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DEVELOPMENT OF A PROTOCOL TO STUDY THE INTERACTIONS OF NUTRITION, AGEING, AND URBANIZATION IN DEVELOPING COUNTRIES

Development of the Reconnaissance project

Pitfalls and experiences in research on nutrition

Experience of the EURONUT-SENECA project

Critique of the IUNS-FHLL study

Community analysis of the Reconnaissance project

Individual analysis of the Reconnaissance project

Interview questions and measurements in the Reconnaissance project

Revision of the protocol

CRONOS protocol



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Tel.: (03) 3499-2811 Fax: (03) 3406-7345 E-mail: mbox@hq.unu.edu

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The development of a protocol to study the interactions of nutrition, ageing, and urbanization in developing countries: Cross-Cultural Research on the Nutrition of Older Subjects (CRONOS)

Edited by Rainer Gross, Noel W. Solomons, Corazon V. C. Barba, Lisette C. P. G. M. de Groot,
and Geok Lin Khor

Preface	—Nevin S. Scrimshaw	217
Foreword	—Rainer Gross, Noel W. Solomons, and Joseph G. A. J. Hautvast	218
Overview of ageing, urbanization, and nutrition in developing countries and the development of the Reconnaissance project	—Corazon V. C. Barba and Lucila B. Rabuco	220
Pitfalls and experiences in nutritional research on the elderly in developing countries	—Noel W. Solomons	226
Experience of the EURONUT-SENECA study in design, implementation, and data analysis	—Lisette C. P. G. M. de Groot, Wija A. van Staveren, and Joseph G. A. J. Hautvast	235
The IUNS study of Food Habits in Later Life: A critique	—Bridget H.-H. Hsu-Hage and Mark L. Wahlqvist	239
Analysis of the Reconnaissance project. Phase 1: The community	—H. Thamrin, A. Rasad, N. W. Solomons, M. L. Wahlqvist, and R. Gross	248
Analysis of the Reconnaissance project. Phase 2: The individual	—N. W. Solomons, I. Mendoza, L. Gutierrez, and C. Monteiro	256
Analysis of the appropriateness and feasibility of the Reconnaissance project interview questions and measurements	—G. L. Khor, P. Migasena, K. Ge, R. Gross, A. Lacle, and A. Kvalbein	261
The process of revision of the protocol	—Rainer Gross and Bridget H.-H. Hsu-Hage	264
CRONOS (Cross-Cultural Research on the Nutrition of Older Subjects). Third edition	—edited by Rainer Gross,	267
Annex: CRONOS collaborating centres		304
News and notes		306

Preface

This issue of the *Food and Nutrition Bulletin* is devoted entirely to the Cross-Cultural Research on the Nutrition of Older Subjects (CRONOS) project, which is a multicentre study of nutrition and related health practices in the elderly of developing countries developed by the Committee on Urbanization and Nutrition of the International Union of Nutritional Sciences (IUNS). It is based on a pilot Reconnaissance project designed to build on the experience gained with two previous studies, mainly in industrialized countries. The end product is a detailed protocol for a multicentre study that appears at the end of this issue [1].

One of the previous studies providing the background for CRONOS is the IUNS study Food Habits in Later Life (FHLL) [2], conducted in 10 sites, of which only 2 were in developing countries. This study provided such an enormous amount of useful information that full publication in conventional print form would have been prohibitively expensive. Fortunately, it has been made available in full on CD-ROM. The other prior study is the EURONUT-SENECA study in 19 sites in 12 European countries, which has also been published in full [3].

While the two studies provided a good picture of

the food habits of elderly populations in industrialized countries, the IUNS Committee on Nutrition and Aging was eager to promote the extension of investigations of this type to the growing populations of elderly people in a broad range of developing countries. To facilitate this effort, the Committee organized the pilot Reconnaissance project described in this issue. Its product is the standardized protocol presented in this issue [1], one that is designed to be not only multicentred but also multidisciplinary and to include both quantitative and qualitative methodologies.

The *Bulletin* is pleased to present the CRONOS protocol and the background discussions preceding it. We hope that it will be implemented by centres in a range of developing countries and the results collated and compared. Such an analysis will be as valuable to developing countries as the EURONUT-SENECA and IUNS-FHLL studies have been for policy formation, planning, training, and implementation of programmes to benefit the elderly in industrialized countries.

Nevin S. Scrimshaw
Editor

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Foreword

The process we are describing, and the reports that we are presenting, in this special issue of the *Food and Nutrition Bulletin* are the work of Committee II/3 on Urbanization and Nutrition of the International Union of Nutritional Sciences (IUNS). The report has been more than four years in the making. Although it is based on the deliberations of participants and consultants at a working conference held in Wageningen, Netherlands, in March 1993, it has undergone revisions based on extensive consultations.

Three major realities are reviewed in the introductory articles. The first is the changing context of demography in the developing countries of Asia and Latin America in which life-spans have increased and fertility has decreased. As a result, the elderly population has begun to increase dramatically. A second consideration is that urbanization and rural-to-urban migration have accelerated over the last half-century. This has cut off many of the elderly from traditional extended-family support systems that characterize rural communities. The third is the lamentable state of the art of ageing research in developing-country settings. Interest in and experience with the study of ageing in third world populations has not kept pace with the rate of ageing in the third world.

