior to that in the corn zone for every nutrient consumed. Statistical tests showed that these mean values were significantly different at the 99 percent level. In both zones the intake of iron, thiamin and vitamin C is nutritionally adequate. In addition, the consumption of protein, calories, calcium, riboflavin, and niacin is adequate in the potato zone if compared to the levels set by the United States Interdepartmental Nutrition Committee for National Defense (ICNND), which regards 86 percent of the National Nutrition Institute (INN) recommendation as acceptable (20):

<i>Adequacy level</i>	<i>Percent</i>
High	116 or more
Acceptable	86 to 115
Deficient	51 to 85
Low	50 or less

By either standard, the consumption of vitamin A is deficient in both zones.

In the corn zone, however, the consumption of calories, protein, calcium, vitamin A, riboflavin, and niacin is deficient by ICNND standards. The greatest deficiency is that of vitamin A, which only reached 28 percent of adequacy in the

⁵ Recommended calorie and protein requirements are as much as 465 calories (16 percent) and 20 grams (44 percent) higher than recommended dietary allowances for the United States population published by the National Academy of Sciences (21). This has little, if any, effect, however, on the comparisons between populations that are made in this article. (See also the ICNND study of 1960 [20].)

corn zone and 40 percent adequacy level in the potato zone. The richest sources of vitamin A are foods of animal origin such as liver, milk, and eggs. Very few farmers are able to include these foods in their daily diet because of their high cost. Other good sources of vitamin A are the green and yellow vegetables such as the carrot, squash, and green leafy vegetables, which contain carotene, a precursor of vitamin A. Consumption of these foods is also very low, not because of cost, but because of local food habits. Yellow corn is also a good source of vitamin A, but in this area—although yellow corn is produced—the preferred corn is white.

Chart 1 compares the nutritional adequacy of the diets consumed in the two different zones.

