

1212-118

DE NUTRICION DE
AMERICA Y PANAMA
GUATEMALA, S. A.

IOTECA

DIETETIC AND ANTHROPOMETRIC DIFFERENCES BETWEEN CHILDREN FROM THE CENTER AND SURROUNDING VILLAGES OF A RURAL REGION OF COSTA RICA

VICTOR VALVERDE AND IAN G. RAWSON

Social Sciences Research Program, Institute of Nutrition of Central America and Panama, Guatemala, and Department of Anthropology, Health Services Research Unit, Graduate School of Public Health, University of Pittsburgh, Pennsylvania, U.S.A.

(Received October 10, 1975; in final form June 23, 1976)

Dietary and anthropometric surveys of children were conducted as part of a nutritional evaluation of the central (urban) and peripheral (rural) areas of San Ramón, a town located in the central plateau of Costa Rica. The findings showed marked differences between the center and the peripheral villages in the intake of selected nutrients, height and weight of children. The data show a primary energy deficiency in children from the peripheral villages. Anthropometric data suggested that there were nutrition problems in the villages, but in the center of the town, 87 percent of the sample, had an adequate height-for-age relationship. The lowering of morbidity, its effect on nutritional status, and the role of public health programs in nutritional planning are discussed.

This information confirms the problem of maldistribution of scarce national resources at the rural level. This is due to the fact that government services promoting rural development are located in the center of rural populations with limited projection to those that need it most: the semi-isolated and isolated rural population.

INTRODUCTION

Malnutrition is one of the most serious health problems affecting the people of Costa Rica (INCAP, 1969). Among Costa Ricans, children under five years of age are one of the most affected groups. In Costa Rica, in 1966, 57 percent of the children in this age group were rated in one of the several grades of protein-calorie malnutrition (INCAP-ICNND, 1972). The interrelationship of malnutrition and infection, and their relationship with mortality, morbidity, mental development and work capacity constitute problems of great importance for the social and economic development of a country (Berg, 1973). A nutritional evaluation survey was carried out in San Ramón, a rural town whose center is located 58 kilometers from the capital city of San José. The objective of the survey was to determine the current nutritional situation of children from 6 months to 5 years of age that could provide baseline data for the formulation of nutrition intervention programs in the central zone of the country, where approximately 60 percent of the

2,000,000 inhabitants of Costa Rica live. The present paper describes the results of the anthropometric and dietary surveys conducted during the evaluation project, and it focuses on the differences found between the central and peripheral semi-isolated populations of San Ramón. The evaluation project also included information on vital statistics, morbidity, prevalence of parasites, cultural factors in relation to diet, and analyses of socioeconomic factors and processes affecting nutritional status of children.

MATERIAL AND METHODS

San Ramón has a total population of 37,000 inhabitants. Twenty-five percent live within a dense central cluster which surrounds the town square. The remainder reside in 12 small semi-isolated, and isolated, peripheral villages which vary in distance from the town square from 5 hours by car and horse to the farthest village, to 10 minutes by road to the closest one. Children from the center, and four representative peripheral villages

were chosen at random for anthropometric and dietary studies covering an estimated population of 17,000 persons. The areas selected showed similar characteristics to those found throughout the central plateau, where the majority of the country's population lives. In this way, comparative information was collected from children of the center and peripheral villages of this rural area.

The dietary information reported in this paper was carried out during January of 1974, which is the height of the Costa Rican summer season. It included 151 children; 42 from the center and the remaining 109 from the peripheral villages, corresponding approximately to the distribution of populations in the center (25 percent) and peripheral villages (75 percent).

Dietary data were collected by visiting the homes of the children twice during one day, utilizing in all cases both the recall and direct weighing methods. Food consumption was recorded in terms of energy, proteins, retinol and iron.

Anthropometric data were collected in their homes from 119 children who also formed part of the dietary survey. A beam balance with

intervals of 0.1 kg. was used for weight determination. Children were weighed without shoes and a minimum of clothes. Height was determined in infants and small children using a portable infantometer. Older children were measured barefooted, standing on a flat floor against a wall, and using a vertical plastic tape. Height was measured to the nearest 0.5 cm.

Weight, height and age were used to calculate indices of weight-for-age, weight-for-height, and height-for-age. The information was compared with the standards adopted by INCAP, which are based on the Iowa and Harvard standards.