Gerontology and geriatrics are emerging disciplines in industrialized countries. Peculiarities of the morbidity and mortality trends, environmental stress, and dietary habits of low-income countries present additional pitfalls and caveats for its study in that setting. The pilot Reconnaissance project and the CRONOS (Cross-Cultural Research on the Nutrition of Older Subjects) protocol discussed in this issue are part of an emerging movement to conduct multicentre surveys on the elderly.

Next, the predecessors of the Reconnaissance project are described. The EURONUT-SENECA study [1] included 19 sites in 12 European countries, and the IUNS study Food Habits in Later Life (FHLL) [2] studied six ethnic groups at 10 sites.

Among the countries included in these two studies, only the Philippines and China could be considered developing countries. The experiences in bringing these two multicentre studies on the elderly to fruition are reviewed in the context of how they might enhance the execution of a similar study exclusively based in low-income societies. In 1992, with financing from the European Commission, the Reconnaissance project, a parallel set of pilot studies using a common draft protocol, was conducted in five Asian countries (China, Indonesia, Malaysia, the Philippines, and Thailand) and three Latin American republics (Brazil, Guatemala, and Mexico).

Under ideal circumstances, before any protocol is drafted, qualitative rapid appraisal techniques and participation of the target population in its development would be desirable. After the Reconnaissance protocol was formulated, several consultants suggested that cultural differences among regions might influence the validity of the responses and their interpretation. Somewhat after the fact, an initial phase of rapid appraisal was added that used techniques of open-ended probing interviews both with key informants and with focus groups. The community was brought into the planning, and a unit of qualitative analysis was added. This technique has been described elsewhere [3, 4] and is summarized briefly in the protocol. The researchers for this qualitative rapid appraisal were nutritionists or physicians who did not have anthropological backgrounds or experience with probing interviews. However, they learned many important lessons about the attitudes of elderly populations and the reasons for their health-related behaviour. The professionals found this added dimension to community-level investigation to be rewarding. In the paper by Thamrin et al. [5], the readers can judge the usefulness of this addition to the original protocol.

The field experience of the collection of the prescribed common elements of the questionnaire and measurement procedures, conducted without pre-

vious intra-site standardization exercises, is recounted, and the lessons derived are enumerated in other chapters. A mid-process evaluation is a luxury that the two predecessor studies did not have available to them. At the meeting in Wageningen, participants and consultants were combined into working groups to apply the lessons learned in the Reconnaissance pilot study to a definitive protocol. Emphasis was on what was unclear, what was superfluous, what was redundant, and what was potentially offensive in the questions. The measurement procedures of the Reconnaissance protocol were then applied in the field in eight countries. Insights are provided into the reasons for the changes made.

What emerges is a protocol for a multicentre study of the elderly in developing countries presented as the final paper in this issue. The acronym for the protocol is derived from the ancient god of time, CRONOS. The real work is now ahead of us, to recruit and enrol research centres to join hands with IUNS Committee II/3 and do the hard work of collecting and reporting survey data that will allow us to learn more about how urbanization and ageing influence health and nutrition in developing societies.

Rainer Gross
Noel W. Solomons
Joseph G. A. J. Hautvast

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Overview of ageing, urbanization, and nutrition in developing countries and the development of the Reconnaissance project

Corazon V. C. Barba and Lucila B. Rabuco

Abstract

Two of the major demographic trends in the developing and transitional countries are urbanization (the growth of cities and metropolitan populations) and ageing (the increase in the number of persons over 70 years of age, due to extended life expectancy). These two trends are felt to present unresolved challenges regarding health, well-being, and quality of life. These uncertainties gave rise to the multicentre Reconnaissance project carried out in five Asian countries (China, Indonesia, Malaysia, the Philippines, and Thailand) and three Latin American countries (Brazil, Guatemala, and Mexico), in collaboration with institutions in the Netherlands, Germany, and Italy, with financial support from the European Community. The findings, experience, and lessons from the preliminary qualitative (community), and quantitative (individual) surveys were shared among the investigators at a conference held at Wageningen, Netherlands.

Introduction

The declining mortality among infants and children and the increasing life expectancy and longevity in developed and developing countries are changing the structure of the population. The percentage of the population that is elderly, i.e., over 60 years of age, has increased worldwide, and this trend is expected to continue. If not properly addressed, this demographic phenomenon will lead to social and economic problems, due to the associated high risk

of disability and morbidity and the need for medical services among the elderly.

In 1980 the United Nations defined 60 years as the age of transition to the elderly segment of the population [1]. This definition was adopted at the World Assembly on Aging convened by the United Nations in Vienna in 1982. Using this definition, it can be calculated that whereas the total world population is increasing at a rate of 1.7% per year, the elderly population is growing at an annual rate of 2.5% [2]. Further, it is estimated that most of this increase will come in developing countries, where the growth rate of the elderly segment of the population will be three times greater than that of the same segment in developed countries.

