SPONTANEOUS GERONTOLOGICAL RESEARCH INITIATIVES IN CENTRAL AMERICA

N Solomons, A Lacle,
M Mazariegos, I Mendoza

Noel W Solomons
Adriana Lacle
Manolo Mazariegos
Ivan Mendoza
Center for Studies of Sensory Impairment, Aging and Metabolism (CESSIAM)
The Research Branch for the National Committee for the Blind and Deaf of Guatemala, Guatemala City, Guatemala
Research Program on Aging Health Research Institute
University of Costa Rica San Jose, Costa Rica

25.1 INTRODUCTION

The study of biologal ageing has rules, caveats and limitations that are not shared in other areas of human biology [1]. Thus, the concept of "spontaneous" gerontological research on a tropical isthmus composed of economically underdeveloped nations or countries in transition is, at first glance, a contradiction in terms. Central America is composed of the five republics: Guatemala, El Salvador, Honduras, Nicaragua, and Costa Rica, which received their independence as a unit on 15 September, 1821. Belize (formerly British Honduras) and Panama (a province of Colombia until separated in 1904) are variously included in Central America, but our present discussion is limited to the five original republics. The aggregate population in this quintet of nations is currently estimated to be 25.5 million. If we accept an average of 5% of the population being 60 years or older [1], Central America would currently have 1,275,000 elderly citizens.

International public health nutrition was probably born in the discovery of Kwashiorkor by Cecily Williams in 1933 [2]. Since that time, the public health nutrition paradigm has been maternal-child health. Scientific interest and resources have pursued the issues of "nutritionally vulnerable" or "at risk" groups which have included infants, toddlers, pre-schoolers, pregnant women and lactating mothers. The elderly have not been a prominent concern in the Third World. Nevertheless, gerontological research has begun to emerge in at least two countries: Guatemala and Costa Rica. This is a recent development, forged in the mid-1980s.

There are various important similarities between the two Republics. Both countries have Spanish as the official language and are largely agrarian in their economy. The majority of the populations of the two nations live on highland plains, and coffee exporting is a major pursuit of both. For the emergence of gerontology in a developing nation, a degree of scientific sophistication is needed. Costa Rica and Guatemala, respectively, have the greatest proportions of PhDs and of research-trained physicians in the region. Moreover, a tradition of human and clinical research was developed in Guatemala by the founding, in 1949 under Nevin Scrimshaw, of the Institute of Nutrition of Central America and Panama (INCAP). In Costa Rica, the Health Research Institute (INISA) at the University of Costa Rica, founded in 1974, and the Institute for Research and Training in Nutrition and Health (INCIENSA), founded in 1978, have attracted and held qualified research talent.

In some other ways, however, these two nations could not be more different and divergent. The racial make-up of Costa Rica is largely uniform, with Spanish-descendants (Latinos) comprising all but a fraction of the population. (A small, bilingual Caribbean black population inhabits the Atlantic coast.) Guatemala, by contrast, has a 65% indigenous population, with 22 Mayan and non-Mayan linguistic groups; the remaining 35% of the population is mostly Latino. Adult literacy (for reading and writing Spanish) in Guatamala is only 42.4%, the second lowest rate in the hemisphere, whereas Costa Ricans are virtually 100% literate. With respect to indices of health statistics, there is also a wide gap between the nations. Guatemala has an infant mortality rate nationwide of 71.4 per 1000; it is highest among the poor and in certain rural areas. The corresponding national figure in Costa Rica is 15 per 1000. Costa Rica, in the 1950s, had the highest birth-rate of any of the Central American nations. Today its natural rate population increase is 2.5%, compared to Guatemala, with a natural increase rate of 3.1%. Guatemala is correctly classified as a less developed country, whereas Costa Rica is a nation in transition to development [3]. With 83% of Guatemalans living below the poverty line, undernutrition would be expected to be a public health concern; alternatively, in Costa Rica, with relative affluence and a more sedentary life-style, problems of nutrient excess would be expected to predominate.

Photo 25.1. Guatemala (1991): elderly woman shopping at the market.

The present analysis is based on the experience of gerontological research in Guatemala and Costa Rica, with emphasis on the contribution by the Center for Studies of Sensory Impairment, Aging, and Metabolism (CESSIAM) and the Institute for Health Research (INISA). The lessons cited include both biological findings from diverse studies and a multitude of disciplines and the organisational aspects of the ageing research endeavour for these developing countries.

25.2 JUSTIFICATION AND ORIGIN OF AGEING RESEARCH

25.2.1 Justifications

The fact that there is a paucity of knowledge, and that there is something important to be learned, is all the intellectual justification that a scholar would need to pursue the investigation of a given phenomenon or hypothesis. The precious nature of financial resources in poor, developing nations, however, is a consideration in spending for biomedical investigation. Within the larger (total) pie of resources, options to undertake health research will be balanced against the immediate and tangible needs of the country, such as health care, education, and infrastructure. Even within any allocation that can be justified for scientific investigation, there are decisions

about the priority allocated to the topics to be examined. Given the long tradition of maternal-child health concerns, and the still expanding population of infants and children in broad-based age-pyramids, most often it is still the problems of the mother, infant and child that get the slices of the Third World research pie.

When it comes to ageing research, an additional consideration is one of talent and capacity in gerontology. Given the caveats in the study of the elderly [1,4], unless the fundamentals of how to avoid pitfalls in design, data collection and interpretation are mastered in the research team, the whole effort could be waisting good money for bad results. Finally, however, when the decision is made to undertake gerontological research in a developing country, it is worth reflecting on two purposes that can be served. The foremost benefit is to describe the health status of the elderly in the population, a profile which is likely to be lacking. A secondary gain, of course, is the development of skills in gerontological research. We would argue that both of these objectives should be achieved before a Third World nation enters into a multi-centre, multi-nation collaborative study such as "Food Habits in Later Life." By somewhat diverse pathways, Costa Rica and Guatemala have achieved enough progress in these goals to be invited to international forums, as is evidenced by our contribution to this volume.

25.2.2 Origins

The development of gerontology in two countries of Central America might perhaps provide illustrative lessons for other areas of Latin America and for the wider developing world. The origins of gerontological research in the respective nations of Central America are, perhaps, instructive lessons in their own right. In Guatemala, with the founding of CESSIAM, we tried consciously to carve out some areas of research that did not conflict with, or overlap with, the traditional interests of our neighbouring research institution, INCAP, so the outcome of the two centres would be complementary rather than redundant. One of the co-founders of CESSIAM (NWS) had spent a five-year term on the Clinical Research Study Section of the National Institute on Aging (NIA) of the National Institute of Health. The purpose of this committee was to review grant submissions for career awards, conferences and Program Project awards in ageing. It was an important school in the nature of ageing research. Each submission was criticised in terms of the classical pitfalls and limitations in interpretation. The NIA was a relatively new institute and it was trying to encourage and induce investigators to enter the field of ageing. It brought forth applicants who, themselves, had not been schooled in the pitfalls.

The affiliation of the newly formed CESSIAM is the research branch for the National Committee for Blind and Deaf of Guatemala (NCBD). Firstly, the President of the NCBD, Dra. Elisa Molina de Stahl, saw the elderly as somewhat analogous to the visually and hearing impaired, insofar as they were disadvantaged and without solid social protection. Secondly, the Committee operated a rehabilitation centre for elderly blind. Information valuable to their care and feeding was at a premium, and CESSIAM was willing, in its earliest days, to turn to the aged blind as the subjects of investigative concern. From these origins, it was a fairly logical step to studies in older,

institutionalised populations and to free-living population in rural and urban settings.

