

**NUTRITIONAL STATUS OF THE ELDERLY  
IN PALMARES, COSTA RICA**

*Diane V. Havlir<sup>1</sup>, Sandra Murillo<sup>2</sup>, Eduardo Robles<sup>3</sup>,  
Alfonso Trejos<sup>4</sup> y Leonardo Mata<sup>2, 5</sup>*

Instituto de Investigaciones en Salud (INISA), Universidad  
de Costa Rica, San José, Costa Rica, and St. Olaf College,  
Northfield, Minnesota, USA

**SUMMARY**

The nutritional status of aged persons living in a small Costa Rican community was evaluated using anthropometric measurements, clinical findings and dietary surveys. Eighteen per cent of the aged were overweight, a condition that occurred more frequently in women than in men. In a random sample

---

Manuscrito modificado recibido: 2-4-83.

- 1 St. Olaf College, Associated Colleges of the Midwest Latin American Field Research Program. Presently at Duke University Medical School, Durham, North Carolina, USA.
- 2 Instituto de Investigaciones en Salud (INISA), Universidad de Costa Rica, Ciudad Universitaria Rodrigo Facio, San José, Costa Rica.
- 3 Palmares Health Center, Ministry of Health, Costa Rica.
- 4 Hospital San Juan de Dios, San José, Costa Rica.
- 5 Address reprint requests to: Leonardo Mata, D. Sc., Director, Instituto de Investigaciones en Salud (INISA), Universidad de Costa Rica, Ciudad Universitaria Rodrigo Facio, San José, Costa Rica.

of subjects, serum albumin values were low in 45%, serum cholesterol values high in 39%, and hemoglobin values low in 3%. The subjects consumed a simple, repetitive diet with few processed foods which met 80% of requirements for protein, calcium, and iron, although calorie and vitamin A values appeared low. The lack of severe nutritional problems of the elderly was attributed to the family structure, good hygiene and protection from debilitating infectious disease, good community health services, and simple balanced diets.

### INTRODUCTION

Costa Rica, a small developing Central American country with a population of two million persons, no longer has a high death rate due to infectious diseases. Like most industrialized countries, the first and second most common causes of death are circulatory diseases and malignant neoplasms, respectively (1). Social reform, better environmental conditions, and an increase in the standard of living have contributed to the rapid improvement of health and nutritional conditions in recent decades (2), but the emphasis and evaluation of these improvements has been focused on infants and children. Although the country has a rapidly growing aging population because of increases in life expectancy, there has been little research done on the health of the elderly, and even less is known about their nutritional status. The purpose of this study, was therefore, to identify the general health and nutritional patterns of a population of noninstitutionalized elderly in a rural setting in Costa Rica.

The location selected was Palmares, a small community with a population of 3,083 located along the Pan American Highway, 52 kilometers northwest of San José. Palmares is the central community of a larger agricultural district providing commerce, educational, and cultural meeting places for the district. It has three major health centers, a dental clinic, and a community-sponsored home for the aged. The Central Health Center, staffed by four full-time nurses and one physician, offers free services to all members of the community. Nurses visit each family at regular intervals and maintain records on health and living conditions. Adjacent to the Health Center is a Nutrition Center providing assistance to pregnant women, young mothers, and children. A Social Security Health Center is also located in Palmares and offers free services to those entitled to social security benefits. For persons requiring hospital

services, a regional hospital is located in the nearby community of San Ramón, 8 km north of Palmares.

#### METHODS

The study was conducted during February through April, 1979, and included a census for characterization and collection of anthropometric data of the entire aged population. Because of time and staff limitations, a random sample was selected for clinical studies, and a further subsample for dietary surveys.

##### *Aged Population*

The names and addresses of all persons 65 years or older were obtained from the records of the Central Health Center, and a census was made to identify their age, civil status, and socioeconomic situation. Of the 243 elderly persons living in Palmares, 28 lived in the home for the aged and were not included in the study because they represented a select, institutionalized group. Many suffered mental disabilities which would greatly restrict data collection; furthermore, the majority were non-ambulatory, which would preclude an appropriate anthropometric evaluation. Of the 215 aged subjects living in the community, 201 participated in the initial census interview; informed consent was freely given by all participants. Of the 14 persons unable to participate, six (30%) were consistently absent from the house because of working or social obligations, five (2.5%) were in the hospital, and three (1.5%) were out of town. The census interviews took place in the home of the subject, and one or more of the family members were often present. The *cedula*, an obligatory identification card issued by the Government, was used to verify information obtained in the interview. All information was recorded on pre-coded data sheets.