Ageing in developing countries

The 1989 WHO Expert Committee on the Health of the Elderly reported that by the year 2000, about 67% of the world's 600 million elderly people will be living in developing countries, compared with about 50% in 1960 [3]. A marked increase is anticipated in the elderly population of Asia, primarily as a result of the rapid increase foreseen in China and India. These two countries alone are projected to have about 270 million more elderly citizens by the year 2020, and it is expected that Indonesia will have 20 million more people over 60 years of age.

By the year 2000, it is estimated that there will be 41 million elderly people in Latin America and the Caribbean [2]. When these projections are extended to the year 2025, the size of the aged population in this region is expected to more than double, to about 93 million. In Brazil and Mexico the increases will amount to 20 and 10 million elderly people, respectively, by the year 2020.

The 1989 WHO Expert Committee also pointed out that the projected increases in elderly populations for the European countries are much smaller than those of some developing countries [3]. Thus,

Corazon Barba is affiliated with the Institute of Human Nutrition and Food in the University of the Philippines in Los Baños, and Lucila Rabuco is affiliated with the SEAMEO-TROPED Philippine National Center in the College of Public Health in the University of the Philippines in Manila.

these developing countries will gradually replace some European countries in the ranking of countries with the largest elderly populations. By the year 2020, Indonesia is projected to move to sixth place from tenth place in 1980, just behind Brazil, which had the eleventh place in 1980 but will have moved to fifth in the new millennium. By 2020 Mexico is expected to be in ninth place, ahead of three European countries: Italy, France, and the United Kingdom.

Demographic trends reflect dramatic increases not only in the proportions of older people in the total population but also in life expectancy. These trends will result in changes in the age structure of the workforce. In developing countries, the rates of participation of 60- to 64-year-old men in the workforce tend to be much higher than in industrialized countries [4]. Considering the physiological changes associated with age, it is imperative to study the problem of ageing and work capacity. In addition, many developing countries are experiencing the effects of rapid urbanization and modernization together with related socio-economic and cultural changes. In the migration from rural to urban areas, the elderly are often left behind, and if they move, the elderly are often more likely to encounter difficulties in adapting to the new conditions than their younger counterparts.

Urbanization in developing countries

Urbanization is a process of geographic concentration of the population, although the precise definition of "urban" varies within and among countries. Although the United Nations defines urban populations as "localities with 20,000 or more inhabitants," Gross and Monteiro [5] report that other factors, such as the level and type of economic activity, may be taken into consideration in classifying or defining urban areas. Nevertheless, it is apparent that the proportion of the world's largest cities located in developing countries is rapidly rising. In 1975, 10 of the largest metropolitan areas were in developing countries. In the 1980s, 22 of the 35 largest metropolitan areas, containing about 45% of the world's metropolitan population, were in developing countries. Moreover, it is estimated that by the year 2000, 25 of the largest urban populations, including Mexico City, São Paulo, and Shanghai, will be in developing countries [6].

The growth rates of urban populations vary across regions. Thus, in Africa, the world's most rapidly urbanizing region, the annual urban population growth rate reached as high as 5.5% during the period from 1985 to 1990. It is expected that this rate will decline slowly, but by 2025 it will still be around 3%. Alternatively, in Latin America, the average urban popu-

lation growth rate declined from 3.9% between 1970 and 1975 to 2.9% between 1985 and 1990; it may only be 1.45% by 2025. In 1990 Latin America was the most urbanized region in the developing world, with 72% of its people living in urban areas. For instance, one of the highest rates of urbanization in the world is found in Brazil, where more than 30 million people live in the three largest cities, São Paulo, Rio de Janeiro, and Belo Horizonte. These three cities are expected to have more than 50 million inhabitants by the year 2000 [7].

In Asia, the annual rate of urbanization was 3.1% during the period from 1985 to 1990. This rate is expected to decline to 2.2% during the period from 1995 to 2000 and 1.1% during the period from 2020 to 2025. However, three of the world's most populous countries—China, India, and Indonesia—are located in the region, and each has a sizeable urban population [6].

There are three main causes of the rise in urban population in developing countries: rapid overall population growth by natural increase, rural-to-urban migration, and reclassification of rural areas as urban areas [5]. Natural increase within urban areas, along with reclassification, accounts for an average of 61% of urban population growth in developing countries, and rural-to-urban migration accounts for the other 39%. However, regional differences in urban population growth exist. For example, in Latin America, where the urbanization level is already high, natural increase will likely dominate urban population growth [8]. In contrast, there is a high level of rural-to-urban migration, as well as a rapid urban growth rate in sub-Saharan Africa and parts of Asia.

With rapid urban expansion, pressure is exerted on housing, water and sewage facilities, transportation, and distribution of basic commodities. In addition, this creates health and nutrition problems, particularly among those who have recently migrated and are living in slums and shanty towns. In some cities, 30% to 80% of the urban population live under such conditions (table 1).

With the incidence of urban poverty still rising, malnutrition and disease are critical problems in poor urban communities. This particularly affects women, children, the elderly, the disabled, and industrial workers—the groups most vulnerable to health risks. The nutritional situation in some Asian cities was described during the First Asian Workshop on Nutrition in Metropolitan Areas in 1991 [10–15].

