Uses of anthropometry in the elderly in the field setting with notes on screening in developing countries

Noel W. Solomons MD, Manolo Mazariegos MD and Ivan Mendoza MD, MSC

Center for Studies of Sensory Impairment, Aging and Metabolism (CeSSIAM), research branch for the National Committee for the Blind and Deaf of Guatemala, Guatemala City.

A field setting can be defined as any setting outside of a fixed, permanent, and sophisticated health facility or research laboratory. The most important applications of anthropometry at field level include biological anthropology, epidemiology, clinical application, and metabolic research. Data collecting in the field setting requires different levels of accuracy and precision; the standardization should also consider intra- and inter-observer variability due to the possibility of more than one observer participating in a given survey. A field setting, in contrast to the laboratory setting, involves special conditions that challenge the application of anthropometry. The required equipment is different and the conditions of data collection are less rigorous. Issues intrinsic to the target group – of education, culture and sophistication – might be limiting factors for carrying out anthropometric surveys in field settings.

Another issue is related to interpretation of the biological, nutritional and health significance of anthropometric findings in relationship to the elderly. Uncertainty regarding the accuracy of chronological age, and geography and differential survival of the elderly should be considered when designing a survey. In addition, because the majority of the elderly now live in developing countries, short stature should be a common finding in the age groups from these regions. It is in these short-stature elderly populations, that there is a problem interpreting and applying anthropometric norms or reference limits or height or weight derived from elderly populations of developed countries.

In conclusion, although the application of anthropometry to the field setting is feasible, given its enormous importance to gerontological biology, nutrition and health, researchers should consider a series of factors and paradigms when designing and carrying out anthropometric surveys at the field level.

Introduction
What is a field setting?
International research has a romantic mystique about it, and the term ‘field setting’ conjures up images of Jane Goodall studying ape colonies, or some pit-helmet adorned archaeologist scraping dirt from an Egyptian burial site.

Field setting should be defined by exclusion, and includes, for us: 'Any setting outside of a fixed, permanent and sophisticated health facility or research laboratory'. In a US perspective, the entire operation of the National Health and Nutrition Examination Surveys (NHANES) studies based in mobile trailers is a valid example of a field setting.

Applications of anthropometry in the field setting
Given this broad and comprehensive definition of the field setting, a large number of applications are conceivable. Table 1 lists a series of field applications of anthropometry which could involve elderly populations.

Biological anthropology

The most creative and exploratory application of anthropometrics may be in the field of biological anthropo-

Table 1. Field applications of anthropometry involving elderly populations

<table>
<thead>
<tr>
<th>Biologicalanthropology</th>
<th>Healthepidemiology</th>
<th>Clinicalapplications</th>
</tr>
</thead>
<tbody>
<tr>
<td>- prevalence studies</td>
<td>- cross-sectional studies of associations</td>
<td>- geriatric practice</td>
</tr>
<tr>
<td>- longitudinal studies</td>
<td>- intervention studies</td>
<td>- disease research/clinical investigation</td>
</tr>
</tbody>
</table>
| - surveillance and monitoring of populations | - Metabolicresearch | - sociology. Since this discipline has traditionally used the dimensions of mineralized structures (bones, dentition) as the subjects of study in a living population, the strategy would be to try to compare measurements of comparative indicators of the living body with skeletal and fossilized skeletal specimens. To some extent.

Center for Studies of Sensory Impairment, Aging and Metabolism (CeSSIAM) research branch for the National Committee for the Blind and Deaf of Guatemala, Hospital de Ojos y Oidos Dr. Rodolfo Robles; V, Diagonal 21 y 19 Calle, Zona 11; Guatemala City, 01011, Guatemala. Fax: +502 2 733906
Metabolic research

Although metabolic research is conventionally thought of as the enterprise of a closed, isolated metabolic in-patient unit of studies in free-living subjects are quite common, and have even been successful in subjects of advanced age. One of the assumptions of metabolic studies is that weight and body composition are stable. Thus, unless the subjects come to a common center for interval weight-ins, outpatient metabolic studies in a dispersed population of elderly may differ in this respect.

Collecting anthropometric data in field settings in elderly populations

Accuracy and precision: their implications for field research

Accuracy is the ability of measurement, in this instance anthropometric, to obtain the precise answer with reference to a ‘gold standard’ arbitre: Precision is the degree to which a measurement reproduces a stable, consistent result. If one has a poorly-calibrated stadiometer, one will never get the correct measurement of height. On the other hand, one can have an imprecise measure, but, if one takes enough repeated measures, the average may produce the correct answer.

The relative magnitude of error in weight and height measurements must be placed in perspective. For biochemical clinical measurement, such as for blood glucose, errors of around 1% are considered acceptable. The true detection limits for height is on the order of 0.5cm or better. For a person of 150cm in height, this implies a tiny precision problem. The next order of differences is 100g which represents 0.14% of the weight of a 70kg person. Variation in weight due to stool in the ampulla, residual volumes in the bladder, etc. imply a biological variability of 500g, which is 0.7%. Both of the basic measures of anthropometry, in terms of their measurement limits and biological variability are intrinsically precise. The kind of changes that interest us in weight are generally of the order of one kg, that is, twice the margin. However, when height is associated with aging, a 0.5cm change would be of biological interest.

The margin between detectable difference and total length or thickness for circumstances and skinfolds is much smaller; thus, the kind of percentage changes detectable in height and weight are not available for the indicators of body composition.

For field studies (as distinct from the clinical setting), the implications of – and tolerance for – inaccuracy and imprecision are different. In the clinical setting, as reviewed, the focus is always on the individual. For diagnostic classification, accuracy for that patient is at a premium; for assessing response to therapy or disease, the magnitude of change is significant. In many applications in the field context, it is the population distribution – rather than the individual – that determines the quality of interest. In general, overall accuracy, is the correct answer for the mean and the extremes of the population is important and that there be no systematic error. For example, in studies dependent on field teams to provide data, the exercise of anthropometric measures and prevalence of abnormal conditions, the assessment can accept imprecision as long as its variability is balanced in both directions. Of course, sample-size considerations come into play. If underweight is of low prevalence in a population, a suitable number of subjects must be examined to produce a confident estimate.