The age distribution, marital status, and educational background as well as occupation, employment, and pension status for males and females in the population, are detailed in Table 1. Seventy-seven per cent of the elderly lived with family members, 15% lived with spouse only, and 8% lived alone. All but two of the houses surveyed had running water and electricity, and 76% of the population lived in houses with flush toilets, 23% with latrines, and 1% with no facilities.

TABLE 1  
 CHARACTERIZATION OF THE AGED POPULATION  
 IN PALMARES, COSTA RICA, 1979

Subjects	Male Number (O/o)	Female Number (O/o)	Total Number (O/o)
<i>Total</i>	92(46)	109(54)	201(100)
<i>Age (years):</i>			
65-69	33(36)	52(47)	85(43)
70-74	23(25)	25(23)	47(23)
75-79	12(13)	15(14)	28(14)
80-84	16(17)	16(15)	32(16)
85-89	7 (8)	0 (0)	7 (3)
≥ 90	1 (1)	1 (1)	2 (1)
<i>Marital status:</i>			
Married	60(65)	39(36)	99(49)
Single	11(12)	17(16)	28(14)
Widowed	20(22)	50(46)	70(35)
Separated	1 (1)	3 (2)	4 (2)
<i>Education:</i>			
0-4 years	58(63)	66(61)	124(62)
5-6 years	26(28)	36(32)	62(31)
≥ 7 years	7 (8)	5 (5)	12 (6)
Unknown	1 (1)	2 (2)	3 (1)
<i>Occupation:</i>			
Agriculture	59(64)	2 (2)	61(30)
Homemaker	0 (0)	95(86)	95(47)
Skilled craft	15(16)	0 (0)	15 (8)
Municipal	4 (5)	0 (0)	4 (2)
Business	3 (3)	3 (3)	6 (3)
Teacher	1 (1)	5 (5)	6 (3)
Other	10(11)	4 (4)	14 (7)
<i>Employment:</i>			
None	61(66)	108(99)	169(84)
Full time	8 (9)	0 (0)	8 (4)
Part time	23(25)	1 (1)	24(12)
<i>Pension:</i>			
None	43(47)	89(81)	132(66)
Government	17(19)	7 (7)	24(12)
Family allowances	29(31)	12(11)	41(20)
Other	2 (2)	0 (0)	2 (1)
Unknown	1 (1)	1 (1)	2 (1)

### *Anthropometric Measurements*

Height and weight measurements were obtained at the time of the census by a trained technician according to standard INISA procedure. Duplicate measurements were taken, and the mean value recorded to the nearest millimeter. Subjects fully clothed except for shoes were weighed using a calibrated, 125 kg limit, 1 kg division *Detecto* scale. Clothing, in general, was light due to the tropical climate. Duplicate weighings were made, and the mean value was recorded to the nearest 1 kg. The percentage of desired weight for height (DWH) was calculated by dividing the actual weight by the ideal weight for a medium body frame (3).

### *Dietary*

One half of the group that participated in the clinical studies was randomly selected for dietary evaluation consisting of two 24-hour recall surveys and an appraisal of food habits and preparation methods. Surveys were carried out in the home of the subject by three skilled interviewers supervised by a nutritionist from INISA. Household measuring devices were used to estimate quantities, and a family member or cook often aided in supplying recipes and portion estimates. The general dietary survey was performed following the first 24-hour recall survey and included questions concerning frequency of intake and manner of preparation of common foods.

Energy, protein, calcium, iron, and retinol values were calculated using food composition tables adopted for Central American countries (4, 5). The per cent adequacy of energy, protein, and other nutrients was calculated using mean values in reference to FAO/WHO recommendations (6, 7).

### *Clinical Studies*

For participation in the clinical studies, a random sample was drawn representing 20% of the population interviewed. Physical examinations specifically designed to detect clinical signs of nutritional problems were done by a local physician of the staff of the Central Health Center. Evaluation included goiter, marasmus, edema, conjunctivitis, Bitot's spots, xerophthalmia, keratomalacia, cataracts, visual acuity, swollen or bleeding gums, angular stomatitis, glossitis, skin abnormalities, hepatomegaly, splenomegaly, bony

deformations, respiratory distress, and neurological disturbances. Vital signs were taken on all patients.