CHART 1.—ADEQUACY LEVELS FOR DAILY AVERAGE PER CAPITA CONSUMPTION FOR FAMILIES SURVEYED

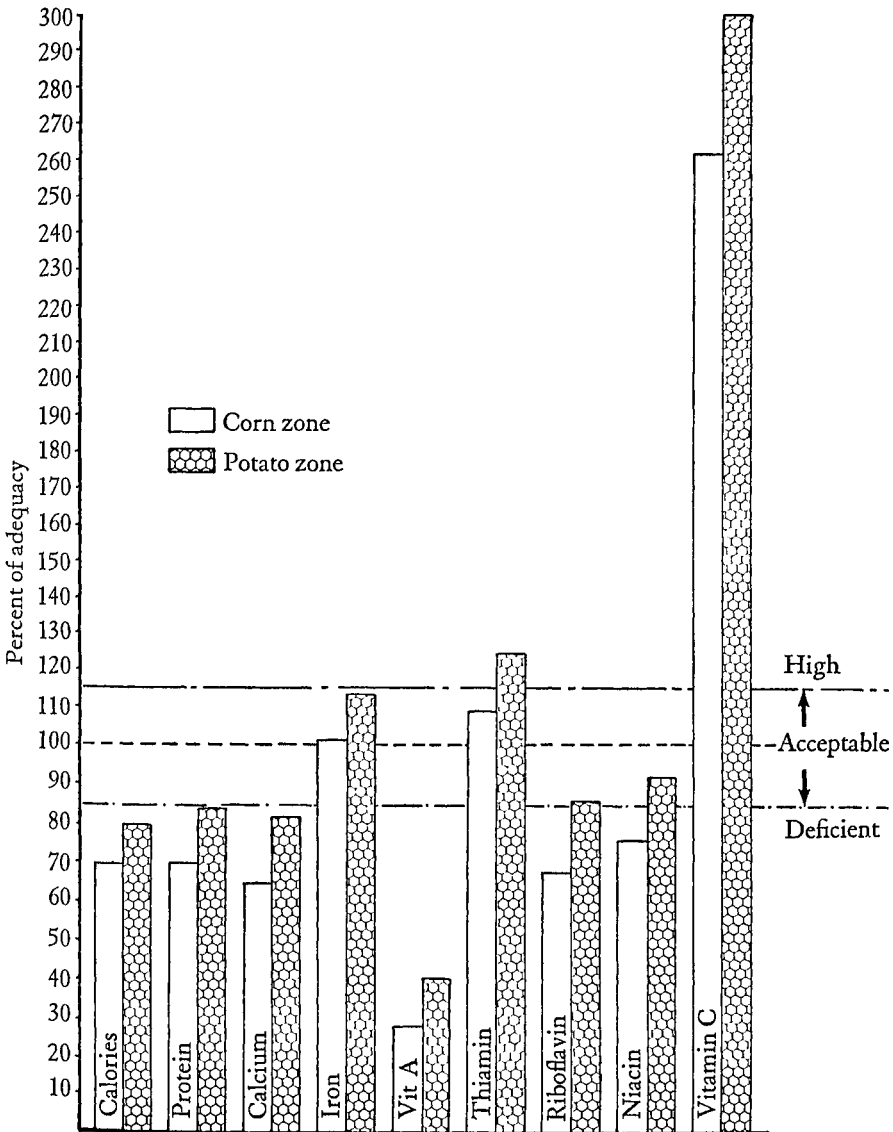


TABLE 5.—PER CAPITA FOOD CONSUMPTION EXPRESSED AS A PERCENTAGE OF RECOMMENDED CONSUMPTION*

Nutrient	Corn zone	Potato zone	Colombia
Calories	69	80	85
Protein (g.)	69	84	78
Calcium (mg.)	64	82	49
Iron (mg.)	101	113	117
Vitamin A (IU)	28	40	69
Thiamin (mg.)	109	124	82
Riboflavin (mg.)	67	85	64
Niacin (mg.)	75	91	89
Vitamin C (mg.)	261	300	153

* Data for corn zone and potato zone from this study, for Colombia from Jaime Ariza Macías, "Recomendaciones Diarias de Calorías y Nutrientes para la Población Colombiana," *Archivos Latinoamericanos de Nutrición* (Caracas), Sept. 1967, p. 255; and Colombia, Instituto Nacional de Nutrición (INN), "Resúmen de las Encuestas Alimentarias Realizadas por el INN de 1963 a 1965" (Bogotá, 1966), mimeo., p. 35.

In observing these nutritional adequacy levels it is important to keep in mind that the recommended adequacy levels are not based on minimum requirements (1, p. 255; 10, p. 156; 17, p. 449). The minimum requirement is the least amount of a nutrient that will prevent the appearance of clinical symptoms of deficiency, whereas a recommended allowance is the average amount of a nutrient required to assure that 95 percent of the individuals within a given population will consume more than the minimum level. In Colombia the recommended daily allowances for all nutrients, but not for calories, are about 60 percent higher than the minimum requirement. Consequently, if intakes of some nutrients are lower than the recommended allowances, it does not necessarily mean that an individual has an inadequate diet. At the same time, it should not be assumed that the intake is adequate for all individuals in the population just because the average intake exceeds the recommended allowance.

It is also necessary to keep in mind the dietary interrelationship that exists between protein and calories. Although the primary function of protein is tissue synthesis, protein may be used to provide energy if the body's energy needs are not met from calorie consumption. Thus, if the calorie intake is inadequate, the level of protein available for tissue synthesis may be lower than that shown. This situation is found in both the zones, but particularly in the corn zone where both the calorie and the protein intake levels are deficient.

It is interesting to compare the adequacy levels found in the Caqueza Project region with those determined by INN for Colombia as a whole (1, p. 255; 5, p. 35). Although there are similarities in the data, there are also differences, thus verifying the necessity for every nutrition program to base its strategy on the situation existing in the region, rather than on generalizations for the entire country (see Table 5).

Diets of Preschool Children

The food consumption of all preschool children in the sample was analyzed separately. There were 40 families with 91 preschool children in the corn zone

and 54 families with 106 children in the potato zone. The same procedure was used to calculate the nutrient content of the diet consumed by this group as was used in determining the daily per capita nutrient content of the family diet. Table 6 shows the nutrient content of the average preschool child's diet and presents the level of adequacy of this consumption in relation to the recommended daily allowance for Colombian preschoolers. These values are also compared in Chart 2.