The aged populations that have comprised the major studies in gerontology at CESSIAM in Guatemala have been:

1. various institutions for the care of the aged in Guatemala City (as well as one in the city of Antigua Guatemala) [5];

2. free-living elderly in the rural village of San Pedro Ayampuc, 23 km from the capital city [6]; and

3. free-living elderly in the peri-urban neighbourhood of Guajitos, 8 km south of the National Palace [7-9].

A recent study, in the form of a masters thesis from INCAP [10], looked at several issues of elderly nutrition in the pensioners of the Guatemalan Institute of Social Security (IGGS) population and their spouses (Table 25.1). In each of the CESSIAM related studies, the public health objective of eye care from the NCBD were never distant, as ophthalmological screening campaigns were offered to each of the populations collaborating in the studies. Interestingly, focal community-based prevalence data on ocular morbidity in the elderly have been obtained at every stage of surveying.

Table 25.1. Description of the elderly populations studies in the gerentological research in Central America.

Costa Rica		
1. Coronado- peri-urban community	n = 876	(M 404; F 472)
2. Puriscal- rural county	n = 1255	(M 1039; F 1092)
Guatemala		
1. Institutionalised populations		
2. Guajitos- peri-urban community		
3. Social Security Institute Affiliates		
4. San Pedro Ayampuc- rural village		

Interest in demography, and expertise in this discipline in Costa Rica, are probably the sparks that ignited progress toward ageing biology research in that nation. The United Nations Latin American Center for Demography (CELADE), the demography centre for the Central American and Caribbean region, has its headquarters in Costa Rica. Working with local counterparts - the Costa Rican General Direction of Statistics and Census (DGEC) and the Health Research Institute (INISA) of the University of Costa Rica analysed the data regarding the elderly in the national census conducted in June 1984 [12]. They consolidated the basic consensus in

September - October, 1986 in two counties: Puriscal and Coronado (see Table 25.2). This led to the publication "Mortalidad y Características Socio-económicas de la Tercera Edad" ["Mortality and Socio-economic Characteristics of the Third Age"] [12]. It also gave impetus to the extension of gerontology under the research Program on Ageing of INISA to study other variables, notably those of morbidity (physical, dental, mental status), and nutritional status (haematological, biological, and anthropometric) in one of the counties.

Table 25.2. Guatemalan Social Security Institute Affiliates San Pedro Ayampuc- Rural Village.

	Institution(1)	Semi-Urban Guajitos(2)	Social Security(3)	Rural-San Pedro Ayampuc(4)
Males				
Mean armspan- height (cm)	165.7-157.7	164.0-158.7	173.4-164.8	160.3-155.1
Span-height difference (cm)	10.0	5.3	9.6	5.2
Height/span ratio	95.0	97.0	95.0	97.0
Females				
Mean armspan- height (cm)	149.0-144.5	150.0-146.2	158.8-152.6	144.1-141.5
Span - height difference (cm)	4.5	3.8	6.2	2.6
Height/ span ratio	97.0	98.0	96.0	98.0

Coronado. These extended gerontological observations have been compiled in the monograph: "Estudio de la Tercera Edad en Coronado, Costa Rica" ["Study of the Third Age in Coronado, Costa Rica"] [13].

25.3 HEALTH AND CHRONIC DISEASES

Of interest is the similarity of the age profiles of persons over 60 years of age both across nations, and within Guatemala among the distinct subpopulations of elderly. The universal median age, for those persons 60 years and over, was 67 to 69. In Costa Rica [13], the age-profile of the combined subpopulations of Puriscal and Coronado paralleled that for the same age-group in the National Census as a whole; this had a median age of over 60 year-olds of about 67 years. In the longitudinal study, mortality rates could be established for the combined communities of highland Costa Rica. For the total elderly population, the annual mortality rate was 45.3 per 1000, 52.7 for men and 38.7 for women. However, for those over 80, men had a mortality rate of 134.3 and women 96.5. These agreed closely with the national vital statistics for Costa Rica. In descending order the causes of death in the combined study populations were:

1. Cardiovascular and circulatory diseases (32.2%);
2. Tumours (20.9%); and
3. Cerebrovascular diseases (11.3%).

These were similar to the national statistics, with slightly less circulatory death (28.2%) and slightly more tumour-associated mortality (24.9%) in the national data. In Guatemala, no systematic inquiry into rates and causes of death has been undertaken, and the national census data are far less reliable than those for Costa Rica.

The Costa Rican survey looked at morbidity as well as mortality. In the two counties survey a total of 1467 of 1778 (82%) responded affirmatively to the question: "Have you had major health problems in the last 12 months?" The three leading causes of morbidity declared were musculoskeletal, comprising 323 (22%) of the positive responses, hypertension (15%), and diabetes (9%). The self-reported prevalence of chronic morbidity in the Coronado county, was: musculoskeletal diseases (49%); high blood pressure (38%); and diabetes (13%). Prosthetic surgery was also of high prevalence (14%), as in industrialised countries [14].

Dental problems were a common denominator among the elderly: 70% were edentulous, 63% had some kind of prosthesis and 7% no type of prosthesis at all. Thirty-three per cent of the population studied required total or partial dental prosthesis, as some prostheses were more than 20 years old [15]. In the peri-urban population of Guajitos in Guatemala, CESSIAM has analysed the morbidity data for 108 subjects of the 223 identified in the course of the survey [16]. The morbidity was based on a combination of physical examination and a structured history and review of systems. The population included 29 men and 79 women. For both sexes, the systematic complaints were, in descending order:

1. cardiovascular problems (encountered in 48% of men, and 56% of women);
2 gastrointestinal disorders (encountered in 24% of men and 30% of women).

In the same population, 100% showed evidence of dental disease. An examination by an ophthalmologist uncovered at least one ocular diagnosis in 92% of 83 elderly participants. Circulating lipid levels are considered to be a risk factor for cardiovascular disease [17]. Both life-style factors (stress, physical activity) and dietary constituents (saturated fat, cholesterol, fibre), as well as genetics, gender and body habits are considered to be determinants of one's lipidaemia status. Data on blood lipids are available on subsamples of elderly populations in peri-urban areas of Coronado, Costa Rica, and Guajitos, Guatemala.

A total of 415 persons were sampled in Coronado for triglycerides and cholesterol. In Guajitos, a total of 91 samples were analysed. In Coronado, the data were disaggregated by gender; the mean plasma cholesterol level for elderly men was 212 mg/dL whereas that for females was 195 mg/dL. For the combined population of Guajitos, the mean plasma cholesterol was 222 mg/dL. A concentration of >250 mg/dL is considered to be elevated. The circulating triglyceride level in Costa Rican males was 141 mg/dL and 138 mg/dL for females. For the entire elderly, peri-urban population of Guatemala, the triglycerides averaged 195 mg/dL (mmol/L). A triglyceride concentration of >160 for men and of >135 for women is considered to be elevated [14].