Ageing and urbanization: The case of the Philippines

Like many developing countries, the Philippines is experiencing both rapid urbanization and an increas-

TABLE 1. Proportion of urban populations living in slums in developing countries

Region and city	Year	City population (thousands)	Slum dwellers and squatters (thousands)	% of city population who were slum dwellers or squatters
Africa				
Addis Ababa	1981	2,000	948	47
Nairobi	1970	535	177	33
Dakar	1969	500	150	30
Latin America				
Bogota	1969	2,294	1,376	60
Lima	1970	2,877	1,148	40
Rio de Janeiro	1970	4,855	1,456	30
South Asia				
Calcutta	1971	8,000	5,328	67
Bombay	1971	6,000	2,475	41
Delhi	1970	3,877	1,400	36
East Asia				
Manila	1972	4,400	1,540	35
Jakarta	1972	4,576	1,190	26
Bangkok/Thonburi	1970	3,041	600	20

Source: ref. 9.

ing number of elderly people. The census projected the median age to increase to 19.5 years and life expectancy to increase to 63 years by the year 2000 [16]. About 2.2 million people (3% of the population) are over 65, and the United Nations Economic and Social Commission for Asia and the Pacific has projected that this number will increase to 2.8 million by the year 2000. As the elderly population increases, particularly in the urban poor sector, there are several implications in regard to the country's response to their needs. Paguio [17] has pointed out inadequate provisions for meeting the needs of the elderly, including inadequacies in health facilities, specialized training of health personnel to manage the sick elderly, geriatric clinics in urban centres, homes for the abandoned elderly, social security provisions, implementation of social regulations for the elderly, and recreational facilities.

Surveys have shown that the elderly in the Philippines are at risk for malnutrition and specific nutrient deficiency disorders. Nutritional anaemia was found in 25% of the elderly [18]. However, there is still a lack of comprehensive studies of the health and nutritional state and the quality of life of elderly people in the Philippines. The four-country study on ageing in Asia/Oceania, in which the Philippines par-

ticipated, underscored the need to emphasize policy and programme development that recognizes the positive characteristics of the ageing population—their physical and mental capabilities and their contribution to the family and community.

History of the Reconnaissance project and the development of CRONOS

Among the industrially developed countries, studies on the nutrition, diet, and health of older persons have been conducted in recent years in the Netherlands [19], the United States (Boston, Massachusetts) [20], and 12 countries of Europe [21]. Additional multicountry research that deals with industrialized, transitional, and deprived populations of the elderly was undertaken in the southern Pacific region [22] and is in progress [23]. However, there are still major descriptive gaps in our knowledge of the patterns of the dietary and nutrient intake and of the state of nutrition and health of the elderly in developing countries. In addition, the effects of urbanization and modernization in developing countries on the socio-economic and cultural life of the people, particularly the elderly, need to be studied.

Realizing the need to focus on the growing population of the elderly, and cognizant of the important role that nutrition plays in health and functional ability, representatives from five Asian countries (China, Indonesia, Malaysia, the Philippines, and Thailand) and three Latin American countries (Brazil, Guatemala, and Mexico), together with three European countries (Germany, Italy, and the Netherlands), decided to undertake a new cross-cultural research study of nutrition and the elderly. The aim of this multicentre, multicultural study was to describe the food habits and the health and nutritional status of the elderly as well as to generate and test hypotheses by examining the relationships between nutritional and non-nutritional variables.

The cross-cultural study was initiated and supported by the South-East Asian Ministries of Education Organization (SEAMEO) with the assistance of its four training centres in Tropical Medicine (TROPED). SEAMEO-TROPED receives technical and advisory support from the Ministry of Economic Cooperation of the Federal Republic of Germany through GTZ (Deutsche Gesellschaft für Technische Zusammenarbeit). The International Union of Nutritional Sciences (IUNS) extended technical assistance to the research, and financial support for the Reconnaissance phase of the study was provided by the European Community (EC).

Before conducting a full-scale cross-cultural study of nutrition and the elderly, the participating research centres decided to undertake a Reconnaissance study, an exploratory pilot survey for initial assessment of the specific nutritional situation of the population group living within a defined geographic area. In particular, this involved:

- » assessment of the overall conditions at the national, provincial, and district levels relevant to the nutritional situation of the elderly;
- » definition of the geographic location of the urban and rural study sites;
- » collection of preliminary information on the nature and importance of nutritional problems and their possible causes at the study sites;
- » acquisition of the opinion of the target groups on the type, scope, and importance of nutritional problems and their possible causes, and the supply of resources in their general surroundings;
- » construction of a causal model, built on the information obtained, to define important variables that might be included in the final research protocol;
- » exploration of nutritionally related norms and values in order to give research questions a substantive worth;
- » definition of anthropometric and biochemical measurement techniques and equipment.

To be able to carry out the Reconnaissance efficiently and effectively, a manual initially prepared in

Jakarta, Indonesia, by Rainer Gross and Asri Rasad was circulated to the associate proposers for comments and suggestions. The aims of the Reconnaissance manual, which outlined methods for obtaining information about the nutritional situation of the elderly, were as follows:

- » standardization of survey methods and techniques that would enable comparison of data and analyses between countries and projects;
- » presentation of a valid and reliable appraisal for the definition of a research protocol;
- » provision of a useful tool to ensure consistent reporting.