The average nutrient intake of the preschool child in both zones is better than that of the family average and met all nutritional requirements at an acceptable

CHART 2.—ADEQUACY LEVELS FOR PRESCHOOL DAILY AVERAGE PER CAPITA CONSUMPTION LEVELS

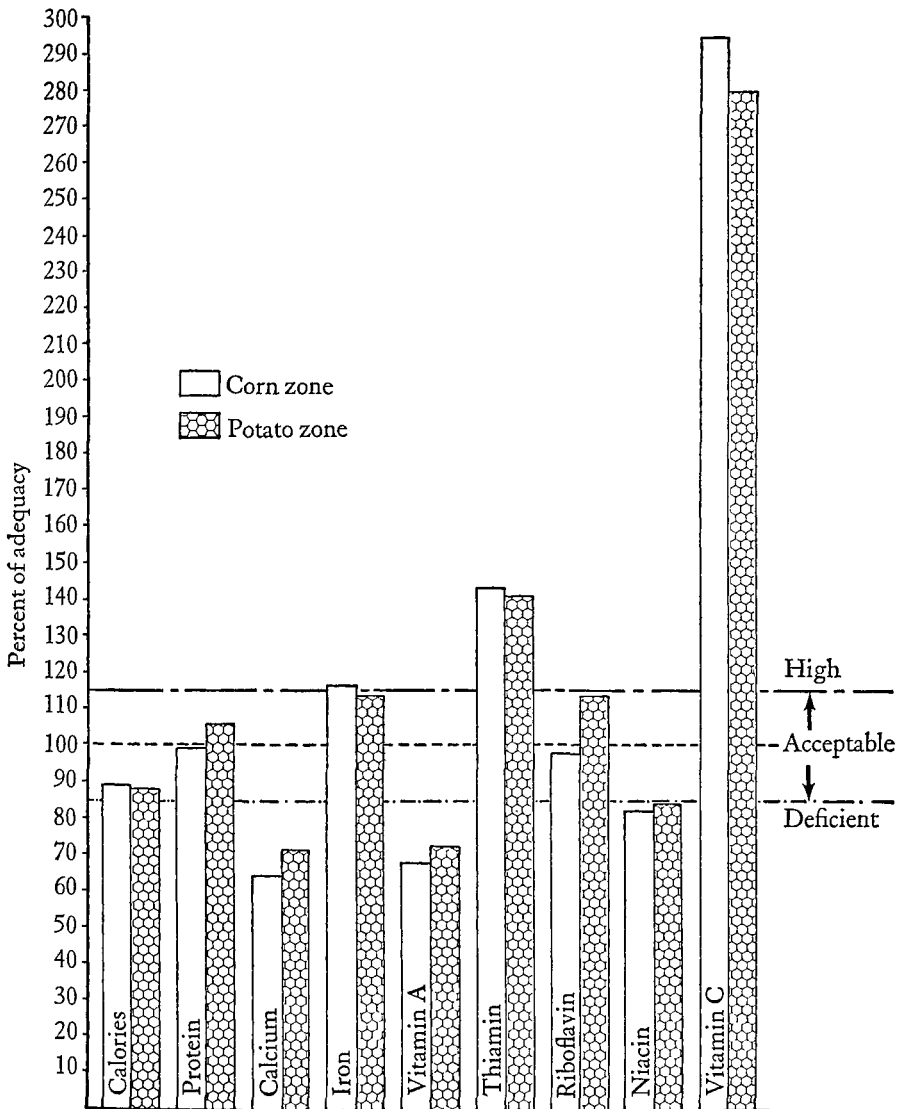


TABLE 6.—RECOMMENDED ALLOWANCES, DAILY AVERAGE PER CAPITA CONSUMPTION, AND NUTRITIONAL ADEQUACY OF THE PRESCHOOL DIETS

Nutrient	Recommendation	Consumption		Adequacy ^a	
	Corn and potato zones	Corn zone	Potato zone	Corn zone	Potato zone
Calories	1,420	1,264	1,252	89	88
Protein (<i>g.</i>)	33.0	32.5	35.1	99	106
Calcium (<i>mg.</i>)	700	446	494	64	71
Iron (<i>mg.</i>)	8.8	10.3	10.0	117	114
Vitamin A (<i>IU</i>)	2,200	1,487	1,585	68	72
Thiamin (<i>mg.</i>)	0.54	0.77	0.76	143	141
Riboflavin (<i>mg.</i>)	0.84	0.82	0.96	98	114
Niacin (<i>mg.</i>)	9.3	7.6	7.8	82	84
Vitamin C (<i>mg.</i>)	40	118	112	295	280