25.4 QUANTITATIVE AND QUALITATIVE PATTERNS OF INTAKE OF THE ELDERLY

25.4.1 Quantitative data

In Guatemala, dietary intake of the elderly has only been studied quantitatively in three settings:

1. A weighed-intake study conducted among blind elderly in an in-patient rehabilitation centre;
2. A prescribed diet in a metabolic study in rural Guatemala; and
3. Food-frequency and multiple 24-hr recall intake studies for the free-living population of Guajitos.

In the blind elderly in-patients of the Center for the Aged Blind for an Independent Life (CAVI), of the NCBD, a total of 9 sightless, male elders had weighed intake studies performed for 10 days. The mean energy intake was 2358 ± 295 kcal/day. Twelve per cent of energy was from protein, 66% from carbohydrates and 22% from fat. With respect to the adequacy of specific nutrients, intakes were generally adequate for the principal micronutrients (Smits E and Mas Y : unpublished findings).

In this study, we had data on true dietary intake measured precisely (to determine how much blindness impairs the ability to participate in conventional dietary recall). Twenty-four hour

recalls were performed in people who were both elderly and blind - not to provide accurate dietary recall data, but to determine how much blindness impairs the ability to participate in conventional dietary recall. A high rate of concordance between items recalled and items ingested was observed. The conversion of recall data to nutrient intake was also in close agreement with that calculated from the observed intakes. Whether this unexpected reliability in the dietary-intake reporting by elderly is due to some form of tactile sensory compensation for the loss of vision was explored [18]. No important differences in tactile discrimination of weights was found between the sighted and blind elderly.

The true energy requirements for healthy elderly rural men and women has been established as a by-product of ageing research in Guatemala. Under metabolic-study conditions, in which all daily sustenance - three meals and two snacks - was provided in a congregate-feeding setting, we had 135 person-months of experience with 24 healthy, rural elderly people [19]. The prescribed daily intake of 2440 kcal produced no significant change in weight or body composition. The subjects performed at their usual level of physical activity despite participation in the study. In this same project, we were able to establish that the riboflavin requirement for the elderly is 1.37 mg/day or 0.56 mg/1000 kcal. The more carbohydrate in the diet, the less dietary vitamin B2 is required for the elderly, presumably due to colonic synthesis and host scavenging of the vitamin produced by the fermenting microflora [19].

The food-frequency data was directed specifically at the consumption of vitamin A-rich foods of plant and animal origin. The mean daily vitamin A intake in the elderly of the peri-urban community of Guajitos was 316 retinol equivalents (RE). Of this, 40% was from animal sources as preformed retinoid, whereas 60% was from plant sources as carotenoids [7]. An interesting, cross-gender difference was found. Women ingested a median of 376 RE/day whereas 50% of men took in less than 280 RE/day. The sources of vitamin A most often mentioned in the food-frequency questionnaire were: egg, tomato, cheese, plantain, carrot and margarine.

In addition to the food-frequency survey, multiple 24-hr recall interviews were completed in 51 women and 34 men in the Guajitos community. The data are still in the process of being converted to metric portion-sizes and entered into the computer for reduction to average individual nutrient intakes. In fact, one of the substantive lessons learned was the importance of adapting the field collection instrument to the computer software before collection. Tremendous post-hoc labour has been required to translate the interview results into some estimation of the frequency of consumption of total energy, macronutrients and some vitamins and minerals.

Photo 25.2. Guatemala (1991): interviewing elderly participants.

In the context of international multi-centre studies, we have learned the limitations of the available food composition table data referent to Central America. The "Tabla de Composición para Uso en América Latina" [10] was published based on food analyses conducted in the late 1950s. It is nevertheless, the single reference source for translation of dietary intake data into nutrients and dietary constituents for Latin America. By today's standards, its limitations are legion. This food table provides data on "crude fibre", but dietary fibre analyses for Central American foods do not exist. The carotene data is derived from open-column chromatography techniques of three decades past, and newer HPLC assays would probably refine the estimates of both provitamin-A and patterns of carotenoids from the point of view of their intrinsic health-protective properties. Sodium intake cannot be assessed. Minerals and trace elements such as magnesium, zinc and selenium, as well as copper and manganese, are virtually non-existent. All of these deficits in the available food composition table will make the effort in Guatemala intrinsically incompatible with other nations in the multi-centre study, such as Sweden, which have food composition values for the aforementioned minerals.

In regards to this lack of information, currently there has been a project undertaken, coordinated by INCAP, known as "LATINFOODS," that is recollecting data of all this regional food to construct a Latin American Table.

The difficulties with estimating alcohol consumption as a contribution to energy intake or as part of the dietary patterns is highlighted in the study on the free-living elderly of "Guajitos". Rallying and contact point for some older men was the cantina (local pub) of the community, yet alcoholic beverages were omitted from some of their 24-hr recalls. Moral and cultural barriers on the part of the interviewers and the interviewees probably combine for an under-reporting of alcohol intake. For Costa Rica, availability of published and analysed work is limited, but there are six graduation projects in nutrition, of the University of Costa Rica, that are worth

mentioning. They look at quantitative and qualitative food-intake in the institutionalised elderly [21-23] or in community elderly of Coronado [24].

25.4.2 Qualitative data

In Guatemala, qualitative data have been studied in various contexts. Usual consumption of milk and dairy products was used as a proxy for riboflavin intake in studies in elderly in two rural areas, Jocotenango and El Paso de Los Jalapas; the customary number of servings of these items was the index measured. Formal anthropological study was combined with quantitative dietary assessment in Guajitos. The food-chain pattern within a food system is the sequence of events from acquisition of food through its transport, storage, primary processing, and meal preparation leading up to consumption. Food security is the availability to all people at all times enough food for an active, healthy life. How the elderly participate in their own food-chain events, and some of the cultural aspects of their own provisioning and food preparation have been studied in the peri-urban settlement of Guatemala [9].

Eighty-five elderly persons of Guajitos, and their households were the subjects of this inquiry. Vitamin A-rich foods were used as the indicators for the food-chain and a proxy for food security. The sources of foods to the household of the elderly were largely purchased (76%), with 12% each cultivated or received as gifts. Only a limited variety of green, orange and yellow plants were in the community marketplace. Storage of vitamin A-containing foods within the home for any significant length of time was virtually non-existent. Only margarine or eggs were kept beyond the day of their purchase. Older women participated much more in the purchase of household food and in its preparation, than men. As persons of both sexes aged, however, they became much more dependent upon others for their food security.

Another qualitative approach is a focus on dietary diversity, using a method utilised previously with pregnant women of the Guajitos [25]. In this approach, the number of different foods and beverage items consumed by the population of elderly as a whole, and the interindividual distribution of items, can be correlated with dietary and health outcomes. This type of analysis will be conducted once the computer-files for the 24-hr recall data are completed.

25.5 NUTRITIONAL STATUS AS ASSESSED BY ANTHROPOMETRY AND BODY COMPOSITION

Again, the paradigms of child nutrition dominate the discussion of nutritional status, or what can be defined as "protein - energy nutriture". Based on the work of Gomez et al. [26] with hospitalised, malnourished children, a concept of classifying nutritional status is based on deficits in weight, with respect to a reference population. In industrialised countries, in which overweight and obesity were more problematic than undernutrition, deviations in weight above the median of a reference population or of an idealised standard population (Metropolitan Life Tables, 1983) were incorporated into systems of defining excessive energy nutriture. With regard

to stature, the concept of chronic malnutrition or "stunting" was introduced in the context of the process by which retardation of linear growth and height attainment occurred. Once again, in relation to reference populations, height classification systems were involved [27], and interpreted in terms of chronic undernutrition. It was then realised that deviations in height and deviations in weight could occur independently. In the nascent gerontological research in Guatemala and Costa Rica, anthropometry and body composition estimates have been prominent.