## RESULTS

### *Anthropometric*

Heights and weights were obtained from 191 of the 201 subjects interviewed (five persons were uncooperative, three were in wheelchairs, and two were bedridden). The values for per cent of desired weight for height (DWH) are presented in Table 2.

Of the total population, 72% fell in the normal (80-119% DWH) range, 10% were underweight, and 18% were overweight. A difference existed between the distribution in the categories for men and women (Chi Square  $P < 0.025$ ); these results are also given in Table 2. Defining obesity as over 119% DWH, 11% of the males were obese while 24% of the females were obese.

TABLE 2  
ANTHROPOMETRIC MEASUREMENTS OF 191 ELDERLY PERSONS,  
PALMARES, COSTA RICA, 1979

Subjects	Per cent of desired weight for height (DWH)					
	≤ 69	70-79	80-119	120-139	140-159	≥ 160
<i>Male (years)</i>						
65-69	0*	3	28	3	0	0
70-79	0	5	31	5	0	0
≥ 80	0	1	12	2	1	0
Total males	0	9	71	10	1	0
<i>Female (years)</i>						
65-69	2*	0	29	12	3	2
70-79	3	3	27	5	0	1
≥ 80	1	2	9	1	0	0
Total females	6	5	65	18	3	3

\* Figures are persons in various DWH categories.

Weights of 60% of the females in contrast to 10% of the males were greater than 140% DWH. While almost an equal percentage of men and women were under 80% DWH, 60% of the women were less than 70 DWH while no men fell into this category.

### *Dietary*

The mean daily intakes of protein, energy, and nutrients compared to WHO recommendations, are presented in Table 3. Using a two-tailed Wilcoxon rank sign test, there was no evidence at the 0.05 level for a difference in intakes for the two days.

In this subsample, all subjects met 4/5th's of the WHO protein requirements while only 35% met 4/5th's of the energy requirements. Four-fifths of calcium and iron requirements were met by 85% and 80% of the subjects, respectively, while 4/5th's of vitamin A (retinol equivalents) were met by none.

Dietary surveys revealed that the elderly live on simple prepared diets with a repetitive meal schedule, comprised of few processed foods. Breakfast was consumed by all of the subjects and usually consisted of a white bread with butter or cheese and coffee. Lunch was the main meal of the day, and frequently it included an egg or meat and a vegetable soup. Twenty per cent of the persons reported eating meat at least five days per week, while 35% consumed eggs daily. With few exceptions, rice, beans, tortillas, and milk were included in the main meal. Seventy-five per cent of the subjects drank milk on a daily basis. Salad, fresh fruit, or fried plantains were also included in many lunches. Dinner consisted of the same foods as lunch, but in reduced portions.

### *Clinical Studies*

Physical examinations were conducted and blood tests done on 38 patients. Two of the 40 subjects were unwilling to participate for reasons not elicitable; both were alert and ambulatory with no gross physical or nutritional disabilities. The physician found no subjects with protein-calorie malnutrition. Positive findings in the clinical exams included goiter (two cases), cataracts (four), angular stomatitis (nine), papillary atrophy of the tongue (five), glossitis (one), and bilateral edema of lower extremities (five).

Blood levels of serum cholesterol, serum albumin, hemoglobin, and hematocrit are presented in Table 4. The sample size

TABLE 3  
ESTIMATED MEAN ( $\pm$  SD) DAILY INTAKES AND PER CENT ADEQUACY OF PROTEIN,  
ENERGY, AND NUTRIENTS, 20 ELDERLY, PALMARES, COSTA RICA, 1979

Subjects	Energy, kcal	Protein, g	Calcium, mg	Iron, mg	Vitamin A, retinol equivalents, $\mu$ g
<i>Male (n = 7)</i>					
Range	706 - 1526	19.7 - 68.4	284 - 1412	6.4 - 14.7	56 - 506
Daily mean intake	1235 $\pm$ 324	45.3 $\pm$ 14.7	824 $\pm$ 424	10.2 $\pm$ 3.6	240 $\pm$ 143
Standard	33.2*	0.57**	450	9	750
<i>Female (n = 13)</i>					
Range	780 - 1364	23.9 - 67.0	112 - 1608	5.3 - 16.4	36 - 398
Daily mean intake	1060 $\pm$ 190	44.6 $\pm$ 12.5	719 $\pm$ 347	10.9 $\pm$ 3.4	190 $\pm$ 93
Standard	29.1*	0.52**	450	9	750
<i>Total (n = 20)</i>					
Per cent meeting 4/5 WHO recommendation	35	100	85	80	0

\* Standard is expressed in kcal/kg body weight. This value was reduced by 10% for those persons over 70 years of age.