RESULTS AND DISCUSSION

Consumption of foodstuffs Table I shows the average intake of foods and the percentage of children living in the center and peripheral villages who consume them. Animal products such as meat, milk and eggs were widely consumed by the children studied in both zones. The amounts of these products eaten was greater in the center than in the peripheral villages. *Panela* (caked unrefined brown sugar) was consumed almost

TABLE I
Mean consumption of foods and percentage of Costa Rican children consuming different items, by place of residence. San Ramón, 1974 (Number of cases).

Food	Center (42)		Villages (109)	
	Mean intake (g)	Percentage of children	Mean intake (g)	Percentage of children
Fresh milk	589	88.0	365	75.5
Powdered milk	4	3.0	12	24.6
Meat	53	61.0	11	31.9
Eggs	37	77.0	21	40.9
Beans	18	65.0	13	57.3
Rice	53	84.0	42	80.9
Tortillas	24	38.0	46	58.2
Bread	25	73.8	31	73.7
Pasta ^a	6	31.0	7	32.8
Roots and tubers	46	66.7	22	45.5
Plantains	37	38.0	22	22.8
Vegetables	34	50.0	11	14.6
Fruits	51	41.0	17	14.6
Sugar ^b	29	98.0	21	70.9
Panela ^c	1	2.0	18	70.0
Fats ^d	12	62.0	4	38.2

^a Macaroni, noodles, etc.
^b Soft drinks and other preparations with sugar are excluded.
^c Brown sugar, locally prepared.
^d Fat in rice preparations not included.

exclusively in the peripheral villages, where white sugar was also consumed. Modernization of the sugar industry has made sugar less expensive than *panela*. This fact, together with a prestige aspect, has caused almost a total abandonment of *panela* consumption in the center.

Intake of nutrients For the purpose of this study, energy, protein, retinol and iron were selected for detailed analysis. Table II presents by place of residence the intake of energy and of three selected nutrients (proteins, retinol and iron) expressed as percentage of intakes recommended by the In-

TABLE II

Intake of energy and nutrients by Costa Rican children expressed as percentage of recommended values^a by place of residence. San Ramón, 1974 (Number of cases).

Place of residence	Energy	Protein	Retinol	Iron
Center (42)	97	193	232	105
Villages (109)	74	122	82	74

^a See Menchú, Arroyave, and Flores, 1973.

stitute of Nutrition of Central America and Panama (INCAP) (Menchú, Arroyave, and Flores, 1973). In relation to needs, energy and nutrient intakes of children from the villages are lower than those of children living in the center of the town.

Table III compares the consumption of energy and selected nutrients with intakes recommended by INCAP for children of different ages. Energy and iron intakes fall below the recommended figures in most age groups. As the data reveal, the energy consumption remains stable in almost all age groups, a finding which is not in accordance with the increasing requirements of growing, healthy and normally active children. Protein

intake is at all ages well above the recommended values. The low energy consumption may reduce the amount of protein used for anabolic purposes.

An analysis was also made of the quality of the dietary protein. Each diet was analyzed to determine the proportion of total protein derived from animal sources, and compared by place of residence. The average consumption of animal protein was approximately 69 percent in the center and 60 percent in the peripheral villages. In 75 percent of all the diets, more than half of the protein was found to come from animal sources. Animal products, cereals, legumes and, in a lesser proportion other protein sources, provide amino acids which form a high-quality protein. A detailed study of protein quality, limiting amino acids and the protein-calorie relationships in these diets, is discussed elsewhere (Valverde *et al.*, 1975). The findings of the dietary study conducted during the summer season do not differ from another survey carried out in one of the villages during the winter season (Rawson and Valverde, 1976).

ANTHROPOMETRIC DATA

Weight-age indices An abnormal weight-for-age relationship in children may indicate the occurrence of nutritional insult. However, this does not discriminate between current nutritional distress, previous insult or a combination of both. Nevertheless, the weight-for-age index is the most commonly recognized international indicator of nutritional status.

The data from San Ramón indicate that a smaller total percentage of children are below the normal weight-for-age standards than those reported by INCAP for the whole country in

TABLE III

Mean intake of selected nutrients and energy and recommended values^a (R.V.) for intakes by Costa Rican children by age. San Ramón, 1974 (Number of subjects).