What certainly can be said about Central Americans, in general, is that they are short in stature. However, as a comparison between Costa Rican and various sectors of Guatemala illustrate, some are shorter than others. The elderly Costa Rican men of the peri-urban neighbourhood of Coronado had a mean height of 163.3 ± 6.1 cm [28]. The Guatemalan elderly men of the peri-urban settlements of Guajitos had a mean height of 159.1± 6 cm, the institutionalised sample had a mean height of 155.9 ± 8.0 cm, the social security pensioners had a mean height of 164.1 ± 7.6 cm, and the rural men of San Pedro Ayampuc had a mean stature of 155.1 ± 5.7 cm. For the Costa Rican elderly women of Coronado, the standing height was, on average, 150.3 ± 5.8 cm; for the older Guatemalan women from the diverse setting, cited in the same respective order as their male companions, the mean heights were: 146.5 ± 6.3 cm; 143 ± 6.6 cm; 151.5 ± 6.4 cm; and 140.3 ± 15.1 cm. The median height from the US National Center for Health Statistics (NCHS) for adult males, for comparison is 177 cm for men and 165 cm for women.

The absolute body mass of Central American elderly are correspondingly low. The peri-urban, free-living Costa Rican men weighed an average of 64.1 ± 10.2 kg whereas their peri-urban counterparts in metropolitan Guatemala had a mean weight of 60.4 ± 12.7 kg. For institutionalised men, older Guatemalans averaged 53.8 ± 8.6 kg, the pensioners, 64.8 ± 11.4 kg, and the rural campesinos, 49.9 ± 8.2 kg. Costa Rican older women of Coronado weighed, on average, 58.4 ± 12.6 kg, whereas those of Guajitos, Guatemala averaged 53.4 ± 11.2 kg. The institutionalised Guatemalan women weighed 48.1 ± 10 kg, the Social Security affiliated 57.9 ± 13 kg, and the rural campesinas, 44.5 ± 8.5 kg. Although the short stature might argue for "chronic" malnutrition, from the point of view of current protein-energy nutritional status or body composition, the aggregate numbers for height and weight provide little enlightenment. Certainly some lessons were learned when as a first approximation for the interpretation of body proportions, the adequacy of weight-for-height was calculated. What we rapidly discovered was that many Guatemalan elderly were below the height for which an associated normative weight had been assigned for adults. Geissler and Miller [29] had also discovered this "flaw" in the weight-for-height curves for adults. They also noted that the projection of the rising curve from childhood and of the descending curve from adulthood did not intersect. The London nutritionists published a curve that represented a computer-smoothing and joining of the two weight-for-height curves across the span of human stature. We found [5] that almost 100% of the 166 elders examined in institutions of Guatemala City had heights in the smoothed-over portion of the height spectrum.

The next option for a nutritional indicator that uses both the height and weight in the formula is Quetelet's body mass index (BMI), expressed as weight (kg) divided by height (m), squared. Various systems have been used to define nutritional deviance based on the BMI. For Costa Rican suburban elderly, the BMI for males ranged from 16.3 to 31.2, with a mean (x) of 24.0 kg/m^2 and for females, from 16.7 to 45.6, with a mean of 25.7. In Guatemala, with institutionalised elderly, BMI in men ranged from 14.3 to 31.8 (x=22.9) and in females, from 12.8 to 24.7 (x=22.3). In free-living peri-urban elderly, the BMI data were: males 17.0 to 30.5 (x=23.1); and females, 16.2 to 36.1 (x=24.7). In Social Security affiliates, the data were: males x=24.1, and females x=25.2.

Since the armspan has been advanced as a proxy for height when adult stature was at its maximum, that is, before compression and curvature of the thoracic spine had commenced. One might argue that the tissue distributed on the human frame should respond to the intrinsic length of the axial skeleton, more than to its suspension acted upon by gravity. Since all of the Guatemalan series have included the measurement of armspan, we can express the armspan-BMI (that is weight/armspan^2) as if the body mass was distributed over the maximal adult stature. Shown in Table 25.3 is a comparison of the height-BMI and the armspan-BMI. In each case, the BMIs are lower with the armspan term. This modification would tend to increase the number of individuals classified as under-weight (under-nourished) and decrease those in the over-weight and obese (over-nourished) categories in the distribution.

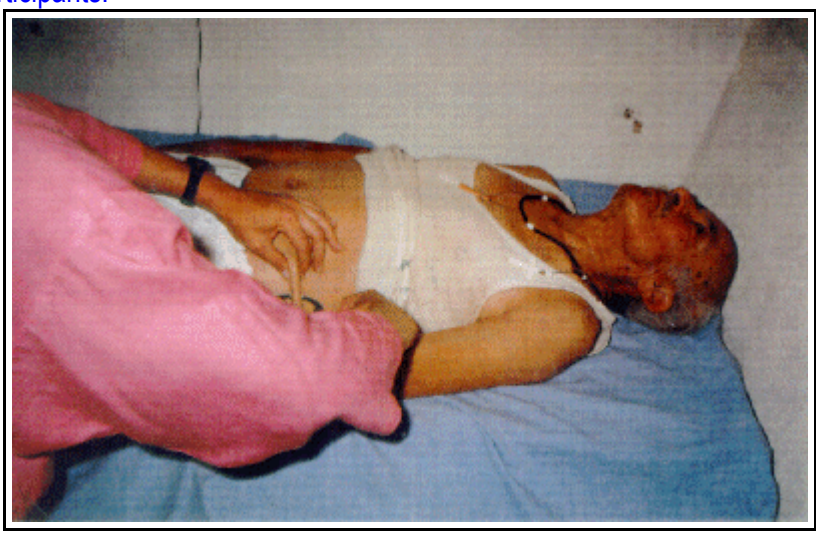
Table 25.3. Comparison of Height BMI and Armspan BMI.

	Inst(1)	Semi-Urban Guajitos(2)	Social Security(3)	Rural-San Pedro Ayampuc(4)
Males				
BMI	22.9	23.1	24.1	20.7
Armspan BMI	20.8	21.6	21.8	19.4
Females				
BMI	22.3	24.7	25.2	21.9
Armspan BMI	21.0	23.5	23.5	21.1

Within the definition of nutritional status and body composition that can be sought through anthropometrics, and their transformation into indices are questions of fat mass (adipose tissue) and lean body mass, and more recently issues of regional distribution of fat deposits. The simplest approach to the estimation of the partition of fat and non-fat in the body is the measurement of subcutaneous fat as skin-fold thickness [30]. The triceps skinfold was measured in both Guatemalan and Costa Rican elderly. For males, the results are comparable. Elderly Costa Rican women, on the other hand, have greater deposits of fat on the upper arm than their Guatemalan counterparts, both in the mean and in the upper range of the distribution [5-8,28]. In

only a limited number of the Central American studies have all four of the skinfolds (biceps, triceps, infra-scapular, suprailiac) been measured to permit the use of the approach of Durnin and Womersley [30] estimating body density from the sum of four skinfold thicknesses. However, the generalisability of this equation for non-British populations has been questioned. Bioelectrical impedance analysis (BIA) represents a new and promising approach to estimating total body water, and hence all of the components of fat and non-fat mass. The electronic apparati for the measurement are light, portable, relatively inexpensive and the measurements are non-invasive. In several of the Guatemalan elderly studies [5,10,16] BIA components have been measured in a consistent manner. With the increasing refinement of the monograms, and their adaptation to older populations, better and better estimations of body composition can be made using these data-sets. Some of this calculation is currently underway in a collaboration between CESSIAM and Dr Paul Deurenberg of the Agricultural University at Wageningen, the Netherlands.