Standardization of measurements under field conditions

When it comes to anthropometry in the clinic, the anthropologist needs instruction and training in making the measurements. In research programs and standardization of the measures for anthropometry, the principles of standardization and the procedures required have been laid out in a classical text. These principles and procedures are designed for measuring all age-groups, including the elderly.

The consistency of data is greatest when a single anthropometrist is involved and the observer variability is less than the inter-observer. In the field our data collection, in contrast, several anthropometricists will be involved, pooling data in common statistical descriptions and analyses. Often, these tests will be at different sites and in different countries. This presents a true challenge to the standardization process. Ideally, prior to the collection of data, and at intervals throughout that studies, anthropometric protocols should be brought together at one site for standardization exercises.

Because gravitational force is inversely proportional to the distance to the core of the earth, a sufficiently exposed subject in a field setting will experience a true difference in weight of an individual measured in Bolivia at sea-level in the Yungas Valley and at 4800 meters in the Potosi region of the Andes at the dispersed geographic sites. More importantly, on this ‘pear-shaped’ planet, would be the greater, fixed difference in gravity on earth weight and body mass across the globe, from the North Pole, Alaska and those in Quixo, Ecuador 80 km below the Equator. Comparisons of elderly Eskimos and Equatorians with the same body mass may not show them having the same body weight.

Feasibility and execution of measurements in elderly in field settings

The willingness of subjects to enrol in studies and comply with the requirements of a study is critical to anthropometry in the field. The elderly populations in a developing country have low levels of formal education. Moreover, adult offspring of rural elderly may not consent on behalf of their aged parents. Issues of pain, inconvenience and immobility are potential barriers to compliance with procedures or enrolment in studies. In the clinical setting, reviewed by Rosenthal and Rosenberg, in which the motives and motivation for contact with anthropometry come from either self-referral or professional referral, and the basis in the field is that of patient for therapy is much more conducive to compliance, even with unpleasant procedures. When the motive is one of scientific curiosity or public health, and the basis in the field is that of the investigator, the potential active is on the part of the investigator, while the potential barriers to compliance loom much larger.

Barriers to enrolment in the field setting ought to be familiar to investigators in studies in the elderly, compensatory maneuvers to obtain their anthropometric measures.

There are recognized pitfalls in obtaining anthropometric measurement in the elderly which have been reviewed by Rosenthal and Rosenberg. These include changes in elasticity and dexterity of skin, which affect the skinfold thickness with progressive compression calipers. Similarly, the looseness of skin and subcutaneous tissue distorts the point for applying tapes and calipers in measuring circumference and thicknesses. Because the potential for error in age may be considered in making stature measurements. Having the patient void before weight measurement is a prescription, but elderly enlargement may have significant and variable – residual volumes of urine in the bladder.

However, in the field setting, other issues of inaccuracy and imprecision come into play. Surfaces of floors or open ground in field settings may not be perfectly level. The consequences for posture and the difficulties for stature measurement are obvious, but uneven ground is also an issue in measuring weight in a population that might have stability problems when standing on the platform of a scale, even under the best circumstances.

Because gravitational force is inversely proportional to the distance to the core of the earth, a sufficiently exposed subject in a field setting will experience a true difference in weight of an individual measured in Bolivia at sea-level in the Yungas Valley and at 4800 meters in the Potosi region of the Andes at the dispersed geographic sites. More importantly, on this ‘pear-shaped’ planet, would be the greater, fixed difference in gravity on earth weight and body mass across the globe, from the North Pole, Alaska and those in Quixo, Ecuador 80 km below the Equator. Comparisons of elderly Eskimos and Equatorians with the same body mass may not show them having the same body weight.
imaging techniques such as radiology and axial tomography would provide the most precise measurements. Conventional physical measurements would also contribute. Specific physical measurements such as waist circumference, body mass index (BMI), and body fat percentage could be recorded and used to assess disease risk.

Health epidemiology
The most probable scenario for the application of anthropometry in the field setting, to the elderly or to any other age group, is that of epidemiology. At the level of descriptive studies, cross-sectional surveys of the prevalence of specific diagnostic conditions are the most common form. The primary calling of these surveys is to produce a representative report of the distribution of anthropometric measurement in a defined population, in order to provide, in the field setting, information for risk of obesity or chronic energy deficiency (as defined on adequacy of weight-for-height or body mass index [BMI]), one can map the prevalence of these over- and underweight conditions. 'Short-stature' prevalence is beyond another quality that has been of interest in population-based studies.

Beyond quantifying, is the relationship of nutritional status and body composition to health or to the influence of environmental factors (e.g., diet and behavior).

The next format would be cross-sectional anthropometry surveys combined with other variables from interview questionnaires, from clinical examination and/or laboratory testing, in which associations among variables are sought with regression analysis or contingency tables. Variables measured among various, however, tell us nothing about causality. To elucidate directionality to a significant association and to eliminate confounding, longitudinal observational studies or longitudinal studies with an intervention component are in order. If stature is the interesting variable such studies would have to be decades in length. Changes in weight, and lean and fat mass, can be observed over much shorter periods of time (months) in intervention studies.

From the point of view of public health, the ongoing surveillance and monitoring of normal and pathological populations of the elderly represents yet another option for the application of anthropometry in health epidemiology. Such surveillance is the paradigm in the risk of acute malnutrition, as with famine brought about by war, natural disaster or climatic shifts, and would likely embrace a cross-section of all the ages of population, not just the elderly.

Clinical applications
Geriatricians can be practised in the form of mobile campaigns. In India, for instance, mass cataract extractions are made in mobile tent camps which cross rural areas with high cataract prevalence. Cataracts are an infirmity of the elderly. At a minimum, the presedation work-up would involve the assessment of body weight.

Research into specific disease prevalence can be carried out in a field setting. A survey of osteoarthritis or rheumatoid arthritis prevalence or of the correlates of hyperension and/or hyperlipidemia and/or hypercholesterolemia and/or hyperglycemia and/or abnormalities of body weight measurements, respectively.