\*\* Standard is expressed in g/kg body weight.



TABLE 4

MEAN ( $\pm$  SD) LEVELS, RANGE, AND PER CENT  
OF ABNORMAL VALUES IN BLOOD LEVELS,  
38 ELDERLY IN PALMARES, COSTA RICA,  
1979

	Cholesterol, mg/100ml	Serum albumin, g/100ml	Hemoglobin, g/100ml	Hematocrit, %
<i>Males</i>				
Mean	263 $\pm$ 80	3.6 $\pm$ 0.6	14.9 $\pm$ 1.0	43 $\pm$ 3
Number of subjects	18	18	16	16
Range	141 - 444	2.4 - 4.3	12.7 - 16.3	37 - 46
Standard	140 - 290	3.6**	13**	39**
Per cent with abnormal values	28	44	6	6
<i>Females</i>				
Number of subjects	20	20	20	20
Range	151 - 421	2.4 - 4.7	12.2 - 15.7	34 - 45
Mean	275 $\pm$ 71	3.6 $\pm$ 0.6	13.9 $\pm$ 1.0	41 $\pm$ 3
Standard	140 - 290*	3.6**	12**	36**
Per cent with abnormal values	50	45	0	5
<i>Total</i>				
Per cent with abnormal values	39	45	3	5

\* Range of acceptable normal values.

\*\* Lowest acceptable value.

precluded a meaningful Chi square evaluation of variables such as age and sex. High cholesterol values were obtained in 28% of the males and 50% of the females. The mean cholesterol values for underweight, normal, and obese persons were in mg/100 ml, 250, 271, and 300, respectively. Serum albumin values were low in 45% of the subjects, with no difference between percentages for

males and females. Low hemoglobin and hematocrit values were found in only 3% and 5% of the subjects, respectively.

#### DISCUSSION

This study focused on a small group of elderly persons living in Palmares, Costa Rica, typical agricultural community with good health care facilities. As the findings revealed, the majority of the elderly enjoy adequate living conditions, and 77% live within a family setting. The family environment is beneficial by providing psychosocial support, participation in family meals, and security and social interaction which prevent feelings of loneliness and uselessness. Periodic home visits by community nurses further detect and care for health and nutritional problems of the elderly living in isolation.

The condition of being overweight was present in the aged, more frequently in women than in men. This trend probably results from several factors. One may be that elderly women who had a more active occupation in the past no longer have a physically demanding routine and remain sedentary in the house. In contrast, some of the men remained engaged in physical labor well into their seventies, and apparently obtain more walking exercise than the women in maintaining social interactions with other men in the community. Although results were not significant at the level of 0.05, the percentages of overweight persons diminished with age. An increase in tooth decay and periodontal disease, digestive problems, and hospitalization probably contributes to this trend. Kohrs *et al.* (11) and McGandy (12) reported decreased calorie intakes in the late age. On the other hand, it has been suggested that overweight persons tend to die at an earlier age.

Physical examinations suggested that protein-calorie malnutrition is not a problem in this population; however, there is evidence of vitamin or mineral deficiencies, understandable in aged people, even in different societies. Goiter was present in three patients, and this was undoubtedly developed before iodine was included in the salt. The presence of papillary atrophy and glossitis as well as several cases of angular stomatitis suggests a possible riboflavin or nicotinic acid deficiency. It is difficult to discern the significance of edema of lower extremities in relation to nutritional deficiencies due to the extensive differential of this condition.

It is also difficult to determine the nutritional significance

and/or contribution to the rather high number of subjects with low serum albumin values (45<sup>o</sup>/o). Low values would be expected in protein malnutrition; nevertheless, this condition of low values has multiple etiologies. Abnormal cholesterol values were also found: 28<sup>o</sup>/o of the males and 50<sup>o</sup>/o of the women presented high values. These are purely descriptive because of the small sample size and yet, they are noteworthy in view of the increasing importance of cardiovascular diseases in Costa Rica. The contribution of the large amounts of fats used in the preparation of the traditional diet to these elevated levels also warrants consideration. Contrary to results of surveys done on elderly people in the United States (13, 14), low hemoglobin values did not appear to be a problem, with only one person having a low value.