Photo 25.3. Costa Rica (1991): skinfold measurements on elderly participants.



Skeletal mass is another consideration in body composition. The extent to which the architecture and the mineral content is dependent (a) upon nutritional factors such as calcium intake, vitamin D intake or sun-exposure, or body mass and adiposity, or (b) upon life-style factors such as physical activity and heavy weight-bearing exercises, or (c) upon racial and genetic constitution is still being debated. Densitometry studies with high energy radiation (photons; X-rays) are the conventional body composition technique for defining skeletal mass. However, the theory of Dequeker et al. [31] allows us to look at the relationship of the armspan and the standing-height, both measured in older age, to infer some of the history and health of, at least, the thoracic vertebrae. The loss of height/ armspan ratio after 30 years or after 60 years is seen as an index of population prevalence of vertebral osteoporosis. In comparison with the Belgian population originally reported by Dequeker et al. [31], Guatemalan women have a far lesser rate of apparent

height loss as estimated by the change in height/ armspan ratio across age-groups over 60 years of age [6]. This derives from a cross-sectional study, however, such that secular trend and other confounders inherently caution the interpretation of differences as due exclusively to the ageing process.

The difference, in cm, between the armspan and the stature on a population basis can be taken as the average amount of height that has been lost since early adulthood. However, since different populations have different stature, the ratio [height/armspan x 100] has been advanced as a normative motif for comparing populations. Only in Guatemala, has the armspan been measured. Table 25.3 provides the deltas between span and height, and the ratios for the four Guatemalan populations. The interpretation of this kind of data has not been validated. However, it is thought that differential magnitude of the various factors that act to reduce stature with age can be detected in cross-population comparisons of this nature. Rate of decline from age 60 could be measured.

25.6 HAEMATOLOGICAL AND MICRONUTRIENT STATUS OF THE ELDERLY: "HIDDEN HUNGER" IN THE ELDERLY

The consuming interest for public health nutrition in the Third World has been protein-energy malnutrition [32]. Nutritional anaemia, hypo-vitaminosis A and endemic goitre were also on the list, but did not receive the attention that "closing the protein gap" or "providing adequate staple food for the calorie needs of the nation" received over the past 5 decades. Meanwhile, zinc deficiency as a public health problem was described [33], and the consequences of low selenium nutriture, in terms of predisposition to Keshan disease were recognised [34].

The discovery of increased child mortality with hypo-vitaminosis A [35] refocused public health nutrition attention on a single, micronutrient: vitamin A. It took the World Conference on Childhood for the Year 2000, held in 1990, and the Montreal Conference on Policy for Micronutrient Malnutrition, to bring micronutrients to centre stage in the international nutrition forum [36]. As the "hidden hunger" paradigm is extended to pre-school children and school-aged children, surveys in Guatemalan elderly have begun to look at micronutrient issues in the Third Age, as well. Iron deficiency is the major cause of nutritional anaemia. Rates of "anaemia" or of "risk of anaemia" are used in the region as indicators of the iron-deficiency situation.

With regard to Central America, this approach has a complication, insofar as the variable, but largely highland, location of the populations invalidates the use of criteria for adequacy of haematocrit or haemoglobin concentrations that might be obtained at sea-level. For the elderly, the haematocrit has interpretative problems due to a putative senescent reduction in red cell size. Within these constraints, haematological data have been generated in the aged population of Coronado in Costa Rica (1340 to 1510 m above sea-level) and in the elderly residents of peri-urban Guajitos (1650 m above sea-level) and rural San Pedro Ayampuc (1250 m above sea-level) in Guatemala. In Costa Rica, the mean haematocrit for older men (n=171) was 44.5 ±

3.9% and for older women (n=234), 42.7 ± 2.8%. About 5% of women and 10% of men had levels below the established limits of normal for the Costa Rican study (Lacle A. et al.., 1990). In Guajitos, the mean haematocrit for men and women, respectively, were 44.1 ± 3.9% and 42.1 ± 4.2%. A total of 6.1% of those examined had levels below 37%, (used as a risk indicator of anaemia in the capital). For the rural Guatemalan population [6], the average haematocrit for men was 41.4 ± 4.7 and 39.3 ± 4.5%. A total of 18% of the elderly Sampedranos had packed red cell volume below the cut-off criteria.

Biochemical indices of vitamin nutrition have only been collected in Guatemala; the micronutrient data in this country are extensive. Collaboration with the United States Department of Agriculture Human Nutrition Research Center on Aging, at Tufts, in Boston, has been instrumental in collecting this information. In institutionalised populations [37], circulating levels of all four fat-soluble vitamins were measured. These included: retinol (vitamin A), alpha-tocopherol (vitamin E), cholecalciferol (vitamin D), and phylloquinone (vitamin K). In general, levels of vitamin K were lower than those reported in North American elderly evaluated in the same laboratory. However, in one institution, the one in which oral vitamin supplements were routinely administered, circulating levels of vitamins A and E were higher than in the non-supplemented institutional elderly population. Given the highland location and Spanish colonial tradition construction (central patios), it is not surprising that vitamin D levels in Guatemalan older persons were normal, and higher than those reported for institutionalised populations in more temperate latitudes. Vitamin K levels were, overall, lower than those that had been seen in North American subjects.

In the SENECA study in Europe, in which biochemical indices of vitamin status were studied [38], there was a generally low incidence of deficiency with respect to vitamins A, E, and folic acid. From 2 to 10% of the population had low levels of vitamin B12, but up to 50% of elderly in some European centres had subnormal vitamin B6 status. In a study involving 166 of the 205 aged individuals in the rural village of San Pedro Ayampuc, biochemical evidence for vitamin deficiency was much more important. Among these elderly campesino, 65% of those examined had subadequate vitamin B2 status as indicated by an erythrocyte glutathione reductase activity coefficient of >1.30; 38% had a vitamin B12 level >200 mg/ml; and 15% had a-tocopherol levels <500 mg/dl (King, 1991).

For plasma folate levels, thiamine status (as indicated by red cell transketolase activity coefficients), and vitamin B6 status (as indicated by red cell amino transferase activity coefficients), the rates of subnormality were 9%, 1%, and 0%, respectively. Total carotene concentrations were measured, and the median was 54 mg/dl. Thirty per cent had a level below an arbitrary cut-off for "low status" of 40 mg/dl [6]. The two-thirds of the subjects who were of indigenous Mayan descent in this population tended to have numerically lower averages for all indicators of vitamin status than the one-third who were of mixed European descent, but this only reached statistical significance for a-tocopherol.