AGE GROUPS	Energy (kJ)		Proteins (g)		Retinol (μg)		Iron (mg)	
	Intake	R.V.	Intake	R.V.	Intake	R.V.	Intake	R.V.
Less than 1 year (12)	4992	4184	41.8	19.0	719	300	8.6	10.0
1 year (36)	4562	4811	37.4	24.0	386	250	7.4	10.0
2 years (31)	4393	5648	35.1	28.0	360	250	7.6	10.0
3 years (31)	4489	6485	33.9	30.0	240	250	8.0	10.0
4 and 5 years (41)	4979	7322	44.6	33.0	210	300	10.0	10.0

^a From Menchú, Arroyave and Flores, 1973.

TABLE IV

Nutritional status of Costa Rican children in 1966 and 1974 based on the Gómez classification,^a expressed as percentages of all children in each sample.

Studies	Normal	Gómez classification of malnutrition			Total
		First degree	Second degree	Third degree	
San Ramón, 1974	52.9	22.8	11.8	2.5	100.0
INCAP, 1966 ^b	42.6	43.7	12.2	1.5	100.0

^a See Gómez *et al.* (1955).
^b Data from INCAP-ICNND Nutrition Surveys, 1972.

TABLE V

Nutritional status of Costa Rican children using the Gómez classification, by place of residence, expressed as percentage of all children in each sample. San Ramón, 1974 (Number of cases).

Place of residence	Normal	Gómez classification of malnutrition			Total
		First degree	Second degree	Third degree	
Center (31)	64.5	32.3	3.2	0.0	100.0
Villages (88)	48.9	32.9	14.8	3.4	100.0

X² value = 2,595 (not significant at 0.05 percent level).

1966. However, analyses of malnutrition by degree of severity (Table IV) show that compared with the results of the INCAP study the decrease is mainly in the percentage of children in the first degree category, with an unexpected increase in the percentage of children suffering from third degree malnutrition.

Differences in nutritional status, by place of residence, are clearly indicated by the weight-for-age data shown in Table V with a larger proportion of children from the center falling within the normal category. Third-degree malnutrition was not observed in the center of San Ramón, while it was found among 3.4 percent of the village children. The proportion of children with second-degree malnutrition was also larger in the peripheral villages, but there was little difference in the percentages of children with first-degree malnutrition, by place of residence.

Weight-height indices The most practical and efficient method of identifying the current nutritional status of a child through anthropometric indicators is believed to be the analyses of

weight in relation to height. Such measurements control for height retardation caused by early malnutrition.

As shown in Table VI, children in the peripheral villages were more likely than those in the San Ramón center to fall within the acceptable weight-for-height category since a greater proportion (69.3 percent) of the peripheral village children exhibit normal or acceptable weight-for-height. This difference is most marked in the group with deficits up to 10 percent.

TABLE VI

Nutritional status of Costa Rican children by place of residence, based on weight for height deficits. San Ramón, 1974 (Number of cases).

Place of residence	Deficits in weight for height		
	Normal	-10%	11-20%
Center (31)	58.0	35.5	6.5
Villages (88)	69.3	22.7	8.0

X² value = 1,217 (not significant at 0.05 percent level).

TABLE VII

Nutritional status of Costa Rican children by place of residence, based on height for chronological age.
San Ramón, 1974 (Number of cases).

Place of residence	Deficit in height for age				
	Normal	-5%	6-10%	11-15%	More than 15%
Center (31)	54.9	32.3	9.7	3.2	0.0
Villages (88)	15.9	36.4	27.3	12.5	7.9

χ^2 value = 16,562 (significant at 0.01 percent level).

Height-for-age index In order to explain the apparent incongruity of the results of weight-for-age and weight-for-height indices, the heights of the children were examined in relation to their age (Table VII). These data reveal that most children with normal weight-for-age in the center have heights above normal for their ages. In other words, tall for age children are classified as normal by weight-for-age criteria; in reality however they show a slight deficit at optimum weight-for-height. The fact that 87.2 percent of the children from the center compared with 52.2 percent from the villages have less than a 5 percent deficit in height-for-age categories, implies a marked difference in the nutritional characteristics of these two populations.