^a Consumption as a percent of recommendation.

level except for vitamin A and calcium (Table 6). In the corn zone, 28 percent of the total protein was of animal origin, while in the potato zone 38 percent was of animal origin but intake of calories, iron, thiamin and vitamin C was marginally higher in the corn zone than in the potato zone. The major conclusion to be drawn at this point is that apparently despite lower incomes in the corn zone, children are equally well provided for in both communities with respect to most nutrients, protein, and calories, but that calcium and vitamin A are equally short in both zones.

Nutritional Status of Preschool Age Children

In addition to food consumption data, the height and weight of all preschool children in the sample families were recorded. These measurements were analyzed according to the Auxometric Combination method developed by R. Rueda-Williamson that uses height, weight, and age of the child to determine his nutritional status (19, p. 23). In the corn zone, 49 percent of the preschoolers were found to be suffering from some degree of malnutrition, while in the potato zone this percentage was only 35 percent. Table 7 shows the differences in nutritional status between the two zones.

It is important to keep in mind that when height-weight measurements are taken only once they may not reflect the entire nutritional picture. It is possible that a period of retarded growth occurred earlier, and that the child was growing

TABLE 7.—NUTRITIONAL STATUS OF THE PRESCHOOL CHILD IN THE TWO ZONES

State of nutrition	Corn zone		Potato zone	
	Number	Percentage	Number	Percentage
Above weight	18	20	31	29
Normal	28	31	36	34
Slight malnutrition	11	12	14	13
Moderate malnutrition	10	11	13	12
Severe malnutrition	24	26	11	10

TABLE 8.—DAILY AVERAGE PER CAPITA FOOD CONSUMPTION COSTS
BY ZONE AND GROUP
(In pesos)

Group	Corn zone	Potato zone	Corn zone as percent of potato zone
Family	6.25	7.66	80
Preschool	5.21	5.54	92

at an adequate rate when the measurements were taken. Consequently, in order to have a more reliable picture of the child's nutritional status and growth rate it is recommended that several height-weight measurements be taken at different time intervals. Nevertheless this measurement shows the nutritional status of the preschoolers in the potato zone to be clearly superior to that in the corn zone.

THE STATE OF NUTRITION AND SOCIOECONOMIC FACTORS

Nutritional status was also compared with the amount spent on food and with a general index of socioeconomic characteristics.

Cost of Food

Less money was spent on food for both preschool and family groups in the corn zone than in the potato zone (Table 8).

The difference in cost between the two zones was greater for the average daily diet than it was for the preschool diet, and families in the lower-income corn zone devoted a relatively greater portion of their food expenditures to their preschool-age children than did families in the potato zone.

This is consistent with the earlier inference that the rural family takes care to assure adequate consumption levels for its children before concerning itself with adult diets.

Food Expenditure and Nutrient Composition

The correlation of consumption of calories and each of the nutrients with total food expenditure was calculated in a linear form with intercept, using the following model:

$$Y_{if} = \alpha + \beta X_f$$

where Y_{if} refers to the quantity of the i th nutrient consumed
by the f th family
 X_f is the amount spent for food by the f th family .

Some of the results are shown in Tables 9 and 10. The significance of the regression coefficients of the independent variable and the intercept, and the power exponent of the model, measured by the level of R^2 in both groups and for both zones studied, are highest for calories and protein intake and lowest for calcium, vitamin A, and riboflavin.⁶ This suggests that protein and calorie con-

⁶ Several consumption studies have shown that malnutrition is income-related. Protein and calories, on the one hand, and the nutrients vitamin A, calcium, and riboflavin were chosen to show the different relationships that exist between consumption levels of each and income. Vitamin A and calcium were the most deficient nutrients in all groups. Riboflavin represented the vitamin B complex and was deficient in part of the population.