Metabolic research
Although metabolic research is conventionally thought of as the enterprise of a closed, isolated metabolic in-patient unit, studies in free-living subjects are quite common, and have even been successful in subjects of advanced age. Once of the assumptions of metabolic studies is that weight and body composition remain stable, thus, unless the subjects come to a common center for interval weight-ins, outpatient metabolic studies in a dispersed population of elderly may differ in this respect.

Collecting anthropometric data in field settings in elderly populations
Accuracy and precision: their implications for field research
Accuracy is the ability of measurement, in this instance anthropometric, to obtain the precise answer with reference to a 'gold standard' arbiter. Precision is the ability of a measure to reproduce a stable, consistent result. If one has a poorly-calibrated stadiometer, one will never get the correct measurement of height. On the other hand, one can have an imprecise measure, but, if one takes enough repeated measures, the average may produce the correct answer.

The relative magnitude of error in weight and height measurements must be placed in perspective. For biochemical clinical measurement, such as for blood glucose, errors of 3% or more can be considered unacceptable. The true detection limits for height is on the order of 0.5cm or better. For a person of 150cm in height, this represents an intrinsic precision of ±0.2cm (±0.13% variation). For scales in particular the calibration process must be repeated frequently. In field studies that involve dispersed populations, the equipment will be portable and moved from one place to another, or have to be transported over asphalt highways, dirt roads, on animals, or in backpacks on the shoulders of the anthropometrists. Movement provokes the decalcification of scales. The pressure exerted by the jaws of skinfold calipers is also a factor to be standardized and maintained constant over time.

Anthropometric performance in the field setting will likely be better for elderly population when the survey exclusively involves this age-group. This, however, is only occasionally the case. Because of the caveats already discussed, eg the duration of caliper compression, an anthropometrist who is not "specialized" in gerontological assessment will likely be less adept and consistent in the treatment of elderly subjects.

Geriatric concerns, which focus on the acutely or chronically ill hospitalized aged, or the polemical and sometimes frail elderly, are much less of a common concern. For the homebound and frail elderly, the overload of a professional concern in the field setting. Because of their reduced survival, any given cross-sectional sample (except for one or two elderly individuals) the burdens would constitute an insignificant fraction of the total population. Hence, in most field settings the elaboration concern is for compensating for the loss of limbs or the quality of life for those of minor relevance. From a logistical standpoint, it would make more practical sense to count the number of invalid and ultra-frail, bedridden subjects and project those figures to the field teams in the elaborate, compensatory maneuvers to obtain their anthropometric measures.

Specific pitfalls to field research
There are recognized pitfalls in obtaining anthropometric measures in the elderly which have been reviewed by Roseman and Rosenberg. These include changes in elasticity and distensibility of skin, which effect the skinfold thickness in a relationship with compression calipers. Similarly, the looseness of skin and subcutaneous tissue distorts the point for applying tapes and calipers in measuring circumference and thickness. These factors must be considered in making stature measurements. Having the patient void before weight measurement is a prescription, but elderly prostatism may have significant – and variable – residual volumes of urine in the bladder.

However, in the field setting, other issues of inaccuracy and imprecision come into play. Surfaces of floors or open ground in field situations may not be perfectly level. The consequences for posture and the accuracy of stature measurements are obvious, but uneven ground is also an issue in measuring weight in a population that might have stability problems when standing on the platform of a scale, even under the best circumstances.

Because gravitational force is inversely proportional to the distance to the core of the earth, a sensitive change in weight of an individual measures in Bolivia at sea-level in the Yungas Valley and at 4800 meters in the Potosi region demonstrates the accuracy of dispersed geographic sites. More importantly, this 'pear-shaped' planet, would be the greater, fixed difference in gravity with weight, weight taking place in Yellowknife, Alaska and those in Quino, Ecuador 80 km below the Equator. Comparisons of elderly Eskimos and Ecuadorians with the same body mass may not show them having the same body weight.

Feasibility and execution of measurements in elderly in field settings
The willingness of subjects to enrol in studies and comply with the requirements of a study is critical to anthropometry in the field. Elderly populations in a developing country have low levels of formal education. Moreover, adult offspring of rural elderly may present their aged parents. Issues of pain, inconvenience and immobility are potential barriers to compliance with procedures or with enrolment in studies. In the clinical setting, reviewed by Roseman and Rosenberg, in which the motives and motivation for contact with anthropometry come from either self-referral or professional referral, and in which the basis in health, and the medical/massaging therapy is much more conducive to compliance, even with unpleasant procedures. When the motive is one of scientific curiosity or public health, and the incentive is the potential for participating in a study, the compliance barriers to compliance seem much larger.

Barriers to enrolment in the field setting ought to be familiar to investigators and solutions in the elaborate, compensatory maneuvers to obtain their anthropometric measures.
Table 2. Variability of inter- and intra-individual weight on repeated measurement in Guatemalan elderly from a suburban area.

<table>
<thead>
<tr>
<th></th>
<th>Average weight (kg)</th>
<th>Average standard deviation (kg)</th>
<th>Correlation coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inter-individual parameters (n=29 subjects)</td>
<td>48</td>
<td>5.8</td>
<td>11.8</td>
</tr>
<tr>
<td>Intra-individual parameters (n=7 repetitions)</td>
<td>48</td>
<td>4.0</td>
<td>0.9</td>
</tr>
</tbody>
</table>

lows of 0.8% (call circumference) and 0.9% (weight), to
out 0.9%, and 0.7% for the bicipital and infants
skinfolds, respectively. None exceeded 10%. Intra-class
correlation coefficients ranged from 0.97 to 0.99. For the
intra-individual parameters, freezed in stable energy intake and expenditure, the means and
distributions of all seven anthropometric measures were
virtually stable over time. Although more instability
would have been expected if the anthropometrist had
gone house-to-house with the ephus, ours repre-
ents the kind of situation that would obtain in a rural
survey center. We can see that extraordinary repre-
ducibility of anthropometric measures is possible in
an older population. In fact, the observed precision is
such that the field conditions of this study go to give high
probabilities of a sensitivity in elderly in the
elderly that picks up small – but real – changes over
time with interventions or changing environmental, dietary or
health conditions in the population.