The anthropometric data indicate that in the peripheral villages nutritional problems are moderate but chronic, and they generate cumulative effects which are more visible in older preschool children than in infants. These children are more often nutritionally deficient than children living in the center of San Ramón. In the center, malnutrition may be considered as a problem which is neither great in magnitude nor severe. Some of these children who appear to be below normal in their weight-for-height are, in fact, above normal in their height-for-age. These findings support those of an earlier study of urban-rural differences in Costa Rican children (Villarejos *et al.*, 1971). That study included children from the capital and five major provincial cities of the country (urban sample) and a rural sample drawn from 12 villages of 2000-3000 inhabitants. It revealed a notable discrepancy in the growth patterns of urban and rural children. The former group showed heights and weights very similar to the Iowa standards (Nelson, 1964), but the rural children lagged far behind them.

The anthropometric data corroborate the dietary data which show that the diets of children from surrounding villages provide less energy, protein, retinol and iron than the diets of children living in the center. Energy is ingested at inadequate levels during the second and subsequent years, a pattern which has been observed elsewhere in this, and other countries (Flores, *et al.*, 1970; Flores *et al.*, 1972; Menchú, Lara and Flores, 1973).

Studies in Central America and other regions of the world where cereals and legumes constitute the dietary staples for the population, have shown that diets consumed by preschool children provide adequate levels of energy and fulfill the protein requirements of these children. A problem appears to exist, not with the quality of these diets, but more with the quantity that the children consume (Parrilla Ríos, 1973; Joy, 1973; Hussain, 1973; Gopalan *et al.*, 1973). In addition to underestimations of the amounts of food that children may consume, there are other problems. These include child-rearing customs and economic restrictions, which impede the purchase and consumption of the quantity of foods needed by children to satisfy their energy requirements (Valverde, 1975; Rawson and Valverde, 1976).

A comparison of the results of the 1966 national anthropometric survey by INCAP with those of the present study, shows that today a smaller percentage of children in this area is below normal compared with the number reported in 1966 for the whole country. This difference is almost exclusively due to a decrease of children with first-degree malnutrition; but there is an increase in the percentage of children with third-degree malnutrition. An acceptable explanation for this difference is that data from the two studies cannot be compared, since the first was carried out at a national level, while the second consti-

tuted only a regional study. We believe however, that this variation could be explained by the fact that the rural health program, which began functioning during the year prior to the present study, had reduced morbidity and gastrointestinal ailments, and eliminated communicable diseases such as measles and whooping cough. The possible reduction of morbidity in children with a largely adequate diet, would counteract the inevitable weight loss that accompanies episodes of illness. This would increase the percentage of children within the normal weight categories. INCAP studies in Guatemala reported by Parrilla (1973) have revealed the effect of morbidity on nutritional status. Studies in Colombia also showed that a decrease of 50 percent in the prevalence rates of malnutrition in preschool children took place with the introduction of improved sanitation (De Tascon *et al.*, 1972).

This second possibility needs to be explored at depth, since for national food and nutrition planning purposes their study may provide the necessary elements to clearly define the actual role of public health programs in the eradication of nutritional problems caused mainly by socio-economic conditions in the developing countries (Payne, 1975).

The study carried out by Villarejos *et al.* (1971) was an initial step that clearly indicates spatial differences in nutritional status of children from urban and rural areas. The differences found in the nutritional status of children of the center and peripheral villages of San Ramón provide evidence of an inequality in the distribution of resources even at the rural level. Unfortunately, most of the government services intended to promote "rural development" are concentrated in the central sections of those rural areas, where they are less needed, with little or no projection to the rural target population—the inhabitants of semi-isolated and isolated villages. This problem must be kept in mind by the planners of intervention programs aimed at bringing a better and more productive life to the rural areas of our countries.

ACKNOWLEDGEMENT

We wish to thank Dr. Rodrigo Gutiérrez Sáenz, Dean of the School of Medicine of the University of Costa Rica, and Dr. Juan Ortiz Guier, Head of the Rural Health Program of San Ramón, for

their encouragement and support of this research. Also Drs. Mark Irwin, Ivan D. Beghin, Alberto Pradilla, Wesley Craig, Bernard Pillet and Robert Stickney, of the INCAP staff, for their technical help in the preparation of this paper.

