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Nutritional status of institutionalised elderly in Ecuador

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SUMMARY. The nutritional status of 111 elderly men and women aged 60 to 99 years in two institutions in the Ecuadorian Andes was evaluated using dietary, anthropometric and biochemical measurements. Mean daily energy intakes of men and women were 1720 and 1650 kcal, respectively (7.2 and 6.9 MJ), corresponding to 1.5 times the calculated basal metabolic rate (BMR). 6 % of subjects had intakes less than 1.2xBMR and 40 % less than 1.5xBMR. Body mass index (BMI) was below 20 kg/m2 in 21 % of subjects; 45 % were between 20 and 24. Only one subject had a BMI over 29. Intakes of protein, calcium, iron, riboflavin and vitamin C were satisfactory, in contrast to those of zinc, vitamin A, niacin and thiamin. Using sex- and altitude-specific cut-offs for hemoglobin, anemia was observed in 11 % of subjects. Nutritional status, evaluated using biochemical indicators, was satisfactory with respect to riboflavin, vitamin A, vitamin E and copper. 14 % of subjects had low serum zinc levels and 17 % had serum albumin values below 35 g/L. Low physical activity was associated with low energy intake and low serum albumin levels.

RESUMEN. Estado nutricional de ancianos institucionalizados en el Ecuador: Se evaluó el estado nutricional de 111 ancianos de ambos sexos, entre 60 y 99 años, en dos instituciones de la Sierra de Ecuador, mediante medidas antropométricas, bioquímicas y de consumo alimentario. Los promedios de los aportes energéticos fueron 1720 y 1650 kcal para hombres y mujeres respectivamente (7.2 y 6.9 MJ), que corresponden a 1.5 veces el metabolismo basal calculado (MB); estas medidas son comparables a los requerimientos para ancianos sedentarios. El 6 % tuvieron aportes inferiores a 1.2 x MB y el 40 % menores a 1.5 x MB. El Indice de masa corporal (IMC) fue inferior a 20 kg/m2 en el 20% y de 20 a 24 kg/m2 en el 45 %. Los aportes de proteinas, calcio, hierro, riboflavina y vitamina C fueron satisfactorios, en contraste con los de zinc, tiamina, niacina y vitamina A. Los valores de hemoglobina fueron en un 11 % menores al punto de corte para anemia por sexo y altura. El estado nutricional, con respecto a los indicadores bioquìmicos para riboflavina, vitamina A, vitamina E y cobre, fue satisfactorio. El 14 % de los ancianos tuvieron valores bajos para zinc sérico y 17 % tuvieron niveles séricos de albúmina < 35 g/L. Se observó la asociación de la escasa actividad física con los aportes bajos en energía y los valores asimismo bajos en albúmina sérica.

INTRODUCTION

The number of persons aged 60 years or more living in Latin América and the Caribbean in 1980 was 23 million, representing 6.5 % of the total population; their numbers are predicted to increase to 42 million by the year 2000 and to 97 million by 2025 (1). It is generally recognised that adequate nutrition, physical and social activity are essential for optimal health and well-being of the elderly, and the health and nutritional status of the elderly in Europe, North America and Asia have received increasing attention during the last two decades. It has been shown that the decline in tissue function and in food intake and the increase in the frequency of chronic diseases with increasing age can have a negative impact on the nutritional status of the elderly (2).

The institutionalised elderly are more likely than their free-living counterparts to suffer from nutritional deficiencies, often related to chronic diseases; despite the provision of nutritionally adequate diets, intakes of energy and other nutrients are often lower and nutritional status poorer in the former (3-8). Very little information exists concerning the nutritional status of Latin American elderly, either living at home or in institutions. The present study was thus undertaken to evaluate the nutritional status of elderly persons living in two institutions in provincial capitals of the Ecuadorian Andes using dietary, anthropometric and biochemical surveys.