Constructing indicators and making diagnostic interpre-
tations of anthropometric data from field studies of the
elderly

Primary anthropometric measurements are just that:
messy and unethical unless they are used for diagnosis and classification. This
can be done (1) by comparing the measurement to a
normal distribution for each age group; or (2) by combining
measurements into indicators that pretend to reflect the
position of the body, e.g. the Quetelet body mass index
constructed from weight and height determinations, the
mid-arm muscle or fat areas determined from upper arm
circumference and triceps skinfold thickness; or (3)
through a combination of the two.

Weathers little yet what we can make an accurate, precise
and non-invasive anthropometric measurement, if its
interpretation is flawed. That would be a formula for
self-deception little chance to advance biological
understanding. The validity of a measure is its ability to
represent what we assume and interpret it to mean. That
is, validity refers to whether a diagnostic measure or a
compound index is a valid measure. As a face validity
interpretation, this retardation in stature in Third World
populations, relative to distributions such as the NCHS
used as standards, has been interpreted as evidence of
chronic undernutrition. What should the height be of adult populations in
developing country and why do they remain so short?

With regard to the former question some students of human
growth, such as Martorell, feel that all human
and childhood growth patterns are equally
and that nutritional insult is the cause of short
stature. Others argue that a more durable genetic component is involved in
the short stature in developing world. As to the mechanism (pathogenesis) of short
stature, we feel that the term `chronic' malnutrition poorly
applies, both as a definition and as a concept. Recent
work from a number of workers has shown that
most of the deficit in height is determined within the first 24 months
of life. That is, newborns in developing countries,
however, rapidly begin to decline with respect to the Z-scores of the
NCHS curve until the median can be at -2 Z-scores
by 18 to 24 months. Weight adequacy also declines but in
proportion to less than half that which is seen in
newborns for weight-for-height on the order of +0.5, it is
slightly overweight for their length.

A life-long pattern emerges. In early childhood,
the children cease losing ground to the reference
population curves and grow parallel to – but below –
the reference curves with no further decline in Z-score.
There is little trend toward recuperation of height
status; that is, there is no catch linear growth, but the
velocity of growth relative to the height is identical to that
of those in the 50th percentile of the reference popu-
lation. Rather than seeing these populations as chronic-
ally malnourished in an enduring process, we should see it
as an early phase of an exclusively dietary, as breast milk
is the major food during most of the stature-loss period, and
recurrent infections and continuous activation of the systemic
acute-phase response may be included in the complex
that leads to short stature.

There is a technical problem in simply transforming anthropometric data. A
methodological and ethical dilemma was pointed out in a classic article by Geissler
and Miller, who were interested in calculating weight-for-
height adequacy for short individuals. They observed that one extrapolated
upwards from children's weight-for-height relationships into the height ranges of
short adults, or if one extrapolated downwards from the
normal weight-for-height adults, the curves did not connect. They
performed a mathematical computerized 'smoothing' of the weight-for-height which
allowed one to determine an estimate of adequacy of
weight-for-height in short-statured adults. The Geissler
and Miller curve (1985) is 'unisexual' without differentiation
among genders. For Guatemalan elderly, to estimate the adequateness of weight
for-height in over 40% of the men and over half of the women, one is operating in the
smoothed portion of the Geissler-Miller curve.

Self-deception in all diagnostic and reference curves, however, raised for us a much more profound conceptual
issue with regard to the validity of the assumption of a linear proportion of weight to stature. Some
structures, compositional indices, and some genetic factors
related to stature, and seem to correspond more to a state of adult
maturity. Are there other organs or systems in human adults rather than one proportional to the frame? If so,
there would be a basic 'minimum package' of adult tissues and organs to be respected, no matter how short the frame.

part of the study team often inspires confidence in the community. Difficulties often occur in randomized studies in order to obtain valid samples. Then the sample is generated. It may be hard to explain to the community why one household's elderly are sought when another's is not. This is why the husband or in a couple is to be enrolled, and the spouse is not measured.

Often, if the level of invasiveness is minimum and the availability of personnel and time is ample, it is better to measure alterations in the age-group, and only use the pre-selected individuals' data in the analyses. Finally, ways in which the participants can realize some benefits from their participation in being measured in a field study should be considered in the planning and design.

Age and cultural tradition intersect to define adverse attudes towards anthropometric measurement pro-
cedures. Among the traditional, rural women in different dress: sarongs (Bali); kaftans (Morocco); saris (India); and cortes (Guatemala). Issues of modesty would need to be addressed, those of a same-sex anthropometrist from exposing enough bare skin to make reliable (standardized approach) measurement of suprailiac skinfolds, calf circumferences, or other hip and front circumferences. On the other hand, the other attitudes of cultural modesty might not allow testers to expose women in the latter three costumes in order to obtain access to the measurement sites. In the same vein, if subjects cannot be weighed nude or in a paper gown as recommended, an adjustment for the 'average' weight of clothing is applied, and at best reflects the magni-
tude of the adjustment is large, and individual-to-
individual variability in clothing weight is substantial. In these circumstances, a more accurate individual weight might be obtained by measuring the actual garments of each female subject.

To the extent that bioelectric impedance analysis (BIA) is measurement of body composition worthy of
consideration, connection to an electrical apparatus – no
matter how innocuous – may simply be unacceptable, especially to the elderly with more of a traditional
grounding in local superstitions.

How stable can anthropometric measures in the elderly be?

In Guatemala, we simulated a field setting, although this was not a mobile survey. In a congregate feeding center
conducted in a suburb of Antigua Guatemala in the interior of the Republic, 50 km from the capital city, we
conducted serial measurements of anthropometric indices on 29 occasions in 24 elderly subjects, all over
60 years of age. There were 15 women and 9 men. Subjects were measured by the same anthropometrist, one
of the co-authors (I.M.), over seven consecutive weeks, and each conformed to biological stability, as during this time the subjects were constant
physical activity patterns and consumed 2400 kcal of
energy. Seven common anthropometric measurements were
obtained (skinfolds: triceps, bicipital, subscapular, suprailiac
skinfolds; and mid-arm, mid-calf circumferences cm). As an example, the mean of serial measurements of weight are shown in Table 2.12

The coefficients of variation (relative standard
deviations) for within-individual measures ranged from

uses of anthropometry in the elderly

19

SOLOMINS, MAZARIEGOS AND MENDEZ

18
part of the study team often inspires confidence in the community. Difficulties often occur in randomized studies when the chief samples or random-number samples are generated. It may be hard to explain to the community why one household’s elders are sought while another’s are not, why the wife or the husband in a couple is to be enrolled, and the spouse is not measured. Often, if the level of invasiveness is minimum and the availability of personnel and time is ample, it is better to measure all members of the age-group, and only use the pre-selected individuals’ data in the analyses. Finally, ways in which the participants can realize some benefits from their participation in being measured in a field study should be considered in the planning and design.