That calorie intakes were found to be low relative to WHO standards is not surprising. In dietary surveys in elderly people in the United States, energy consumption was inadequate in almost all studies (15). The fact could be accounted for by a methodology which has been found to underestimate energy values (16) as well as by current overestimation of energy requirements for the aged. Studies in Costa Rica suggest that the WHO dietary requirements may be artificially elevated as much as 20<sup>o</sup>/o, particularly for children (17).

The elderly have maintained a steady diet over the years, not incorporating processed or convenience foods. The simple, repetitive diet contributed the minimum protein requirements in the form of egg, meat, and milk products, while the relatively high consumption of milk and cheese helped fill the calcium requirement. In several studies of the aged in the United States, calcium intake was found to be inadequate (18-20). While the iron requirement was met by 80<sup>o</sup>/o of the subjects, vitamin A intake was consistently low. In a national survey undertaken in Costa Rica in 1966 (21), vitamin A values were also reported as being low, but a recent survey showed a virtual absence of vitamin A deficiency.

The present results suggest that the elderly population of Palmares is not suffering from overt nutritional deficiencies. This observation is relevant as there is scarce or no information on community studies of the nutritional status of the elderly in Latin America. Seventy-two per cent of the population had an adequate weight for height, and 18<sup>o</sup>/o had excess weight. Mean daily values of protein, calcium, and iron met the WHO requirements; only 10<sup>o</sup>/o of elders were underweight, more prominent in women. However, edema or protein-calorie malnutrition was not found in

anyone upon physical examination. The family structure, good health, care facilities, a balanced diet, and an environment relatively free of infections, seemed to be three important factors influencing the health of the elderly. Possible nutritionally related problems of this population brought forth by this study include the incidence of obesity especially in women, high cholesterol levels, low serum albumin levels and low vitamin A, riboflavin, and nicotinic acid intake. These and other nutritional problems deserve attention in the future, as many Latin American countries are in frank transition in lifestyles and quality of life.

#### RESUMEN

##### EL ESTADO NUTRICIONAL DE LAS PERSONAS DE EDAD AVANZADA EN PALMARES, COSTA RICA

Se evaluó el estado nutricional de las personas de edad avanzada de una pequeña comunidad costarricense, valiéndose de mediciones antropométricas, hallazgos clínicos, y encuestas dietéticas. Según revelaron los resultados, el 18% de dichas personas tenían sobrepeso, condición que se observó con mayor frecuencia en las mujeres que en los hombres ( $P < 0.025$ ). En una muestra de sujetos seleccionada al azar, los valores séricos de albúmina fueron bajos en un 45%, los de colesterol, altos en un 39%, y los de hemoglobina, bajos en un 3%. Los sujetos consumían una dieta sencilla, repetitiva, que incluía pocos productos procesados y que satisfacía el 80% de los requerimientos establecidos por la Organización Mundial de la Salud (OMS) para proteína, calcio y hierro, aunque aparentemente, los valores para calorías y vitamina A eran bajos. La ausencia de problemas nutricionales graves entre las personas de edad avanzada de Palmares se atribuyó a la estructura familiar, buena higiene y protección contra las enfermedades infecciosas debilitantes, servicios de salud en la comunidad efectivos, y dietas simples y balanceadas.

#### ACKNOWLEDGEMENTS

Special thanks are given to Virginia Vásquez and the staff of INISA and the Central Health Center, as well as to the elderly of Palmares who willingly participated in the study.