Vitamin A status has been a focal issue in Guatemala because of its history of hypo-vitaminosis A in young children. Circulating levels of retinol are available not only for San Pedro Ayampuc [6], but also for elderly in the coverage population of pensioners of the Social Security Institute [10] and in the peri-urban neighbourhood of Guajitos [7]. The median plasma level for the rural village elderly population was 39 mg/dl, with 21% with low levels [6]. Among 286 fasting plasma samples measured in the pensioner populations, the median was close to 50 mg/dl, but 27% had levels <30 mg/dl [10]. For the 110 elderly sampled in Guajitos, only 4.5% had retinol concentrations <30 mg/dl; the overall median was 48 mg/dl.

For the urban pensioners, b-carotene levels had a median value of 140 mg/dl in females and 104 mg/dl in males. For peri-urban residents, median b-carotene levels for women was 18 mg/dl and those for males, 8 mg/dl. In both populations, there is a trend to higher levels in the women. The marked absolute difference in levels between studies are not readily explained. Status of additional vitamins was evaluated among 111 elderly persons in Guajitos. A total of 36% had subnormal values for plasma vitamin B12, 20% had evidence of riboflavin deficiency, and 15% had an abnormality in red cell amino transferase activity coefficients, indicating evidence of vitamin B6 depletion. For vitamin E, thiamine, and folate status, less than 10% of the elderly populations of this peri-urban community had subnormal vitamin-status indicators (Mendoza I, Boisvert W : Unpublished findings).

Of specific, and newsworthy, revelation from the gerontological studies related to vitamins in Guatemala has been the wide-spread finding of riboflavin deficiency in most elderly populations. Both within individuals, and within populations, it is correlated with the frequency of milk consumption [39].

Photo 25.4. Guatemala (1991): elderly woman looking after her grandchildren at the market.

25.7 ASSESSMENT OF FUNCTIONAL STATUS

Human disability can occur, even when it does not always have a name in the International Disease Classification. Morbidity assessment provides a diagnosis for a pathological condition, but it does not tell much about the functional capacity of an individual. The most accessible method for quantifying function in the elderly are measures of Activities of Daily Living (ADLs).

ADL instruments are based on a paradigm for developed countries. The basic purpose of the ADLs is to determine the level of care (nursing care, assistance of family members) that a nursing home resident or a home-bound elder will require. They are useful in planning the care of the chronically-debilitated and in estimating its cost. In the two-site Costa Rican ageing surveys [12], the ability to complete six self-care activities- eating, going to bed, dressing, bathing, combing one's hair (female) or shaving (male) and cutting one's toenails, and one physical effort (walk a specified distance) was incorporated into the Activities of Daily Living instrument. Whereas close to 90% of the over-60-year-olds could perform all but one of the tasks without assistance. Only 70%, however, could cut their own toenails. By the age of 80, however,

20% of persons required help in combing or shaving, 26% could not walk without assistance, and 54% needed assistance in cutting their toenails.

In Guatemala, at CESSIAM, the concern has not been so much on applying instruments of functional capacity to large populations, but rather with determining their reproducibility and their validity. To this end we have examined the correspondence between the answers to specific questions on an ADL questionnaire, and the demonstrable capacity for the subjects to carry out or simulate the activity physically. A gratifyingly high correlation was observed (Valdez C and Zonnveld S : Unpublished findings). It is of note that inability to walk more than a block is a leading complaint. The pathophysiological basis appears to be in the musculoskeletal system, namely in osteoarthritis of the knee. A life-long history of heavy weight-bearing work for both men and women could explain this degenerative process on the knee joints. A questionnaire instrument for history of osteoarthritis combined with a physical inspection was found to be highly reproducible on repeated testing in the elderly (Valdez C & Schlinker J: unpublished findings).

25.8 NETWORKING AND SCIENTIFIC DIVERSIFICATION: SOME PERSONAL NOTES

For the orthodox gerontology community, undoubtedly the foremost figure in the very recent history of gerontology in developing countries is Prof Gary Andrews, of Flinders University in Australia. He and his colleagues conducted a comparative study of health of the elderly in Fiji, Malaysia, Philippines, and the Republic of Korea [40]. Dr Andrews has been called upon to give the synthetic discourses on gerontology in "developing countries" at the Workshop on Research and the Aging Population in Bethesda, Maryland [41].

Yet another lesson from Central America is the importance of networking and metamorphosis in the development of spontaneous initiatives in the region. Gerontological research in the isthmus has its origins at the interface of classical gerontology, epidemiology and clinical nutrition. In its evolution, communication and interaction have been the key elements. The meeting of the Costa Rican gerontologist and co-author (AL) and a contingent of Guatemalan researchers including Jane King, Carmen Castañeda, William Boisvert, and another co-author (NWS) occurred by virtue of our mutual attendance at the International Gerontological Congress in Acapulco, Mexico. It was also at that event that all of us met Prof Mark Wahlqvist, and thus began the dialogues that would lead to our participation in this book.

Prof Wahlqvist went on immediately from Acapulco to Toronto, Canada and the Second International Symposium on Body Composition Study in Humans; there he met Dr Mei-Ling Siu-Lui and yet another co-author of this chapter (MM), both instrumental in the nutritional assessment and body composition research on aged Guatemalans. Thus, attendance by Third World researchers at international meetings is crucial for the networking process. The gerontological linkages across the isthmus were strengthened by subsequent opportunities -

again through international meetings, held in Spanish and headquartered in Mesoamerica - for the protagonists of gerontological research from Costa Rica and Guatemala to meet. This occurred in Antigua, Guatemala at the Subregional Latin American Workshop on Health of the Elderly in 1990, at the XIV Mexican Congress on Gerontology and Geriatrics in 1990, and at the II Latin American Workshop on Nutrition and Health in Urban Areas in 1992. Ageing and nutrition has become a topic of wider interest in the Latin American nutrition community; a symposium on that topic was organised in Puerto Rico at the XIV Latin American Nutrition Congress and the four authors of this chapter were the invited speakers.

Finally, one must recognise the assistance and investment of time and opportunities by institutions in First World countries in the growth of Central American gerontology. Collaborations with professionals at the USDA Human Nutrition Research Center on Aging in Boston, USA and with professors and students at the University of Bonn, in Bonn, Germany, have been the most instrumental for CESSIAM. The University of California and the Agricultural University at Wageningen, the Netherlands, have also contributed to Guatemala. For INISA in Costa Rica, the Pan American Health Organization has played a fostering role, funding the publication of the monograph of the Elderly in Coronado [14]. The fruits of the effort to develop a research presence for ageing biology in Central America are beginning to be savoured in the respective countries. Membership by one of us (NWS) on the IUNS Committee on Ageing and Nutrition and the opportunity to present this chapter is one such example. In addition, the co-authors from Guatemala have been invited to participate in the deliberations of the WHO Expert Committee on Elderly on Use and Interpretation of Anthropometry. For the group in Costa Rica, selection for collaborative research under the Special Program on Research on Aging of the World Health Organization (UN) and the National Institute on Aging (USA) has come about as a result of the track record in gerontological research established in the national and regional surveys. Development of gerontological competence in a developing country requires an incubation period in which experience is gained, skills are honed, international contacts are made, and the first research projects are initiated. This combination brings the research group to the "take-off" stage for more ambitious under-takings such as multinational, multicenter collaborative projects.