Age and traditional culture interact to define adverse attitudes towards anthropometric measure- ment. Studies of the height, weight, and biological traits of traditional, rural women in different dress: sarongs (Bali); kafnius (Morocco); sari (India); and cortes (Guatemala). Issues of modesty would not normally permit a same-sex anthropologist from expressing enough bare skin to make reliable (standardized approach) measurement of subcutaneous skinfolds, calf circumference, or weight at hip, chest, and arm circumferences. On the other hand, what might be considered modesty might not allow testees to expose women in the latter three costumes in order to obtain access to the measurement sites. In the vein, if subjects cannot be weighed nude or in a paper gown as recommended, an adjustment for the ‘average’ weight of clothing is applied. The validity of the arm or chest and circumference of the adjustment is large, and individual- to-individual variability in clothing weight is substantial. In these circumstances, a more accurate individual weight might be obtained by measuring the actual garments of each female subject.

To the extent that biochemical impedance analysis (BIA) is a reflection of body composition worthy of consideration, connection to an electrical apparatus – no matter how innocuous – may simply be unacceptable, especially to the elderly with more of a traditional grounding in local superstitions.

How stable can anthropometric measures in the elderly be?

In Guatemala, we simulated a field setting, although this was not a mobile survey. In a congregate feeding center constructed in a suburb of Antigua Guatemala in the interior of the Republic, 50 km from the capital city, we conducted serial measurements of anthropometric indices on 29 occasions in 24 elderly subjects, all over 60 years of age. There were 9 women and 15 men. Subjects were measured by the same anthropometrist, one of the co-authors (I.M.), over seven consecutive weeks. Observations were conducted on a biological stability, as during this time the subjects were on constant physical activity patterns and consumed 3400 kcal of energy. Seven common anthropometric measurements were taken (in cm): triceps, subscapular, bicipital, tricipital, biacromial, and mid-calf circumferences (cm). As an example, the mean serial measurements of weight are shown in Table 2.13

The coefficients of variation (relative standard deviations) for within-individual measures ranged from Table 2. Variability of inter- and intra-individual weight on repeated measurement in Guatemalan elderly from a suburban area.

<table>
<thead>
<tr>
<th>Measurements</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Coefficient of variation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>5.6</td>
<td>11.8</td>
<td>20.8</td>
</tr>
<tr>
<td>Inter-individual</td>
<td>48</td>
<td>5.6</td>
<td>11.8</td>
</tr>
<tr>
<td>Intra-individual</td>
<td>48</td>
<td>4.0</td>
<td>9.4</td>
</tr>
</tbody>
</table>

The means and standard deviations of body mass index (BMI) (weight in kg divided by the square of the height in meters) were 26.6 ± 4.5 kg/m². The main body mass distribution is in the range of 15±5 kg. The variation coefficient of BMI is 17.2%.

When with regard to the former question some students of human growth, such as Martorell361 feel that all human beings have their own growth pattern, and that nutritional insult is the cause of short stature. Others argue that a more durable genetic component is involved in the short stature developing world. As to the mechanism (pathogenesis) of short stature, we feel that the term ‘chronic’ malnutrition poorly applies, both as a definition and as a concept. Recent work has indicated that about half of the deficit in height is determined within the first 24 months of life. That is, newborns in developing countries, housed, breastfed, and living, rapidly gain height to decline with respect to the Z-scores of the NCHS curve until the median can be at –2 Z-scores by 18 to 24 months. Weight adequacy also declines but in proportion to less weight and more fat in the infants and children Z-scores for weight-for-height on the order of +0.5, is slightly overweight for their length.

Growth failure is an important issue for child- hood, the children cease losing ground to the reference population curves and grow parallel to – but below – the lower percentiles with no further decline in Z-score. There is little tendency toward recuperation of height status; that is, there is no catch-up linear growth, but the velocity of growth relative to height is identical to that of the growth of the 50th percentile of the reference population. Rather than seeing these populations as chronically malnourished, the first thing we need to do is the term ‘obesity’ for the overnutrition of the body fat stores in the same way as the term ‘overnutrition’ is confined to the body mass in the reference curve.

There is another technical problem in simply transforming anthropometric data into two-dimensional graphs. It was pointed out in a classic article by Geisler and Miller,2 who were interested in calculating weight-for- height adequacy for short individuals. They observed that if one extrapolates upwards from the percent weight-for-height relationships into the height ranges of short adults, or if one extrapolated downwards from the normative ‘average’ adult weight-for-height curves did not connect. They performed a mathematical computerized ‘smoothing’ of the weight-for-height which allowed one to determine an estimation of adequacy of weight-for-height in short-statured adults. The Geisler and Miller curve (1985) is ‘unixes’ without differentiation across genders. For Guatemalan elderly, to estimate the approximate percentage of weight-for-height over half of the women, one is operating in the smoothed portion of the Geisler-Miller curve.

The interaction of short stature and the validity of anthropometric measures

As seen from the tables of Launer and Harris (1992)213, there is an overriding trend in the development countries South America and Africa: popu- lations tend to be short stature. Guatemalan rural males had a mean height of 155 cm whereas the women had a mean height of 154 cm. As a face validity of interpretation, this retardation in stature in Third World populations, relative to distributions such as the NCHS used as standards, has been interpreted as evidence of ‘chronic malnutrition’26.

What should the height of adult populations in developing country and why do they remain the same short?
UES OF ANTHROPOMETRIC IN THE ELDERLY

Research into the possible non-linearity of body mass and body composition with extreme variation in stature for a given age, or long ovulation.