METHODS

Institutions: The study was carried out in 1992 at the Instituto Estupiñan, a public institution in Latacunga (alt. 2770m), Cotopaxi Province and at the Hogar Sagrado Corazón de Jesús, a private institution in Ambato (2575m), Tungurahua Province. These two provincial capitals are located some 90 and 120 km, respectively, south of Quito, Ecuador. At the beginning of the study, there were 56 and 120 elderly persons, respectively, residing at the two institutions in Latacunga and Ambato. In Latacunga, medical attention was available as required from local health services. In Ambato, there was a permanent medical service.

Subjects: All persons aged 60 years or more, living in either institution, characterised by the absence of severe physical or mental handicaps likely to impede adequate data collection and giving informed consent were eligible to participate in the study. A total of 111 elderly persons aged 60 to 99 years were included, 42 in Latacunga (20 men, 22 women) and 69 in Ambato (9 men, 60 women). The participation rates were thus 75 % at Latacunga and 58 % in Ambato.

Anthropometry: Anthropometric measurements were performed by the same person (LH) on 82 subjects using standard techniques (9). Briefly, weight (WT) measurements were made in the morning

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after breakfast with subjects in light clothing using a mechanical balance accurate to 250 g (Detecto Scales Inc., New York). The balance was calibrated daily using a known weight. Standing height (HT) was measured without shoes to the nearest 0.5cm using a vertical rule. Reclining knee height was measured to the nearest 0.5cm with a broad-blade calliper specially made by the Nestlé R&D Center, Quito. Mid-upper arm (MAC), waist (WC) and hip circumferences (HC) were measured to the nearest 0.5cm using a fibre glass tape. Body mass index (BMI, kg/m2) and waist/hip ratio were calculated. 29 subjects were unable (bedridden) or unwilling to undergo anthropometry.

Dietary intake: Food intakes were measured for 93 subjects at breakfast, midday and evening meals and at snacks on 3 separate days at least one week apart. 18 subjects were unable (illness) or unwilling to undergo dietary assessment. All foods were weighed during meal preparation in the institutions' kitchens and standard meal portions were characterised. An electronic scale (Fortec CR-105, Hong Kong) accurate to 1g was used. Specially trained observers estimated the number and/or the fraction of portions consumed per person. Nutrient intakes were calculated using the food composition tables of Ecuadòr (10) and INCAP (11) with additional analytical data from The Nestlé R&D Center, Quito, on common local foods. Energy intakes were also expressed as multiples of basal metabolic rate (BMR) calculated from body weight using sex-specific equations for persons over 60 years (12). The adequacy of energy and nutrient intakes was evaluated by comparison with recommended levels (12, 13).

Health status, hematology and biochemistry: A clinical history including information on chronic pathologies, current acute illnesses and medical treatment was established for 94 subjects, and fasting morning blood samples by venipuncture from 81 subjects. Blood samples were transported in a portable refrigerator to the Nestlé R&D Center, Quito where hematological measurements were carried out on the same day. Serum was separated by centrifugation, immediately frozen at -70 °C and transported on dry ice to the Nestlé Research Center, Switzerland for analysis within 6 months. All samples were protected from light at all times. Hemoglobin was measured by the cyanmethemoglobin method using a portable battery-operated COMPUR M 1100 D2 photometer. Hematocrit was determined using a battery-operated COMPUR M 1100 microcentrifuge (Compur-Electronic GmbH, Munich, Germany). Serum ferritin was measured by immunoradiometry with a Clinical Assays kit (Incstar Corporation, Stillwater, MN 55082, USA). The serum proteins albumin, C-reactive protein (CRP) and alpha-1 acid glycoprotein (AGP) were determined by immunonephelometry using Behring equipment and reagents (Behringwerke AG, Marburg, Germany). Serum levels of retinol, ∝ and ß carotene, ∝ and γ-tocopherol were measured by reversed-phase HPLC (14) with Merck-Hitachi equipment (Merck, Darmstadt, Germany). Serum total cholesterol and whole-blood glutathione reductase activation coefficient (WBGRAC) were determined colorimetrically using a Cobas-FARA centrifugal analyser (Roche Diagnostica, Basel, Switzerland). Serum zinc and copper were measured by atomic absorption spectroscopy (Varian SpectraAA 20, Varian Techtron, Mulgrave, Australia). Data for 11 of the 81 subjects (3 men, 8 women) with high AGP (>1.4 g/L) and/or CRP (>12 mg/L) values were eliminated from the analysis since states of infection and inflammation cause changes in levels of some hematological and biochemical indicators of nutritional status.