The manual described the core variables and the procedures necessary to achieve the objectives of the Reconnaissance. The exploratory study specified two levels of data collection: the use of the country's and the community's secondary/census data on demographic, socio-economic, environmental, and health statistics, food availability, food consumption, and nutritional status; and the collection of primary data from key informants and individual respondents. Primary data to be collected from the respondents consisted of:

- » data on socio-demographics and health, food behaviour, physical activities, and social behaviour, including memory tests;
- » anthropometric measurements;
- » blood pressure and haemoglobin determinations.

Collection of dietary intake data by the 24-hour food recall method was optional. The manual also detailed the preparation of forms, scheduling of data collection activities, data processing, and reporting of results.

Guided by the revised Reconnaissance manual for the Multicenter Study of Nutrition and the Elderly, which was distributed in November 1992, the participating East Asian and Latin American countries chose rural and urban communities (representative of low- and middle-income households) and collected data from randomly selected men and women from two age groups: elderly people aged 60 to 70 years and adults aged 35 to 40 years.

The workshop in Wageningen

Country experiences as a result of the Reconnaissance project were presented at the workshop of the SEAMEO/EC/IUNS Multicenter Study of Nutrition and the Elderly held on 15–19 March 1993 at the International Agricultural Center and the Wageningen Agricultural University at Wageningen, Netherlands. Findings of the semi-quantitative appraisal of the situation in the communities and of the quantitative measurements taken from a minimum of 24 respondents, according to a matrix of age, sex, economic

level, and geographic location, as specified in the Reconnaissance, were reported by the representative(s) of each participating country. Issues and concerns encountered during the Reconnaissance were discussed. Representatives from the IUNS [23] and the EURONUT-SENECA [21] studies and other interested observers from Costa Rica, Canada, and the World Health Organization (WHO) in Switzerland also shared their experiences.

The participants, facilitators, and observers were divided into five groups to review the variables and methods used to meet the specified objectives. Each group tackled a specific concern and reported their recommendations during the plenary session. The group leaders incorporated the suggestions emanating from the discussions and rendered group reports to the project coordinator, as described by Gross and Hage [24]. These were incorporated in the revised protocol and procedures manual to be used for the full studies.

During the workshop, the representatives from the eight countries signified their willingness and commitment to be part of the multicentre process and to proceed in carrying out a full study on the Nutritional and Food Security Situation of Rural and Urban Elderly from Selected East Asian and Latin American Developing Countries. The workshop was highlighted by the birth of CRONOS (Cross-Cultural Research on the Nutrition of Older Subjects).

The Reconnaissance and workshop provided each participant not only with additional knowledge of the nutritional situation of the elderly in eight developing countries, but, more importantly, with experience in the process of developing and organizing a multicentre, multicultural study. It is hoped that through this publication we can share with others the wealth of experience from the lessons learned in networking to address problems of nutrition and the elderly in the third world.

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Pitfalls and experiences in nutritional research on the elderly in developing countries

Noel W. Solomons

Abstract

Life expectancy is increasing in developing countries. Gerontology, the study of the biology of ageing, has had only limited application to third world populations. The published literature on ageing and the elderly in developing countries is generally sparse and primarily descriptive. Nutrition and diet, however, comprise an important fraction of the extant literature. Barriers to gerontological research in the third world include the traditional focus on maternal and child health, limited human and material resources, and methodological pitfalls inherent in the study of ageing. Additional pitfalls related to the ecological and genetic characteristics of pre-industrialized and transitional countries, per se, must also be recognized and avoided. This will allow gerontological research to flourish and create understanding of the problems of ageing in the third world.

Introduction

C. Gopalan, at the VI Asian Congress of Nutrition in 1991, emphasized the nutritional vulnerability of the elderly people of the third world and called for actions such as sustaining the productivity of the aged into the seventh and eight decades; giving special attention to elderly women, who might be marginalized or widowed; ensuring the micronutrient value of the diet in the context of a reduced total energy demand; encouraging extended family support in preference to collective care by the state; and encouraging the development of geriatrics (and by implication gerontology) as public health specialties [1].

Noel Solomons is affiliated with the Center for Studies of Sensory Impairment, Aging and Metabolism (CeSSIAM), the research branch for the National Committee for the Blind and Deaf of Guatemala, in Guatemala City, Guatemala.

The maximal life-span for the species *Homo sapiens* is estimated to be 120 years. It is unlikely that diet or nutrition can extend the range any more. It is important to realize that many elderly persons experience variable periods of chronic illness, invalidism, and dependence. This has both a social and an economic cost, in addition to affecting adversely the individual quality of life. This has led to a universal motto for applied gerontology: "Add life to years, rather than years to life." This concept is known, technically, as "compression of morbidity" [2] or the extension of the "health-span" [3]. It is thought that diet and nutrition can help to maintain function and avoid chronic disability.

Knowledge from research on ageing and the aged has the dual potential of advancing science and assisting in the formation of social and health-care policy. With respect to the former, the more durable, generalizable, and consistent an observation, the more likely that it is truly a generic feature of the ageing process itself [4]. On the other hand, Andrews [5] cites a number of ways in which gerontological research can and should contribute to policy development, such as developing a general profile of the elderly population, including its age composition, sex distribution, levels of education, residence, income, and general socio-economic conditions; describing the problems and needs of the target population, with emphasis on those that influence health status and general well-being; and obtaining feedback on the operation, quality, and impact of particular policies and programmes for the elderly segment of the population.