The validity of many of our fundamental assumptions based on them are on NCISH-sized adult populations under 75 years of age, are called into question by the phenotypic, and that stature matter in their study they apply to the majority of countries in the Developing world.

In the Third World’s elderly, we have short stature in the first years. If the logical reasoning above suggests a non-linear paradigm of weight relationship to height, a specific focus on body composition in relation to stature needs to be pursued.

But, the shortness of elderly in developing countries has dual components. It can be attributed to the desiccation of the intervertebral, cartilaginous disks, considered a ‘senescent’ thickening, and vertebral body compression, a ‘pathological’ process of osteoporoic ‘fracturing’. Both processes can lead, moreover, to curvature of the thoracic spine: both scoliotic and kyphotic.

What these processes produce is an elderly person with standing height (stature), diminished with respect to the maximal adult height achieved in the second or third decade of life. The contribution of genetics, diet and environmental stresses shape a person’s stature attain- ment of X at an early age. What we measure in older age, however, is a stature of X-Y, with Y being the height lost due to senescent and osteoporo tic processes. A question with both philosophical and practical consequences in which X-Y is most relevant and appropriate to the biology and physiology of the elder person?

At DeSIAM, we have been working on a working speculation that X, or the maximal adult height, is the more appropriate. With analogy to a sausage casing being stretched by a traditional butcher: should be put any less meat in a casing that is curved that one that is perfectly straight? Most consumer-protection inspectors would consider such a practice to be short-weighting the customer’s waistline, and they would be right. Weighting older adults by referring their anthropometric indices to their current stature, rather than correcting back to their point of maximum standard.

Since long bones do not lose length with aging, several potential options are open to estimate back to an original adult height. Knee-height can be conveniently measured with a specifically devised caliper. This technique was originally described for the geriatric concerns of bedridden elderly. Could it be adapted, through a nomo- graphic regression, to predict young adult stature? In fact, work in Boston using the knee-height measurement as a free-standing index (Roubenoff: unpublished findings) shows its promise in making a non-square approximation of height than when the Chumlea formula, or any equation, is applied.

Another is another option that involves long bones. The use of this measure would inherently extrapolate back to young adult height, as shown by Dequeker et al. (1969). These Belgian physicians have confirmed an inverse relationship between stature and height growth, the height/CM ratio is 1.0 as a population average. They assert that the regression of height/span index over time gives a probable epidemiologic gauge of the burden of spinal osteoporosis. Belgian women lost 1.5 cm per decade from the industrial to the tenth decade. We find in Guatemala, a nation of short-statured people with pure or mixed Mayan descendency and exposed several of the putative protective factors against osteoporosis (eg low protein, high calcium diet), but still abnormally low vitamin D-forming sun exposure, high activity, weight- bearing on the axial skeleton, and increased weight- bearing on the pelvis. This may mean the absolute and relative of both men and women is virtually flat. It has been stated that restricted mobility of the shoulder or sternocavicu- lar joints may limit the ability of older – potentially arthritic – individuals to give appropriate maximal lateral extension of the arms for the armspan measurement. In both urban and rural Guatemalan populations, we have not encountered this problem. The life-style factors (above) may themselves facilitate the preservation of joint mobility, permitting accurate assessments of span in later years.

Finally, options for ‘correcting’ actual stature to reflect maximal stature in the elderly are potentially available in any of the imaging techniques from radiography to tomography to the more general tracer studies. A non-invasive way to determine the absolute and relative height in early adulthood from total body or segmental imaging should be explored.

Obviously, if one uses a ‘corrected’ stature, as a starting point, it will alter the magnitude of composite anthropometric indices. BMI, with its height-squared term in the denominator, will be reduced when span is added to the formula. The biological ‘proof of the pudding’ for the validity and utility of the alternative use of corrected – rather than actual – height will be based on the reason- ableness of its prediction of the distribution in elderly populations of such expressions as the body mass index, the Harris-Benedict equation of basal energy expendi- ture, or the formula for body fat estimation in the elderly using the approach of the AAO/WHO/UNU (1985) Expert Committee.

Interpreting the biological nutritional and health significance of anthropometric findings in relationship to the elderly

The foremost issue in interpreting the biological, nutritional and health significance of anthropometric findings in relationship to the elderly is to be firmly grounded in the fundamentals of aging biology. Recognizing the distinctions between aging and non-aging in the interpretation of data, specifically the biological underpinnings of the various anthropometric indices, and the challenge to conventional interpretations that can be raised by virtue of age or ethnocultural (above) must be considered. That’s only as strong as its weakest link. The link has never been the confidence interval in reference to a data-set from an older population in exploring aging biology.

Uncertainty regarding the accuracy of chronological age in All aging processes are predicated on a classification of chronological age. Eligibility to be classified as ‘elderly’ is based on a cut-off criterion: >60 years is the convention of the World Health Organization. Most studies subdivide the elderly into age-groups. In developed countries, this could be the ‘young old’, ‘old’, ‘old old’; in developing countries, this would be 60-70, 70-80, 80 or for the assigning of groups will result from inaccurate age data. Most crucial for the use of chronological age as those analyses in which regression analyses may be used against other measured, individual variables, eg age versus height/span ratio. A dramatic attenuation of association in regression analysis is introduced by classification errors. By poor estimates of age, accurate determination of chronological age is essential. The absolute arbiter of age is the birth record. In both developed countries, due to wars, and in developing countries, for a host of reasons, birth records may not be available. Under these circumstances, self-reported age must be used. In developing countries, a host of barriers to obtaining accurate age data are present. True, in illiterate, semi-literate, or illiterate, semi-literate, or illiterate, semi-literate, or illiterate, semi-literate, or illiterate, semi-literate, or illiterate, recording, birth records may have never been taken, or if taken, they could be registered in church ledgers which may not have withstood the strains of time. It has been observed that, in Guatemala, that mothers make up to one-year errors in reporting age of preschool children.