REFERENCES

- Berg, A. (1973). *The Nutritional Factor: Its Role in National Development*. The Brookings Institution, Washington, D.C., pp. 9–30.
- De Tascon, F., V. de Martínez, A. Aguirre and A. Pradilla (1972). Nutrition effects of a simplified system of health delivery in a semi-urban community. (In) P. Arroyo *et al.* (Eds) *Summaries—IX International Congress of Nutrition*, Mexico, D. F., September 3–9, 1972, p. 99.
- Flores, M., M. T. Menchú, M. Y. Lara and M. Bébar (1972). Dieta del preescolar en el area rural de El Salvador. *Arch. Latinoamer. Nutr.* 22, 205–225.
- Flores, M., M. T. Menchú, M. Y. Lara and M. A. Guzmán (1970). Relación entre la ingesta de calorías y nutrientes en preescolares y la disponibilidad de alimentos en la familia. *Arch. Latinoamer. Nutr.* 20, 41–56.
- Gómez F., R. Galván, J. Cravioto, S. Frenk (1955). Malnutrition in infancy and childhood, with special reference to Kwashiorkor. *Advances in Pediatrics*, 7, 131, Yearbook Publishers, New York.
- Gopalan, C., M. C. Swaminathan, V. K. Krishna Kumari, D. Hanumantha Rao and K. Vijayaraghavan (1973). Effect of calorie supplementation on growth of undernourished children. *Am. J. Clin. Nutr.* 26: 563–566.
- Hussain, M. A. (1973). A fresh look at the incidence of protein deficiency in Pakistan. *Brit. J. Nutr.* 29: 211–219.
- INCAP (1969). *Evaluación Nutricional de la Población de Centro America y Panamá, Costa Rica*. Instituto de Nutrición de Centro América y Panamá (INCAP); Oficina de Investigaciones Internacionales de los Institutos Nacionales de Salud (EEUU); Ministerio de Salubridad Pública. Guatemala, Instituto de Nutrición de Centro América y Panamá, 113 p.
- INCAP-ICNND (1972). *Nutritional Evaluation of the Population of Central America and Panama. Regional Summary*. Institute of Nutrition of Central America and Panama (INCAP), Center for Disease Control (Formerly Inter-departmental Committee on Nutrition for National Development), Department of Health, Education and Welfare, Washington, D.C., 165 p. (DHEW Publication No. (HMS) 72-8120).
- Joy, L. (1973). Food and nutrition planning. *J. Agr. Econ.* 24: 165–192.
- Menchú, M. T., M. Y. Lara and M. Flores (1973). Efecto del nivel socioeconómico de la familia sobre la dieta del niño preescolar. *Arch. Latinoamer. Nutr.* 23: 305–323.

- Menchú, M. T., G. Arroyave and M. Flores (1973). *Recomendaciones Dietéticas Diarias para Centro America y Panamá*. Instituto de Nutrición de Centro América y Panamá, Guatemala, C.A., 33p.
- Nelson, W. (1964). *Textbook of Pediatrics*, 8th Edition. Saunders, Philadelphia, p. 48.
- Parrilla Ríos, C. M. (1973). *Valor Nutritivo Global de Dietas cuyas Proteínas Proviene Predominantemente del Maíz y del Frijol Negro en Niños de 2 a 7 Años. Interrelación entre Morbilidad y Desnutrición*. (M.S. Thesis). Centro de Estudios Superiores en Nutrición y Ciencias de Alimentos (CESNA), Universidad de San Carlos de Guatemala, Facultad de Ciencias Químicas y Farmacia/INCAP, Guatemala, C.A.
- Payne, P. R. (1975). Safe protein-calorie ratios in diets. The relative importance of protein and energy intake as causal factors in malnutrition. *Amer. J. Clin. Nutr.* 28: 281-286.
- Rawson, I. G. and V. Valverde (1976). The etiology of malnutrition among preschool children in rural Costa Rica. *J. Trop. Pediat.* 22: 12-17.
- Valverde, V. (1975). Analysis of some economical aspects relating to prevalence of malnutrition in medium and low income groups of urban and rural areas of Costa Rica (*Magister Scientiae Thesis*). University of London. London, England, 46 p.
- Valverde, V., W. Vargas, I. Rawson, G. Calderón, R. Rosabal and R. Gutiérrez (1975). La deficiencia calórica en preescolares del área rural de Costa Rica. *Arch. Latinoamer. Nutr.* 25, 351-361.
- Villarejos, V., J. Osborne, F. Payne and J. Arguedas (1971). Heights and weights of children in urban and rural Costa Rica. *J. Trop. Pediat. Environm. Child Health* 17: 32-43.