Data analysis: Descriptive statistics comprise mean ± SD values and percentages of subjects with values outside commonly accepted normal ranges. Sex- and altitude-specific cut-offs for hemoglobin values (15, 16) were used for the determination of the prevalence of anemia; Ambato (altitude 2575 m); men: 145 g/L; women: 135 g/L; Latacunga (altitude 2770 m); men: 147 g/L; women: 137 g/L. The probability of association between independent variables and nutritional status indicators was evaluated using the two-sided Fisher exact test; p values < 0.05 were considered to be statistically significant. Data analysis was performed using the BMDP statistical package (BMDP Statistical Software, 1990, UCLA Press, Los Angeles).

RESULTS

Subject description and anthropometry: The mean ages of the subjects were 79y for men and 82y for women, and the mean duration of institutionalisation was 5 years for both sexes (Table 1). Nearly 80 % of subjects had one or more chronic diseases; they included hypertension, diabetes, rheumatism and cardiovascular diseases. 36 % of men and 56 % of women were receiving medical treatment for sight, hearing, dental, spinal and neurological pathologies. 20 % of men and 22 % of women had a BMI less than 20 kg/m2, 65 % and 38 %, respectively, were between 20 and 24 kg/m2, 15 % and 38 % were between 24 and 29 kg/m2, and one woman only had a BMI over 29 kg/m2 (Table 2).

TABLE 1
Subject description and anthropometric measurements (mean ± SD)

		Men (n=29)	Women (n=82)
Age	Years	79±10	82±8
	range	(60-96)	(62-99)
Duration of institutionalisation	years	5±6	5±6
	range	(0-22)	(0-35)
Health status		n=24	n=70
Chronic pathology	%	79	76
Current acute illnes	%	46	20
Current medical treatment	%	36	56
Anthropometry	n=22	n=60	
Height*	cm	151±7	141±7
Weight	kg	49.6±6.4	45.0±9.7
Body mass index (BMI)*	kg/m2	21.7±2.5	22.9±3.4
Midarm circumference	cm	23.6±1.9	24.2±3.3
Waist circumference	cm	81±5	77±9
Hip circumference	cm	86±4	90±9
Waist/Hip ratio	cm/cm	0.94±0.005	0.85±0.06
Knee height	cm	47±3	44±3

* 75 subjects (20 men, 55 women)

TABLE 2
Body mass index (BMI) distribution

Range		Men(n=20)	Women (n=55)
<20.0	kg/m^2	20 %	22 %
20.0 - 23.9	kg/m^2	65%	65%
24.0 - 29,0	kg/m^2	15%	38%
>29.0	kg/m^2	-	2%

Hematology and biochemistry: Mean (+ SD) values and the proportions of abnormal values of hematological and biochemical indices are given in Tables 3 and 4 for subjects with normal levels of AGP and CRP. 15 % of men and 10 % of women had low hemoglobin compared to the sex-specific altitude-corrected cut-offs, but only one subject had a low serum ferritin. 10 % of men and 19 % of women had serum albumin levels below 35 g/L. Serum total cholesterol levels were higher for women than for men and were above 6.2 mmol/l for 15 % of men and 42 % of women. Only one subject had a high glutathione reductase activation coefficient (WBGRAC>1.4). None had serum retinol levels less than 0.70 µmol/L; 6 % of women had values less than 1.05 µmol/L; 15% of men and 14 % of women had values below 1.40µ mol/L. No low ∝-tocopherol values or ∝-tocopherol/cholesterol ratios were observed. 15% of men and 14 % of women had serum zinc levels less than 10.7 µmol/L; all serum copper values were in the normal range.