## BIBLIOGRAPHY

1. **Health Conditions in the Americas 1973-1976.** Washington, D.C., Pan American Health Organization, 1978, p. 241. (Scientific Publication No. 364).
2. Mata, L. J. & E. Mohs. As seen from national levels: developing world. In: **Progress in Human Nutrition.** Vol. 2. S. Margen and R. A. Ogar (Eds.). Westport, Conn., Ari Pub. Co., 1978, p. 254-264.
3. Keyes, A. Normal nutrition. In: **Modern Nutrition in Health and Disease.** Chapter 1. Wohl and R. S. Goodhart (Eds.). Philadelphia, Lea and Febirger, 1960.
4. Flores, M. M., T. Menchú & M. Y. Lara. **Valor Nutritivo de los Alimentos para Centro América y Panamá.** Guatemala, Instituto de Nutrición de Centro América y Panamá (INCAP), mayo de 1971.
5. Wu-Leung, Woot-Tsuen, con la colaboración de Marina Flores. **Tabla de Composición de Alimentos para Uso en América Latina.** Preparada bajo los auspicios del Comité Interdepartamental de Nutrición para la Defensa Nacional, Instituto Nacional para Artritis y Enfermedades Metabólicas, Institutos Nacionales de la Salud, Bethesda, Maryland, EE.UU., y del Instituto de Nutrición de Centro América y Panamá (INCAP), ciudad de Guatemala, C. A. Washington, D. C., U.S. Government Printing Office, junio, 1961, 132 p.
6. **Energy and Protein Requirements.** Report of a Joint FAO/WHO ad hoc Expert Committee, Rome, 22 March-2 April, 1971. Rome, Food and Agriculture Organization of the United Nations, 1973, 20 p. (FAO Nutrition Meetings Report Series No. 52; WHO Technical Report Series No. 522).
7. Passmore, R., M. Narayana Rao, B. M. Nical, G. H. Beaton & E. M. DeMaeyer. **Handbook of Nutritional Requirements.** Geneva, World Health Organization, 1974 (WHO Monograph Series No. 61).
8. **Manual de Técnicas de Laboratorio Químico Clínico.** San José, Costa Rica, Universidad de Costa Rica, 1978.
9. **Hematología Técnico-Práctica.** Vol. 1. **Morfología Hematológica.** San José, Costa Rica, Universidad de Costa Rica, 1977.
10. **Nutritional Anaemias.** Report of a WHO Scientific Group. Geneva, World Health Organization, 1968, 39 p. (WHO Technical Report Series No. 405).
11. Kohrs, M. B., P. O'Hanlon & D. Eklund. Title VII. Nutrition program for the elderly. *J. Am. Dietet. Assoc.*, **72**: 487, 1978.
12. McGandy, R. B., C. H. Barrows, A. Spanias, A. Meredith, J. L. Stone & A. H. Norris. Nutrient intakes and energy expenditures in men of different ages. *J. Gerontol.*, **21**: 581, 1966.

13. Jansen, C. & I. Harril. Intakes and serum levels of protein and iron for 70 elderly women. *Am. J. Clin. Nutr.*, **30**: 1414, 1977.
14. U. S. Department of Health, Education and Welfare. **Ten State Nutrition Survey 1968-1970. IV. Biochemical.** Atlanta, Georgia, Center for Disease Control, 1972 (HEW Publication No. (HSM) 72-8132).
15. O'Hanlon, P. & M. B. Kohrs. Dietary surveys of older Americans. *Am. J. Clin. Nutr.*, **31**: 1257, 1978.
16. Madden, J. P., S. J. Goodman & H. Guthrie. Validity of the 24 hour recall. *J. Am. Dietet. Assoc.*, **59**: 129, 1971.
17. Novotny, R., L. Mata & H. Brenes. Consumo de leche por lactantes del área rural de Puriscal, Costa Rica, 1978. *Rev. Méd. Hosp. Nal. Niños*, **15**(1): 45-58, 1980.
18. Joering, E. Nutrient contribution of a meals program for senior citizens. *J. Am. Dietet. Assoc.*, **59**: 129, 1971.
19. Clarke, M. & L. Wakefield. Food choices of institutionalized vs. independent living elderly persons. *J. Am. Dietet. Assoc.*, **66**: 600, 1975.
20. Duthrie, H. A., K. Black & J. P. Madden. Nutritional practices of elderly citizens in rural Pennsylvania. *Gerontol.*, **12**: 330, 1972.
21. **Evaluación Nutricional de la Población de Centro América y Panamá. Costa Rica.** Instituto de Nutrición de Centro América y Panamá (INCAP); Oficina de Investigaciones Internacionales de los Institutos Nacionales de Salud (EE.UU.); Ministerio de Salubridad Pública de Costa Rica. Guatemala, Instituto de Nutrición de Centro América y Panamá. 1969, 113 p. más Apéndices A-E.