This can be exaggerated with the passage of years. In developed countries, complications in fertility and the free sale of the elderly. ‘Were you born before or after the outbreak of World War One?’. The response to this for any group of 75 year-olds, that males make up a 75 year cut-off point. For developing countries, such cata- strophic events may not be known to contemporary investigators. Political events are of marginal relevance for rural population; among the elderly women of San Pedro Ayampu, a rural community only 23km from Guatemala City, less than had half ever visited the capital. Here, natural disasters such as floods, earthquakes, volcanic eruptions, or epidemics can be used as reference dates even in illiterate, rural popula- tions to refine the accuracy of self-reported age. The largest change in chronological age assessment, applicable to comparative, cross-cultural aging studies, is the culture conventions for reporting age. The Chinese date life from the birth of the most recent population, which is when they are born. Central Americans report the age to be completed on their next birthday, in their ordinal year in life, rather than that of their birth. The same. Both of these conventions make the mean reported age of a Chinese or Central American population one year older than one computed from actual births.

Geography and differential survival of the elderly

Even when accuracy of age is assured, other issues of differential survival of populations are a major concern. A recognized, major confounder of aging research based on cross-sectional data is selective mortality (differential survival) of the populations of a given birth cohort. For comparative, cross-national studies, this differential survival raises another question: what is a comparable group of elderly in a country X, comparable in country Y, comparable in country Z? To date, most studies use chrono- logical age as the criterion, but often raise the ill-defined term of comparable populations. Multicenter study of the IUNS Committee on Ageing and Nutrition, the protocol called for enrolling study participants over 70 years of age. Among a settlement of Australian Aboriginals, only 10% were elderly who had survived seven decades. What is the aged population of these Aboriginals compared with other subs? One approach is to take a certain upper percent of the age pyramid, for instance, the elderly 65%. This suffers from the difficulty that mortality in the current youngest age-groups determines the size of whole population. A potentially valid critical examination of cross-comparison would be the same number of remaining years of life expectancy. This projection can be made with some representative longitudinal data. In any event, the current state of our knowledge, that differential life-long survival pressures is uncertain, and requires some creative exploration.

Remaining uncertainties and recommendations related to the use of anthropometry in the elderly in field setting

In both developed and developing countries, there has been little experience in the anthropometric study of the elderly in field settings. For instance, the ceiling age in the first two National Health and Nutrition Examination Survey (NHANES I) and NHANES II were subjects in the older bracket for nation-wide representative- ship for the US young-elderly population. The present NHANES III survey, currently underway, only expands the upper age range.

Worldwide, developing countries contain an increas- ing proportion of the elderly. There has not been a high priority for aging research in nations dominated by concern for maternal child health. The topic of anthro- pometric ‘screening’ of elderly populations in developing countries has been raised, and with it a series of barriers to the use of anthropometry to filter of a population to classify them into categories, and calculate the prevalence of ‘conditions’ of health or nutritional interest. The potential for and logistics of the field activities necessary for a survey of elderly in developing countries has been addressed. That cultural barriers to obtaining some measures exist, and the value of recalibrating equipment, has been emphasized. It is important to point out, however, that the traditional paradigm of the rural poor is giving way, through migration and urbanization, in all developing countries, to an urban poor. This offers advantages to the realization of data collection, but introduces addi- tional issues about the selective nature of the elderly population sampled.

The overriding anthropometric reality of the Third World is short-stature populations. Not the accuracy nor the prevalence, but the interpretation of anthropomet- ric measures and indicators is called into question when considering the interaction between the lower extreme of height and body mass and composition. Simple linear extrapolation from current industrialized
Research into the possible non-linearity of body mass and body composition with extreme variation in stature for the elderly, and in the long overdue. The validity of many of our fundamental assumptions based as they are on NCIS-sized adult populations under 75 years of age, are called into question by the phenotypic, and genetic diversities they apply to the majority of countries in the Developing world.

In the Third World's elderly, we have short popula- tional differences in the last few years. The log- ical reasoning (above) suggests a non-linear paradigm of weight relationship to height, a specific focus on body composition in relation to stature needs to be pursued. But, the shortness of elderly in developing countries has dual components. It can be attributed to the desiccation of the intervertebral, cartilaginous discs, considered a 'senescent' 'aging' and intervertebral body compression, a 'pathological process' of osteoporotic 'fracturing'. Both processes can lead, moreover, to curvatures of the thoracic spine: both scoliotic and kyphotic.

What these processes produce is an elderly person with standing height (stature), diminished with respect to the maximal adult height achieved in the second or third decade of life. The contribution of genes, diet and environmental stresses shape a person's stature atany point. What we measure in older age, however, is a stature of X-Y, with Y being the height lost due to senescent and osteoporotic processes. A question with both philosophical and practical consequences in: which one's height (X-Y) is most relevant and appropriate to the biology and physiology of the older person?

At DeSIAM, we have concluded on a working speculation that X, or the maximal adult height, is the more appropriate. With analogy to a sausage casing being stretched by a traditional method: should put any less meat in a casing that is curved that one that is perfectly straight? Most consumer-protection inspectors would consider such a practice to be short-weighting the customer, and they would have reason not to accept the earl by referring their anthropometric indices to their current stature, rather than correcting back to their point of maximum standard.

Since long bones do not lose length with aging, several potential options are open to estimate back to an original adult height. Knee-height can be conveniently measured with a specially designed caliper. This technique was originally described for the geriatric concerns of bedridden elderly. Could it be adapted, through a nomo- graphic method, to predict young adults? In fact, work in Boston using the knee-height measurement as a free-standing index (Roubenoff: unpublished findings) shows its promise in making an accurate prediction of body composition than when the Chumlea formula, or any equation, is applied.

Anthrop is another option that involves long bones. The use of this measure would inherently extrapolate back to young adult height, as shown by Dequeker et al. (1969). These Belgian physicians have confirmed an inverse correlation of knee-height growth, the height/span ratio is 1.0 as a population average. They assert that the regression of height/span index over time gives a probable epidemiologic gauge of the burden of spinal osteoporosis. Belgian women lost 1.5cm per decade from the age of 60 to the tenth decade. We find in Guatemala, a nation of short-statured people with pure or mixed Mayan descendency and exposed several of the putative protective factors against osteoporosis (eg low animal protein diet, abundant protein supply) that apply to the majority of countries in the Developing world.