TABLE 3
Hematology and biochemistry: mean±SD values

		Men (n=20)	Women (n=52)
Hemoglobin	g/L	158±15	148±11
Hematocrit	%	47±5	44±4
Albumin	g/L	39±3	38±4
Cholesterol	mmol/L	5.5±1.1	6.0±1.4
WBGRAC		1.20±0.07	1.20±0.09
Retinol	µmol/L	2.06±0.50	1.99±0.44
ß-carotene	µmol/L	0.28±0.16	0.38±0.22
∝-tocopherol	µmol/L	26±9	26±9
∝-tocopherol/cholesterol	µmol/mmol	4.9±0.8	4.4±1.0
Zinc	µmol/L	12.4±1.5	12.1±1.4
Zinc/Albumin	µmol/L	0.32±0.05	0.32±0.03
Copper	µmol/L	17.3±2.4	19.9±2.8

Subjects with normal AGP (≤ 1.4 g/L) and CRP (≤ 12mg/L) only.
WBGRAC= Whole-blood glutahione reductase activation coefficient (riboflavin status).

TABLE 4
Hematology and biochemistry: percentage of abnormal values

	Cutoff	Men (n=20)	Women (n=52)
Hemoglobin	<145/147 g/L*	15%	
	<135/137 g/L*		10%
Ferritin	<12 µgl/L	-	2%
Albumin	<35 g/L	10%	19%
Cholesterol	>6.2 mmol/L	15%	42%
WBGRAC	>1.4	-	2%
Retinol	<0.70 µmol/L	-	-
	<1.05 µmol/L	-	6%
	<1.40 µmol/L	15%	14%
∝-tocopherol	<11,6 µmol/L	-	-
∝-tocopherol/cholesterol	<2.5 µmol/mmol	-	-
Zinc	<10.7 µmol/L	15%	14%
Copper	<12.6 µmol/L	-	-

Subjects with normal AGP (≤ 1.4 g/L) and CRP (≤ 12mg/L) only.
* Hemoglobin cut-offs for Ambato/Latacunga.
WBGRAC= Whole-blood glutahione reductase activation coefficient (riboflavin status).

Dietary intake: Dietary intake data are given in Tables 5 and 6. Mean energy intakes were 1720 and 1650 kcal/day respectively for men and women (7.2 and 6.9 MJ/day), corresponding to 1.5 and 1.6xBMR respectively; 12% were derived from protein, 20% from fat and 68% from carbohydrate. Energy intakes less than 1.2xBMR were observed in 9% of men and 5% of women; 50% and 35%, respectively, had intakes less than 1.5xBMR. Compared to recommended levels, the nutrients with the lowest mean intakes, and with the highest proportions of subjects with low intakes, were zinc, vitamin A, niacin and thiamin. The intakes of protein, phosphorus, iron, riboflavin and vitamin C were satisfactory compared to the recommended intakes.

TABLE 5
Daily nutrient intakes: mean ± SD values

		Men (n=26)	Women (n=67)
Energy	kcal	1720±230	1650±190
	kcal/kg*	35±7	38±7
	MJ	7.2±1.0	6.9±0.8
	#BMR*	1.5±0.2	1.6±0.3
	% Protein	12±1	12±1
	% Fat	20±2	2-±2
	% CHO	68±3	68±2
Protein	g	51±8	49±6
	g/kg*	1.0±0.2	1.0±0.3
	%RDA*	136±29	150±30
Fat	g	39±8	37±5
CHO	g	294±38	282±36
Fibre	g	5.8±1.2	5.3±0.9
Calcium	mg	895±230	790±230
	%RDA	112±29	98±28
Phosphorus	mg	1010±180	930±130
	%RDA	126±23	116±17
Iron	mg	13.3±3.7	10.5±2.4
	%RDA	133±3.7	10.5±24
Zinc	mg	7.5±1.5	7.1±0.9
	%RDA	50±10	59±7
Thiamin	mg	0.87±0.20	0.75±0.13
	% RDA	72±17	75±12
Riboflavin	mg	1.37±0.30	1.30±0.25
	% RDA	98±22	108±21
Niacin	mg	9.4±2.5	8.9±1.4
	% RDA	62±16	69±11
Vitamin C	mg	105±25	96±18
	% RDA	175±41	161±30
Vitamin A	µgRE	420±100	600±160
	% RDA	42±10	75±20
ß-Carotene	µg	1290±400	1870±540

* 79 subjects (22 men, 57 women)
RDA= Recommended Dietary Allowances (Ref. 13).