The convergence and confluence of country-specific and regional initiatives provided the motivation and momentum that has brought us through the pilot exercise of the project on the Nutritional and Food Security Situation of Rural and Urban Elderly from Selected East Asian and Latin American Developing Countries. This has led to a broader interest in the elderly population of the respective coun-

TABLE 1. Barriers to gerontological investigation in developing countries.

Demographic
The elderly are perceived as a small and unimportant segment of the population
Human resources
There is a lack of professionals trained in modern gerontology
Material resources
There are scarce funds and few specialized facilities for biological research
Methodological and disciplinary
The biology of ageing has conceptual and methodological pitfalls that must be recognized and addressed in gerontological research

tries represented by the CRONOS (Cross-Cultural Research on the Nutrition of Older Subjects) protocol.

What are the barriers to gerontological investigation in developing countries?

One would assume that if gerontological investigation were easy (or popular) in developing countries, it would be well established. The following survey of recent literature suggests that this type of research is rare. Hence, one is motivated to look for barriers. Table 1 lists some of the barriers, limitations, and issues that have hindered the development of gerontology in the third world.

What are the demographic issues?

A typical age pyramid for a developing country is characterized by a broad base and a rapidly narrowing point. This signifies that “new” members of the population (infants, toddlers, pre-schoolers, and children) constitute the largest single segment. The median age is often in the teens. From a public health point of view, the major constituency, numerically, is the young. Because of adverse sanitary conditions, infectious and parasitic diseases are rampant in tropical countries. They represent a major focus of medical (curative) and public health (preventive) attention, on the one hand, but they contribute to a cumulative early mortality that reduces the number of survivors to adulthood, on the other. Maternal and child health is the traditional watchword of the developing world.

The elderly will always be a small fraction of the population, especially one that is growing rapidly. However, the absolute numbers may be large. Five percent of 10 million is 500,000. To the extent that

health-care needs are greatest at both extremes of the life-span, it is necessary to factor into the equation the amount of suffering (pain and disability) and of medical expenses (for consultants and medications) to arrive at the weighted perspective of health problems.

Evolution of age pyramids

There is a gradual evolution both in the orientation of priorities and in the contour of age pyramids in the third world. In countries such as Chile and Cuba, more than 10% of the population is now over 65 years of age [6]. Most contemporary reviews are full of the demographic projections of the expansion of the older population for the year 2000 or the year 2020 in a global sense, a globe composed primarily of poor countries [7]. It is not so much the demographic facts, but the reflex pattern of attending to maternal and child health to the exclusion of other population groups, that needs to be addressed. Again, the convening of this meeting and the financial support from the European Economic Community testify to some recognition of the demographic imperatives.

What are the human resource limitations?

In developed and developing countries alike, there is a shortage of professionals to attend to the needs of the elderly. These needs include both care (geriatric medicine, dentistry, psychology, social work, etc.) and research (gerontology). Because of the slow-to-change patterns and poor incentives, the deficit is greatest where concern for ageing and the elderly is less prominent, i.e., in the third world.

Numerous training programmes based on the special biological characteristics of ageing (see below) have been developed in North America and Europe. Gerontology is inherently cross-disciplinary. Traditionally, the need for personnel has been addressed by inducing professionals to make a mid-career transition. In the area of health research, these professionals are most often physicians and research-trained public health specialists, although non-medical nutritionists and social scientists have made important contributions. However, in developing countries paediatricians often become the new gerontologists.

Language barriers often stand in the way of a third world student or professional who wishes to participate in a gerontology programme in an industrialized country. Moreover, the development of learning skills and study habits and training in the principles of biology and the scientific method may be deficient in the educational systems of developing

countries. Conversely, the focus of training centres in affluent countries on the model of ageing that applies in those countries may limit the applicability of this training to third world needs.

The evolution of training opportunities

Training programmes are improving for potential third world researchers in gerontology. The creation of networks of communication is one way to facilitate the process. The International Institute on Aging in Malta, affiliated with the United Nations, has taken the leadership in this international networking. It also is coordinating a modest training programme. For Latin America, there now exists a Latin American Committee (COMLAT) of the International Association of Gerontology, with headquarters in Belo Horizonte, Brazil. The COMLAT held a meeting in Spanish and Portuguese just before the XV International Gerontology Congress in Budapest in July 1993.

Indigenous development of gerontology research centres or of gerontology research within centres is a very common motif in the current evolution of the investigation of ageing in developing countries. It is a case of "learning by doing." Two cases in Central America can be cited. In Guatemala, the Center for Studies of Sensory Impairment, Aging and Metabolism (CeSSIAM) was born with "Aging" as its middle name. As the research branch of the National Committee for the Blind and Deaf of Guatemala, CeSSIAM has been involved with sensory deficits. Ocular and visual problems are most common in later life, and this was a firm justification for—and an incentive to—the development of research in the elderly. In Costa Rica, a country in transition, with improving life expectancy and the emergence of chronic diseases, demographic investigations of the elderly fortified the development, within the University of Costa Rica's Institute for Health Investigation (INISA), of the Programme for the Study of Aging (PROINVE).