TABLE 9.—FITTED REGRESSION EQUATIONS FOR THE RELATIONSHIP BETWEEN CONSUMPTION OF SPECIFIED NUTRIENTS CONSUMED AND FOOD EXPENDITURES FOR THE FAMILY AVERAGE GROUP*

Nutrient consumed	Corn zone			Potato zone		
	Intercept	Slope	R ²	Intercept	Slope	R ²
Calories	477 ^a (6.9)	161 ^a (15.8)	.68	793 ^a (7.7)	126 ^a (10.3)	.46
Protein	3.18 ^a (3.2)	5.13 ^a (13.6)	.61	14.2 ^a (4.9)	4.5 ^a (13.0)	.58
Riboflavin	.14 ^b (2.0)	.12 (2.9)	.07	.46 ^a (5.2)	.09 ^a (8.3)	.36
Calcium	87 (1.4)	56 ^a (6.4)	.25	170 ^b (2.5)	53 ^a (6.5)	.26
Vitamin A	286 (.9)	138 ^a (2.9)	.07	205 (.06)	220 ^a (5.7)	.21

* The *t* values are in parentheses.

^a Significant at .01 level.

^b Significant at .05 level.

sumption is directly related to expenditure, while the consumption of calcium, vitamin A, and riboflavin is more related to regional food habits. It is interesting to note that consumption of riboflavin, one of the nutrients in the vitamin B complex, which comes from foods that are generally high in protein, is not as highly correlated with expenditure as is protein in the potato zone and not at all in the corn zone. It also indicates that only some kinds of malnutrition can be reduced through increasing the incomes of rural families. Others must be attacked through nutrition education in order to change the food consumption patterns.

TABLE 10.—FITTED REGRESSION EQUATIONS FOR THE RELATIONSHIP BETWEEN CONSUMPTION OF SPECIFIED NUTRIENTS CONSUMED AND FOOD EXPENDITURES FOR THE PRESCHOOL GROUP*

Nutrient consumed	Corn zone			Potato zone		
	Intercept	Slope	R ²	Intercept	Slope	R ²
Calories	617 ^a (3.5)	124 ^a (3.9)	.28	389 ^a (4.3)	153 ^a (10.4)	.67
Protein	12.8 ^a (3.1)	3.8 ^a (5.0)	.40	9.17 ^a (3.1)	4.6 ^a (9.7)	.64
Riboflavin	.40 ^b (2.4)	.08 ^a (2.8)	.17	.34 ^a (3.1)	.11 ^a (6.1)	.41
Calcium	305 ^b (2.5)	27.1 (1.2)	.03	161 (1.7)	59.1 ^a (3.7)	.21
Vitamin A	529 (.9)	184 (1.8)	.08	1,041 ^b (2.0)	97 (1.1)	.02

* The *t* values are in parentheses.

^a Significant at .01 level.

^b Significant at .05 level.

The State of Nutrition and Socioeconomic Factors

Health status of preschool children as indicated by the Rueda-Williamson index was compared with socioeconomic characteristics of the family and with consumption levels. The Rueda-Williamson index gives five different health levels, and in this analysis one more was arbitrarily added on either end of the scale. The index value, from 1 to 7, was then regressed against family size, the child's consumption of nutrients, family income, per capita food expenditure, farm value, value of farm capital, and farm net worth.

The results of this model in linear and quadratic form were not significant at any statistically meaningful level, and the coefficients were extremely small. As was mentioned earlier, height-weight measurements reflect nutritional and health conditions over the period leading up to the time of measurement whereas the other variables in the model indicate present conditions. Nevertheless, it could be inferred from the negative results of the model analysis that other factors may be more important determinants of health than are nutrition and wealth. Disease, infection, and unfavorable sanitary conditions, which were not measured, are major determinants and their incidence must be considered if a complete set of health conditioning factors is to be obtained.