TABLE 6
Daily nutrient intakes: percentages of subjects with low intakes

	Cutoff	Men (n=26)	Women (n=67)
Energy*	<1.2xBMR	9%	5%
	<1.5xBMR	50%	35%
Protein *	0.50 g/kg	-	-
Calcium	533 mg	4%	2%
Phosphorus	533 mg	-	-
Iron	6.7 mg	4%	-
Zinc	10(8) mg	92%	90%
Thiamin	0.8 (0.7) mg	35%	18%
Riboflavin	0.9 (0.8) mg	12%	-
Niacin	10 (9) mg	81%	34%
Vitamin C	40 mg	-	-
Vitamin A	670 (533) µg	100%	28%

79 Subjects (22 men, 57 women)
Cutoffs for nutrient intakes (except energy) correspond to 2/3rds of US RDA (Ref. 13); values in parentheses are for women when different to those for men.

Cereals (rice, wheat, barley, oats, quinoa) and cereal products (bread, pasta) were major sources of most nutrients (Table 7); intakes of maize products were low. Milk products contributed large proportions of calcium, riboflavin, phosphorus and protein. Iron was derived mainly from cereals, with important contributions from sugars (principally panela; raw cane sugar), milk, potatoes, vegetables, fruit and legumes. Cereal and milk products were the principal sources of zinc, and vitamin A was derived almost exclusively from vegetables and milk products.

Factors associated with nutritional status: Low physical activity (Table 8) was significantly associated with low energy intake and with low serum albumin levels. Current medical treatment was also significantly associated with low energy intake. Age, duration of institutionalisation and sex were not significantly associated with energy intake or serum albumin.

TABLE 7
Daily intakes of different food groups and their percentage contributions to nutrient intakes (mean± SDD; sexes combined)

Food groups	grams/day	Energy	Prot	Fat	CHO	Fibre	Ca	P	Fe	Zn	Vit A	B1	B2	Niac	Vit C
Milk products	362±185.1	17.2	33.5	38.2	7.8	0.0	76.8	43.1	10.0	27.0	28.3	19.9	63.9	4.9	3.9
Eggs	4.2±4.5	0.4	1.1	1.3	0.0	0.0	0.3	1.0	0.9	0.8	0.8	0.9	1.5	0.0	0.0
Legumes	23.2±7.9	2.8	6.7	1.2	2.7	17.0	1.8	5.3	7.7	9.7	0.4	9.2	2.6	6.5	0.4
Vegetables	88.4±31.7	1.8	3.7	0.8	2.0	19.7	7.4	4.4	8.7	4.2	60.7	9.5	8.2	7.8	36.7
Fruit	101.8±65.1	6.2	2.1	0.7	9.1	17.9	2.6	3.3	8.3	1.9	4.1	7.7	4.4	6.4	26.5
Potatos	132.7±48.2	6.8	5.2	0.8	9.1	14.4	1.6	5.7	9.3	5.4	0.6	14.8	3.4	25.1	27.3
Cereal products	194.8±35.1	39.5	38.4	10.7	47.6	26.6	7.9	30.3	39.6	36.5	1.0	34.5	12.1	3..9	0.0
Maize products	10.4±9.6	2.3	1.6	0.3	3.0	1.2	0.3	1.9	1.3	3.3	0.0	34..5	12.1	33.9	0.0
Sugars	55.3±13.2	12.7	0.2	0.2	18.5	3.2	0.9	0.6	10.1	1.7	0.0	0.1	0.6	0.4	0.8
Fats and oils	16.5±3.5	8.6	0.0	42.8	0.0	0.0	0.1	0.1	0.0	0.0	4.2	0.0	0.0	0.0	0.0
Other	0.6+1.1	0.2	0.2	0.0	0.3	0.1	0.1	0.4	0.7	0.2	0.0	0.0	0.1	0.0	0.0

TABLE 8
Percentage of subjetcs with low energy intake and low serum albumin in function of physical activity and medical treatment

		Energy intake <1.5 BMR		Serumalbumin* <35 g/L	
Physical activity:	none to light	58%	p=0.265	37%	p=.0039
	moderate to good	31%		6%	
Current medical treatment	yes	55%	p=0.061	22%	p=.1752
	no	24%			

* Subjects with normal AGP (≤ 1.4 g/L) and CRP (≤ 12 mg/L) only.
p values: Two-sided Fisher exact test.