It is important that this "home-grown" ageing research, however, be connected to the larger body of concepts and experience. Participation in international forums in overseas venues and the rigours of peer review of the publications are two ways in which indigenous developments of gerontology can be guided over the correct terrain. Third world countries have certain selective advantages in research. Malnutrition paradigms are widely familiar. Anthropometry is well known, and studies of body composition in the elderly can be conducted easily. The interest in juvenile micronutrient deficiencies can be readily converted to include the elderly. Both Guatemala and Costa Rica have followed these strategies.

What are the material resource limitations?

Part of the generic definition of a developing country is general poverty and maldistribution of wealth. The small amount of investment in academic facilities rarely takes gerontology into account. In developing countries gerontology has a very low priority compared with laboratories, computer facilities, survey resources, etc.

Development of research

Those who would do gerontology research in developing countries can take advantage of a common strategy for efficiency, the sharing of resources. Only a few approaches and techniques for epidemiological or clinical research are specific to a given age group. The same haematological tests serve in both children and adults. The basic biochemical laboratory, although primarily responsible for measuring albumin and retinol, can also be used to measure cholesterol, triglycerides, uric acid, and growth hormone, which are of concern in studies of the elderly.

Specific equipment needs do exist, however. The knee-height caliper [8], which makes measurements specific to the loss of height in the elderly, is inexpensive and readily accessible. On the other hand, dual-energy X-ray absorptometry (DXA) and computerized axial tomography (CAT scan) are becoming increasingly useful for defining not only the skeletal tissue but also the soft tissue in the body composition of adults. Huge investments of capital are needed to purchase DXA or CAT scan equipment, which may be beyond the reach of developing countries.

What are the methodological or disciplinary limitations?

Ageing biology is concerned with distinguishing true ageing from non-ageing. There are two theoretical debates raging in gerontology. The first is whether the ageing of cells, tissues, and organs is a genetically programmed event or the cumulative result of disease [9]. If one accepts that senescence is a process distinct from pathology, there are a host of theories as to its origins [10].

In observational and experimental gerontology, the study design must distinguish true ageing from non-ageing confounders. The ideal format is a longitudinal study design, but with human ageing from birth, the amount of time required is more than an investigator's professional lifetime. More often, inferences about ageing are drawn from cross-sectional comparisons of younger and older people.

TABLE 2. Sources of differences between young and old age groups

True ageing
<i>Intrinsic (genetic):</i> Metabolic cost of tissue repairs and mutation of cells with age
<i>Extrinsic (environmental):</i> Accumulated insults from illnesses and environmental mutagens
Non-ageing
<i>Selective survival:</i> Characteristics that determine whether individuals in a given cohort will die before a certain age
<i>Cohort effects and secular trends:</i> Exposure to various external insults that differ in exposure times and groups exposed
<i>Differential challenge:</i> The ways in which societies treat and the benefits they confer upon members of different age groups

Source: refs. 4 and 11.

Table 2 is modified [4] from an illustration in the WHO report *Health in the Elderly* [11]. True ageing can be the result of either intrinsic forces or common extrinsic forces. A common pitfall in drawing inferences from cross-sectional studies is confusing selective survival, secular trends, and differential treatment. Selective survival is non-random death due to the lower fitness of those members of a cohort who die in comparison with the fitness of those members who survive. One cannot select comparable populations of 40-year-olds and 80-year-olds, because it is impossible to know which of the 40-year-olds will survive for another four decades. Nevertheless, for asking questions about true ageing, this type of pairing across ages is implicit.

In addition, secular trends, that is, changes in exposure to the external environment or in lifestyle, from the formative years of one age group to the formative years of another, may distort the meaning of across-age comparisons. If 100% of a group of 80-year-old men have smoked for 30 years or more, and none of a group of 40-year-olds have smoked, differences between the groups in lung function may be attributed to more than just age effects. Finally, if society treats older people differently from younger ones by giving them a greater or lesser share of wealth, health care, food, etc., across-age differences may be the result of differential treatment or challenge and not just the ageing process.

Another practical issue relates to the distinction between chronological age (the number of years lived) and biological age (the degree of advancement of senescent processes). The former is generally easy to calculate; the latter is difficult both to define conceptually and to measure biologically in humans. There has been much recent discussion of proposed “biomarkers” of ageing [12, 13].

The heterogeneity of the population is another problem associated with the study of ageing in free-living individuals [14]. As one studies older populations, the variation between the two ends of the spectrum at a given age for any variable of interest will widen. For example, 25-year-old men have a relatively narrow distribution of pulmonary function, but among surviving 75-year-olds, one will find lung performances ranging from close to that of a 25-year-old man to severely deteriorated values.

The last methodological problem is the comparative interpretation of traditional measurements and indexes across ages. The classical case, and one that influences our present study, is anthropometry. Is the meaning of a skinfold the same with distensible aged skin as it is with taut young skin? Is the body mass index the same with the maximal stature as the denominator term as it is with a standing height compromised by curvature and compression? Is a limb circumference the same when fat is only in subcutaneous locations as it is when fat has infiltrated the bellies of the muscles? These are but a few of the ever-recurring questions about body measurements of the elderly and their interpretive and comparative meaning.