25.9 SUMMARY OF LESSONS LEARNED

The purpose of a chapter such as this is perhaps to foster the solid development of gerontological research in general, and research related to diet and nutrition of the elderly in developing countries that have not yet begun to explore these disciplines. Both lessons of process and lessons of research product have been gleaned from the divergent and convergent experiences in Costa Rica and Guatemala, both beginning in or about 1985. We shall try to synthesise in capsule form some of the more important lessons in this concluding section.

25.9.1 Lessons of gerontological process

- Quality gerontological research can be conducted in developing countries. A minimum prerequisite may be a tradition of biomedical research in the professional community. Both Guatemala, with INCAP, and Costa Rica with INISA, and other elements of the State University, possess these research traditions.

- Ageing research is unlike other aspects of human biology in the assumptions and the interpretation of data. Success on an international platform requires mastering the limitations and pitfalls of design and interpretation in gerontological research [1].

- The proper planning of and standardisation of methods can maximise the accuracy and precision of measurements. The variance with repeated measures from Central American ageing research is comparable with those of literature published from developing countries although the range of values for certain variables are displaced.

25.9.2 Lessons of ageing biology from Central America

- In contrast to findings in Europe from the Euronut-SENECA study [42], micronutrient deficiency states exist commonly among the elderly of Guatemala.

- In terms of anthropometric assessment and body composition, both ends of the nutritional spectrum - underweight (deficiency) and overweight and obesity (excess) exist in populations of Central American elderly. States of nutritional excess appear to be more common in Costa Rica than Guatemala.

- Ethnically determined differences in limb proportions and body habits found among the ethnic groups resident in the Central American isthmus must be examined for their influence on the normative interpretation of such indices as the armspan/ height ratio, Quetelet's body mass index, Chumlea's predicted height from leg length, and the waist/ hip circumference ratio.

- Cultural nuances are important in any cross-cultural applications of instruments to measure physical and cognitive function. Simple translations from the original language into Spanish is insufficient to provide a reliable and serviceable instrument for functional assessment of the Central American elderly.

25.10 ACKNOWLEDGEMENTS

For the contributions to the Costa Rican ageing studies, the authors would like to acknowledge the efforts of the multidisciplinary research group of the research Program on Ageing of INISA, especially to Licda. Xinia Fernandez. In Guatemala, the authors are indebted to the gift of the thesis by Dr Leticia Pacheco. The CESSIAM staff members who have contributed to these gerontological studies in Guatemala included: Dr Carmen Castañeda, Lic Héctor Gamero, Ms

Marjorie Haskell, Ms Jane King, Licda Lilian Portocarrero, Licda Julieta Quan, Licda Isabel Ramírez, Licda Ma Eugenia Romero, Dr Mei-Ling Siu-Lui, Dr Carlos Valdez, and Dr Alejandrina Vasquez.

Student participants at CESSIAM have included: Licda Alves-Araujo (Federal University of Rio de Janeiro), Dr William Boisvert (Tufts University, Boston, MA, USA), Ms Katharina Breuer (University of Bonn, Bonn, Germany), Ms Yolanda Maas (Agricultural University at Wageningen, the Netherlands), Ms Els Smits (Wageningen), and Ms Kerstin von der Heiden (Bonn). International nutrition professionals whose collaboration has been invaluable to the research in Guatemala include: Prof Paul Deurenberg (Agricultural University at Wageningen, the Netherlands), Prof Rainer Gross (University of Bonn, Bonn, Germany), Dr Frank Morrow (United States Department of Agriculture Human Nutrition Research Center on Aging, Boston, MA, USA), Ms O'Neill (USDA-HNRC), Prof Robert Russell (USDA-HNRC), Dr James Sadowski (USDA-HNRC), Dr H Weiser (Vitamin and Clinical Nutrition Laboratory, Hoffmann-La Roche, Basel, Switzerland). We also appreciate the material contribution of Mr Rudolph J Leidtke of RJL Systems of Detroit, Michigan.

25.11 SUMMARY

- The data presented in this chapter are based on the experience with gerontological research in Guatemala (classified as a less developed country) and Costa Rica (classified as a nation in transition to development). In Guatemala, undernutrition is a public health concern; in Costa Rica problems of nutrient excess are more predominant.

- In descending order the causes of death in Central American elderly include: cardiovascular and circulatory diseases (32.2%); tumours (20.9%); and cerebrovascular diseases (11.3%).

- The three leading causes of morbidity amongst the elderly include: cardiovascular problems (52%); musculoskeletal diseases (49%); high blood pressure (38%); gastrointestinal disorders (27%) and diabetes (13%).

- There has been a wide-spread finding of riboflavin deficiency in most elderly Guatemalans.

- Micronutrient deficiency states exist commonly among elderly Guatemalans (e.g. iron, vitamins B6, B12, A and E) .

- Underweight (more common in Guatemala) and overweight/ obesity (more common in Costa Rica) both exist in populations of Central American elderly.

- Ethnically determined differences in limb proportions found among the ethnic groups

resident in the Central American isthmus must be examined for their influence on the normative interpretation of armspan/ height ratio, Quetelet's body mass index, Chumlea's predicted height from leg length, and the waist/ hip circumference ratio.

- Assessment of cognitive function (using the Mini-Mental State Questionnaire) of Central American elderly may not be a reliable and serviceable instrument when simply interpreted into Spanish.

25.12 REFERENCES

1. World Health Organization. Health in the Elderly, WHO, Geneva, 1989.

2. Williams CE. A nutritional disease of childhood associates with a maize diet. Arch Dis Child, 1933; 8: 423-433.

3. Mata L, Allen MA, Jimenez P, Garcia ME, Vargas W, Rodriguez ME, Valerin C. Promotion of breast-feeding, health and growth among hospital-born neonates, and among infants of a rural area of Costa Rica. In: Chen LC, Scrimshaw NS (eds.) Diarrhea and Malnutrition. Interactions, Mechanisms and Interventions. New York, Plenum 1983: 177-202.

4. Grimley-Evans J Ageing and Disease. In: Evered D, Whelan J (eds) Research and the Ageing Population, CIBA Foundation Symposium 134. Chichester, John Wiley & Sons, 1988: 38-46.

5. Sui-Lui M-L. Composición Corporal en Ancianos: Determinación de Agua Corporal Total, Grasa Corporal Total y Masa Magra de una Población entre 57 y 103 Años. Thesis, Faculty of Medical Sciences, San Carlos University, 1987.

6. King JE. Nutritional assessment of the elderly of San Pedro Ayampuc, Guatemala: Evaluation of anthropometry, biochemistry, and helminthic infection. Masters Thesis, University of California at Berkeley, Berkeley, 1991.

7. Breuer K. Vitamin A Status and Anthropometric Measurements in Elderly Persons Living in a Peri-Urban Area of Guatemala City. Diploma thesis. Rheinischen Friedrich-Wilhelms-Universitat, Bonn, 1990.

8. Haskell M, Breuer KE, Valdez C, Vasquez A, Mendoza I, Pietrzik K, Gross R. Nutritional Status, body composition and anthropometric risk indicators in a population of peri-urban elderly in Guatemala. FASEB J, 1991; 5: A1448.

9. von der Heiden. Food Security Problems of Elderly People in Developing Countries, exemplified by a Peri-urban Community of Guatemala City. Diploma Thesis, "Friedreich-Wilhelm" University of Bonn, 1992.