DISCUSSION

The present paper describes the nutritional status of institutionalised elderly persons as evaluated using dietary, anthropometric and hematological/biochemical measurements. To our knowledge, there is no information concerning the nutritional status of the institutionalised elderly in Latin America, and despite the limitations in the representativity of the subjects studied here, these data may point to nutritional problems that may be encountered in such elderly in other Andean regions.

Energy intake: Mean daily energy intakes were comparable to the requirements of sedentary elderly; 6% of subjects however, had intakes less than 1.2 x BMR per day, and 40 % had intakes less than 1.5 x BMR. The energy requirements of the elderly are substantially lower than those of younger adults mainly due to the declines in physical activity and lean body mass with age. The average requirement for elderly people for light physical and social activity is about 1.5 x BMR whilst that of bed-bound elderly is 1.2 x BMR (17), the latter figure sometimes being referred to as the short term survival requirement (12).

Anthropometry: Low energy intake may be compensated by decreased physical activity and body mass; however, the requirements for some micronutrients may no longer be satisfied if the nutrient density of the diet is not optimal, thereby leading to deficiency. Indeed, in this group of elderly, the measured anthropometric and biochemical indices suggested the presence of chronic energy deficiency and the risk of micronutrient deficiencies. The body sizes of the elderly studied here were small compared to European and U.S. elderly. The mean body weights and heights of men and women were respectively 15-20 kg and 15-20 cm lower than for free-living European (18) and U.S. (19) elderly. The mean BMI values of 22 kg/m2 for men and 23 kg/m2 for women were also lower than for

European and U.S. elderly but were similar to those observed in urban Chinese (20) aged 70 years and older (men: 23.2, women: 23.0). 20% of subjects had BMI less than 20 kg/m2; such low values are likely to be associated with low energy and micronutrient intakes and status and with depressed immune response (21). On the other hand, obesity was practically absent in this group of elderly.

Serum albumin: Another indicator of sub-optimal nutritional status was the low serum albumin values; 17% of subjects had serum albumin levels below 35 g/L, after exclusion of subjects with elevated AGP or CRP levels. Mean serum albumin values were lower than those of free-living South African (47 g/L, (ref. 22)), European (41 g/L, (18)), U.S. (41-43 g/L, (23,24)) and Chinese (43 g/L, (25)) elderly, but were similar to those of institutionalised elderly in the U.S. (35-38 g/L, (6,8)) and Australia (34 g/L, (26)). In the Euronut-SENECA multi-centre study (18), only 2 % of both men and women had serum albumin values below 35 g/L, and although not controlled for, this may have been due to states of infection or inflammation which are known to significantly alter the levels of several biochemical indicators of nutritional status including serum albumin. In the present study, those subjects showing biochemical evidence of infection or inflammation, as judged by elevated serum levels of acute phase proteins (AGP > 1.4 g/L or CRP > 12 mg/L), were excluded from data analysis for that very reason. Although serum albumin is neither a specific nor a sensitive indicator of protein status (27), it is considered to be the simplest and best single predictor of mortality (28) and of general health status in the elderly. The low serum albumin levels in the present study were associated with low physical activity (Table 8) and low energy intake (data not shown) and it seems unlikely that they reflect poor protein nutritional status since protein intakes were satisfactory. The low levels observed may have been the result of pathological states leading to low physical activity and to low energy intakes; they are therefore a cause for concern and need to be examined more closely in the future.