Specific pitfalls relevant to developing countries

Greater selective pressures may produce a greater degree of selection among survivors, and the harsh nutritional and microbial conditions of early life seven to eight decades ago—and throughout the years—in most developing countries have produced a much greater mortality of the original birth cohorts and a much harder survivor remnant. This makes selective mortality an even greater confounder of the interpretation of cross-sectional studies in third world than in first world countries. Paradoxically, however, this severe selective pressure may counter one of the other features of ageing populations, the greater heterogeneity alluded to above. It is worth testing data sets from elderly populations of developing countries to determine whether the distributions of variables may be narrower than those from industrialized countries with higher survival rates to any given age.

The extent to which overprotective attitudes from other generations within the family will impede the recruitment of older subjects into studies is unknown. It was our anecdotal experience in recruiting for a metabolic study in healthy elderly people [15] that persons who were living alone or as cogen-erational elderly couples were more likely to volunteer for the study than those living in multigenerational homes. In countries like Nepal, in which the

elderly are truly venerated and doted upon by their offspring, it is not clear whether investigators would be given easy access to the older subjects, or whether family protests would impede such studies.

The chronological versus biological ageing paradigm truly becomes important in the context of research in developing countries. First, it is widely believed that the error in classification by chronological age is greater where birth records are not available and self-reported age must be relied on. Also, there is the convention of calculating and reporting age. In China life begins at conception, so that Chinese are one year old when they are born. In Central America and Mexico, people report ordinal rather than cardinal years, so that a person in the 44th year of life, having completed 43 years, reports his or her age as 44. The larger issue, however, is that of age "comparability" across regions and ethnicities. If the extrinsic ageing processes differ from one area to another, would it not be reasonable to compare people who are "equally aged" rather than of "equal age"? Logically, this is the case, but "biomarkers" [12, 13] must be agreed upon before such a concept can be operationalized.

One of the rationales of multinational studies is to develop "universal" generalizations about ageing processes. When the focus of the study is a common problem of an industrialized country, such as fall-related hip fractures or Alzheimer's disease, which are of low prevalence in a given third world country, the advantages for knowledge can be great, i.e., the possibility of identifying the protective factors that may be prevalent in the latter. However, there may be some logistic disadvantages, such as finding enough cases to study in a case-control format.

Widespread illiteracy impedes the self-administered questionnaires that have become so important in studies of chronic diseases [16]. In Haiti and Guatemala more than half of the population is illiterate in the dominant language. For the literate elderly in developing countries, poor vision, uncorrected presbyopia, and poor comprehension limit the feasibility and reliability of self-administered instruments. Even where the older population can read and write, a telephone infrastructure to remind the participants to send in their questionnaires and to clarify problems often is lacking.

The evolution of knowledge and understanding of the elderly

It is only through critical reading of the scientific literature and exchange with colleagues from the leading centres of excellence in gerontology that disciplinary insights can be gained. The status of scientific and medical libraries is, if anything, deteriorating with rising subscription costs and shrinking

budgets. Electronic accessing of bibliographic citations can partially compensate in countries with e-mail access if the telephone costs can be covered. The Pan American Health Organization is experimenting with the distribution of microfilmed literature on ageing to fortify the bibliographic knowledge in Latin America. Textbooks of gerontology are becoming more widely distributed, ensuring the transfer of the latest knowledge of the biology of ageing to those who can afford them and are multilingual enough to read them. Currently, the third world has made the greatest gerontological progress in epidemiology, followed at a considerable distance by clinical and metabolic research, while research on ageing in animal and *in vitro* cell models and theoretical gerontology are virtually non-existent.

What is the present experience?

To assess the present experience, I have focused on three bodies of evidence: recent citations from *Index Medicus* of research on the elderly of developing countries outside Central America and Mexico; recent citations of abstracts and publications on gerontological and geriatric investigations from Central America and Mexico; and existing multicentre, transnational collaborative studies of the elderly in developing countries.

The first supplemental bibliography of this paper lists 51 publications that show the distribution of emphasis in research or policy publications related to the health of the elderly or the biology of ageing from developing and transitional countries around the world. They are quite diverse in flavour, from generic educational articles on specific diseases to nutritional surveys to socio-gerontology themes. There are many more offerings from transitional countries, such as China, Taiwan, Singapore, Malaysia, Hong Kong, Puerto Rico, Chile, and Brazil, or from disadvantaged populations within developed countries, such as Amerindians in the United States or blacks in South Africa, than from struggling countries, such as Nigeria or India. This could reflect the greater development of scientific publication in the more advanced emerging countries, the greater emphasis on the problems of ageing in these countries, or both.

Another supplemental bibliography lists 21 publications on gerontology or geriatric research from Mesoamerica. Some of these come from the Center for Studies of Sensory Impairment, Aging and Metabolism. One of the few metabolic studies in the elderly from developing countries was performed by our group to determine the true riboflavin requirements for the healthy elderly. As survey research uncovers heretofore poorly appreciated health and nutritional conditions, gerontologists in developing