SUMMARY AND CONCLUSIONS

The nutrition study in the Caqueza Project was specifically designed to investigate the nature of food consumption patterns in the area. Several conclusions that conflict with accepted nutrition theory are summarized below.

1. Consumption levels of iron, thiamin, and vitamin C were more than adequate in both ecological zones and for both the family average group and the preschoolers. In the potato zone, fairly acceptable intake levels of protein, calories, calcium, niacin, and riboflavin were observed for the family average group, while in the corn zone these nutrients were deficient for the same group. For the preschool group, only calcium and vitamin A were deficient and this was true of both zones. The nutrient with the lowest consumption in both zones for the family average group was vitamin A, which met only 28 percent of the recommended allowance in the corn zone and 40 percent of the recommended allowance in the potato zone. Chemical analysis of defective sight was not tested for in this study, but has been included in subsequent research efforts for the preschool population in connection with the establishment of several preschool centers in the low-income zone. Consumption of both vitamin A and calcium was found to be about 70 percent adequate in both zones for the preschool group.

2. The nutritional quality of the diet was higher in the potato zone than in the corn zone. However, the difference was slight for the preschool group. The diets in the potato zone also cost more—7.66 pesos per person per day for the family average and 5.64 pesos for the preschool group—than in the corn zone—6.25 pesos for the family average and 5.21 pesos for the preschool group. Nevertheless, it appeared that the difference in the dietary values for the preschool groups between the two zones was not statistically significant, whereas the difference in dietary values for the family average groups was significantly different at the 5 percent level. Expenditure levels can be expressed in another way: the

preschool diet cost 74 percent as much as the family average diet value in the potato zone, whereas it cost 84 percent as much in the corn zone. The rural family appears to take care to meet the consumption needs of its children before satisfying adult requirements regardless of income levels.

3. The height-weight measurements showed that 49 percent of the preschool children in the corn zone and 35 percent of the preschoolers in the potato zone suffered from some degree of protein-calorie malnutrition according to the Auxometric Combination scale developed by Rueda-Williamson. The nutritional status as far as this scale was concerned was significantly better in the potato zone than in the corn zone.

4. The foods most commonly consumed in both zones were roots, tubers, cereals, and legumes, with much less consumption of other vegetables, fruits, meat, or eggs. Food consumption patterns in the higher income potato zone included relatively more meat and milk than in the lower income corn zone. The preschool group in each zone consumed more milk and fruit than its family average group.

5. Protein and calorie intake were found to be more highly correlated with expenditure than were calcium, vitamin A, or riboflavin. (Vitamin A was the principal nutrient found to be deficient.) In the corn zone, family and preschool consumption of riboflavin were not highly correlated with expenditure, whereas in the potato zone more correlation was encountered.

6. Little significant correlation existed between the health index based on height-weight measurements of preschoolers and variables such as wealth, income, and nutrient consumption.

This study has shown that food consumption in general is highly related to income while the consumption of some critical nutrients and the diets of some groups are not so income-dependent. Hence, nutrition programs which are not income-generating have a potential for creating significant nutritional impacts.

The results of this study have led to the creation of fifteen preschool centers, where nutrition education will be imparted to the rural families, along with a school lunch program. The Government of Colombia has now recognized the need for a more concentrated effort on nutrition education and preschool training as a necessary component in its rural development program.

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APPENDIX

AVERAGE DAILY FOOD CONSUMPTION IN EACH ZONE FOR THE
TWO GROUPS STUDIED
(In grams)

Food	Average family per capita diet		Average preschool per capita diet	
	Corn zone	Potato zone	Corn zone	Potato zone
Milk and derivatives	118	163	155	210
Meat	25	35	15	29
Eggs	7	6	8	14
Legumes	74	59	49	35
Vegetables	32	42	36	32
Fruits	8	5	16	22
Corn and derivatives	68	79	48	40
Rice	46	53	32	32
Other cereals and derivatives	39	53	39	38
Potatoes	240	295	174	203
Other roots and tubers	134	155	122	117
Sugar and derivatives	70	67	60	63
Oils and fats	3	5	2	—
Miscellaneous	6	11	7	10