Iron: The percentage of anemic subjects (sexes combined: 11 %; men: 15 %, women: 10 %) was higher than those observed in free-living European (men: 5.2 %, women: 5.7 % (18)) and US (men: 4.5 %, women: 3.5 %, (29) elderly. Analysis of the NHANES II hematological data (30) revealed that anemia in infants and young women was predominantly caused by iron deficiency, in contrast to inflammatory disease in the elderly. In the present study, although iron intakes were generally satisfactory, the bioavailability of the dietary iron was probably low since only 3.4 % was derived from meat compared to 40 % from cereals, known to contain inhibitors of iron absorption such as phytic acid. However, since only one low serum ferritin value was recorded, it seems unlikely that the anemia was due to inadequate iron intake.

Zinc: Both the dietary and the biochemical data indicate suboptimal zinc nutrition in these elderly persons, in accordance with the previously demonstrated presence of zinc deficiency in preschool children in the same region (31). Mean zinc intakes were low (6-8 mg/d) and 90 % of subjects had intakes less than two-thirds of the recommended allowances. Furthermore, since most dietary zinc was obtained from plant sources, its bioavailability was probably low due to the presence of phytic acid and other inhibitors of absorption. Mean serum zinc values (men: 12.4 µ women: 12.1 µmol/L) were slightly lower than for the 65-74 year-old North Americans (32) studied in NHANES II (men: 13.1 µmol/L, women: 12.8; 3 % below 10.7 µmol/L for both sexes,). Serum zinc was not correlated with energy or zinc intakes but there was a significant correlation with serum albumin (r=.448; p<.001). Given that 60-70 % of serum zinc is bound to albumin, serum proteins should be taken into account when interpreting serum zinc levels (26,33). Zinc/albumin ratios for subjects with low serum zinc were similar to those with normal levels, and it seems likely that low serum zinc levels were related to poor general health status as well as to inadequate zinc intake.

Vitamin A: Vitamin A was derived mainly from vegetables (60 %) and milk products (28 %). Mean intakes of vitamin A (men: 420 µgRE/day, women 600 µgRE/day) were low and all the men and 28 % of women had vitamin A intakes below two-thirds of the recommended allowances. In spite of the this, no subjects had serum retinol levels below 0.35 µmol/L, nor even below 0.70 µmol/L, indicating the absence of moderate or severe vitamin A deficiency. In comparison, mean intakes in the Euronut-SENECA study (18) ranged from 300 to 1500 µgRE/day, and there too, vitamin A status, as evaluated using serum retinol, was generally satisfactory. The NHANES I survey (34) confirmed the results of other studies in US elderly showing that even though very large proportions of elderly subjects had intakes below two-thirds of RDA, serum retinol levels were normal. This may be due, at least in part, to large hepatic retinol stores and delayed plasma clearance of retinyl esters in the elderly (35).

Other nutrients: The intakes of protein, calcium, phosphorus, riboflavin and vitamin C were satisfactory and reflected the frequent consumption of dairy products, vegetables and fruit; intakes of thiamin and niacin, however, were somewhat low. The absence of biochemical evidence of risk of riboflavin deficiency in the present study is in accordance with the intake data. The major source of riboflavin was milk products, as was the case for Guatemalan elderly (36). This is in contrast with the findings in Ecuadorian preschool children where riboflavin deficiency was highly prevalent and increased with age (15).

Dietary fat provided 20 % of energy intake, appreciably lower than the 25-40 % found in the Euronut-SENECA study (18). Mean total cholesterol levels were in the low range of the values observed in European elderly (men: 5.2-6.6 mmol/L, women: 5.9-7.8); mean values were about 0.5 mmol/L higher in women than in men, in agreement with findings in Europe (18). 15 % of men and 42 % of women had values greater than 6.2 mmol/L.

Overall, these results show that mean energy intakes, expressed in terms of BMR, were comparable to recommended levels for sedentary elderly persons, but that 6 % of subjects had intakes below their minimum calculated requirements and 21 % had a BMI < 20 kg/m2. Dietary intakes of zinc, vitamin A, niacin and thiamin were low compared to recommendations. The biochemical evaluation of nutritional status gave a generally satisfactory picture, with the exception of serum albumin and zinc; vitamin A status was satisfactory despite the apparently low intakes. The presence of anemia in 11 % of these elderly subjects did not appear to be due to inadequate iron intake. Low energy intake was associated with low levels of physical activity and poor general health status as indicated by the low serum albumin levels.

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