10. Pachecco-Taracena ML. Hepatic Vitamin A reserves and Nutritional Status of the Elderly. Thesis. Guatemala City, Centro de Estudios Superiores en Nutricion y Ciencias de Alimentos (CESNA), 1992.

11. Krotki, K. Características sociodemográficas de la población de 60 a y mas en Costa Rica.

Noveno Seminario Nacional de Demografía CELADE, San José, 1987.

12. Garcia V. La Mortalidad y Caracteristicas Socioecónomicas de la Tercera Edad. Centro Latinoamericano de Demografía, San José, 1990.

13. Llanos, G (ed). Estudio de la Tercera Edad en Coronado, Costa Rica (ETEC). Adult Health Series 90-01. Pan American Health Organization, San Jose, 1990.

14. Lacle A, Porras A, Esquivel JM Valores de Referencia Hematologicos y Bioquimicos en ETEC. In: Estudio de la Tercera Edad en Coronado, Costa Rica (ETEC). Adult Health Series 90-01. San Jose, 1990: 55-73.

15. Brenes W. Oral Health in the elderly and the use of dental health services. In: Llanos G (ed), OPS/OMS Estudio de la Tercera Edad en Coronado, Costa Rice (ETEC). Adult Health Series 90-01. San Jose, 1990: 99-189.

16. Valdez C. Morbilidad de ancianos de una comunidad peri-urbana de la ciudad capital de Guatemala. Revista Mexicana de Geriatría y Gerontología, 1992 (in press).

17. Miller NE. Associations of high-density lipoprotein subclasses and apolipoproteins with ischemic heart disease and coronary atherosclerosis. Am Heart J, 1987;113(2 pt) 20: 589-97.

18. Alves-Araujo MA. Adaptacao Sensorial nos Sentidos Relacionados a Ingesta Dietetica" Analise entre Individuos Cegos e nao Cegos, Master in Human Nutrition Thesis, Instituto de Nutricao, Universidad Federal do Rio de Janeiro, Brazil, 1987.

19. Boisvert WA, Mendoza I, Castañeda C, Portocarrero L, Solomons NW, Gershoff SN, Russell RM : Riboflavin requirements of the healthy elderly and its relationship to macronutrient composition of the diet. Am J Clin Nutr, 1993;123: 915-925.

20. Wu-Lueng WT, Flores M. Tabla de Composición para uso en America Latina. ICNND-INCAP, Guatemala City, 1961.

21. Mora Z. Evaluación de la calidad de la dieta consumida y del estado nutricional de los ancianos internados en el Hogar de Ancianos de Palmares. Nutrition Thesis, University of Costa Rica, 1986.

22. Piedra I. Modelo de capacitación nutricional para personal voluntario de tres centros diurnos de ancianos. Nutrition Thesis, University of Costa Rica, 1990.

23. Moreira, N.J. Reorganización del servicio de alimentación del Hogar de Ancianos

"Alfredo y Delia González F." Nutrition Thesis, University of Costa Rica, 1990.

24. Flores, M. Consumo de fibra dietética en ancianos de dos niveles Socio-económicos diferentes del área urbana de Coronado. Nutrition Thesis, University of Costa Rica, 1991.

25. Fitzgerald SL, Gibson RS, Quan De Serrano J, Portocarrero L, Vasquez A, Zepeda E, Lopez-Palacios CY, Solomons NW : Food consumption patterns and dietary diversity of pregnant women living in a peri-urban area of Guatemala City. Ecol Food Nutr, 1992; 27: 1-15.

26. Gomez F, Ramos-Galvan RR, Frenk S, Cravioto-Munoz J, Chavez A. Mortality in second and third degree malnutrition. J Trop Pediat, (1956); 2: 77-85.

27. Waterlow JC, Classification and definition of protein-calorie malnutrition. Brit Med J, 1972; 3; 566-569.

28. Fernandez X, Fernandez P, Lacle A. Perfil Anthropometrico de la Poblacion del Estudio de Tercera Edad de Coronado (ETEC). In : Estudio de la Tecera Edad en Coronado, Costa Rica (ETEC). Adult Health Series 90-01. San Jose, 1990: 77-96.

29. Geissler C, Miller D. Problems with the use of "weight for height" tables. J Nutr 1985; 115: 1546-1549.

30. Durnin JVGA, Womersley J. Body fat assessed from total body density and its estimation from skinfold thickness measurements on 481 men and women aged from 16 to 72 years. Br J Nutr 1974; 32: 77-97.

31. Dequeker JV, Baeyens JP, Claessens J. The significance of stature as a clinical measure in ageing. J Am Ger Soc, 1969; 17: 169-179.

32. Brown KH, Solomons NW : Nutritional problems of developing countries. In : International Health. In : Velji AM (ed.) Infectious Disease Clinics of North America. New York, WB Saunders, 1991: 297-317.

33. Prasad AS, Miale, A, Farid Z, Sandstead HH, Sculert AR. Zinc metabolism in patients with the syndrome of iron deficiency anemia, hepatosplenomegaly, dwarfism and hypogonadism. J Lab Clin Med, 1963; 61: 537-548.

34. Yang GQ, Ge KY, Chen JS, Chen XS. Selenium-related endemic diseases and the daily selenium requirement of humans. World Rev Nutr Diet, 1988; 55: 98-152.

35. Sommer A. New imperatives for an old Vitamin (A). J Nutr 119: 96-100.

36. ACC/SCN. Micronutrient deficiency - the Global situation. SCN News 1993; 9: 11-16.

37. Siu ML, O'Brien ME, Sadowski JA, Garry P. Omdahl JL, Mazariegos M, Solomons NW. Circulating fat-soluble vitamin concentrations in North and Central American elderly. FASEB J 1989; 3: A662.

38. Haller J, Lowik M, Ferry M, Ferro-Luzzi A. Nutritional status: blood vitamins A, E, B6, B12, folic acid and carotene In: de Groot LCPGM. van Staveren WA, Hautvast JGAJ (eds) EURONUT - SENECA Nutrition and the Elderly in Europe. Eur J Clin Nutr, 1991; 45(3): 63-82.

39. Boisvert WA, Castañeda C, Portocarrero L, Solomons NW, Gershoff SN, Russell RM : Prevalence of riboflavin deficiency among the Guatemalan elderly and speculations on its etiology. J Nutr, 1993;58:85-90.

40. Andrews GR, Esterman AS, Braunack-Mayer AJ, Rungie CM. Ageing in the Western Pacific - A four country study. Western Pacific Reports and Studies No. 1. WHO Regional Office for the Western Pacific, Manila, 1986.

41. Andrews GR. Health and ageing in the developing world. In : Evered d. Whelan J eds. Research and ageing population. Chichester, Wiley 1988: 17-37.

42. de Groote LCPGM, van Stavern WA, Hautvast JGAJ (eds.) EURONUT-SENECA Nutrition and the elderly in Europe. Eur J Clin Nutr 1991: 45(3).

25.13 ILLUSTRATIONS

Photo 25.1. Guatemala (1991): elderly woman shopping at the market.

Photo 25.2. Guatemala (1991): interviewing elderly participants.

Photo 25.3. Costa Rica (1991): skinfold measurements on elderly participants.

Photo 25.4. Guatemala (1991): elderly woman looking after her grandchildren at the market.

CHAPTER 25

SPONTANEOUS GERONTOLOGICAL RESEARCH INITIATIVES IN CENTRAL AMERICA