Unercerainty regarding the accuracy of chronological age All aging processes are predicted on a classification of individuals. Eligibility to be classified as 'elderly' is based on a cut-off criterion: >60 years is the convention of the World Health Organization. Moreover, studies subdivide the elderly into age-groups. In developed countries, this could be the 'young old', 'old' and 'old old'; in developing countries, this would be 60—70 years, 70—75 years and 75—100 years (in height), the arbitrary assignment of groups will result from inaccurate data age. Most crucial for the use of chronological age are those analyses in which regression analysis is used against other measured, individual variables, eg age versus height/span ratio. A dramatic attenuation of association in regression analysis is induced by classification errors (Hodge et al. 1980). The more accurate data will not result in younger age. In developed countries, due to wars, and in developing countries, for a host of reasons, birth records may not be available. Under these circumstances, self-reported age must be used. In developing countries, a host of barriers to obtaining accurate age data are present. For illiterate, post-colonial societies, education, and birth registration, birth records may have never been taken, or if taken, they could be registered in church ledgers which may not have withstood the strains of time. It has been observed in Guatemala that mothers make up to one-year errors in reporting age of preschool children. This can be exaggerated with the passage of years. In historical research it is necessary to validate the self-reported age of the elderly. 'Were you born before or after the outbreak of World War One?'. The response to this for ages 60—70 years is not to be easily distinguished those around a 70—80 year cut-off point. For developing countries, such cata- strophic events may not be known to contemporary investigators. Political events are of marginal relevance for rural population; among the elderly women of San Pedro Ayampu, a rural community only 23km from Guatemala City, less than half had ever visited the capital (Diaz). Sometimes, natural disasters such as floods, earthquakes, volcanic erupptions, or epidemics can be used as reference dates even in illiterate, rural popu- lations to refine the accuracy of self-reported age. The data to be in chronological age assessment, applicable to comparative, cross-cultural aging studies, is the culture conventions for reporting age. The Chinese date life from the birth of Confucius; in the United States, they are born. Central Americans report the age to be completed on their next birthday, in their ordinal year in life, rather than that of their last birthday. In developing countries, both of these conventions make the mean reported age of a Chinese or Central American population one year older than one computed from actual birthdays.

Geography and differential survival of the elderly Even when accuracy of age is assured, other issues of differential survival must be considered. A recognized, major confounder of aging research based on cross-sectional data is selective mortality (differential survival) of the populations of a given birth cohort. For comparative, cross-national studies, this differential survival raises another question: what is a comparable 'control' age? For example, a country X, compare with in country Y? To date, most studies use chronolo- gical age as the criterion, but often raise the ill-defined term of comparable, multicenter sample of the INUS Committee on Ageing and Nutrition, the protocol called for enrolling 200 subjects over 70 years of age. Among a settlement of Australian Aborigines, only women who had survived seven decades. What is the aged population of these Aborigines compared with other sites?

One approach is to take a certain upper percentage of the age-pyramid, for instance, the oldest 20%. This suffers from the difficulty that mortality in the current youngest age-groups determines the size of whole population. A potentially valid criticism is that the cross-comparison would be the same number of remaining years of life-expectancy. This projection can be made with some representative longitudinal data. In any event, the current state of the art in group-wise, differential life-long survival pressures is uncertain, and requires some creative exploration.

Remaining uncertainties and recommendations related to the use of anthropometry in the elderly in field settings

In both developing and developed countries, there has been little experience in the anthropometric study of the elderly in field settings. For instance, the ceiling age in the first two National Health and Nutrition Examination Surveys (NHANES) was 70 years. Fewer than 7% of the subjects in the older bracket for nation-wide represent- ation for the US young-elderly population. The present NHANES III survey, currently under way, is designed to extend the upper range.

Worldwide, developing countries contain an increas- ing proportion of the elderly. There has not been a high priority for aging research in nations dominated by a concern for maternal child health. The topic of anthro- pometric 'screening' of elderly populations in developing countries has been raised, and with it a series of heretofore unmet problems: the filtering of a population to classify them into categories, and calculate the prevalence of conditions, health or nutritional interest. The process for and logistics of the field activities necessary for a survey of elderly in developing countries has been addressed. That cultural barriers to obtaining some measures exist, and the value of recalibrating equipment, has been emphasized. It is important to point out, however, that the traditional paradigm of the rural poor is giving way, through migration and urbanization, in developing countries, to a rural urban poor. This offers advantages to the realization of data collection, but introduces addi- tional issues about the selective nature of the elderly population sampled. The overriding anthropometric reality of the Third World is short-stature populations. Not the accuracy nor the precision, but the inherent interpretive framework of anthropometric measures and indicators is called into question when considering the interaction between the lower extreme of height and body mass and composition. Simple linear extrapolation from current industrialized
country reference populations is likely to be inappropriate. More to the point for creating reference populations of short stature, however is developing a fundamental understanding of the human biology and physiological imperatives of adult maturity with reduced height. Only then, can appropriate and valid classifications be developed, and only then does screening for deficits, excesses and imbalances of body composition have a legitimate basis. In the final analysis, this is more of a task for an emphasis on body composition relationships than on normative distribution. Our challenge in field anthropometry of the elderly is to refine the interpretation to physical measures in terms of fat mass, lean tissue, their distribution, their interrelationship, and their predictive significance for further function, good health and survival.

References

Uses of anthropometry in the elderly in the field setting
Noel W. Solomons, Manolo Mazariogar and Ivan Mendoza.

老者人體測量的應用
摘要
本文介紹了發展中國家老年人群的人體測量及一系列尚未解決的問題。本文並討論了發展中國家老人群體所需要的行動與措施, 作者試圖以實驗室的實證性和文化屏障考察測量數據的影響。第二部分聚集於身高, 體重和體組成是低年齡的相輝耀時, 對人體測量的尺度和指標的正確解釋出現了問題，但並非純粹的和精密的問題。而應該以身體小的人類群體建立一個基本和一致的身體組成的生物和生理指標。只有這樣，才能建立適當和有效的分級。有這樣，才能表達身體組成的不足，過多和不平衛的合理的理論基礎。

Un ambiente de investigacion a nivel de campo puede ser definido como cualquier ambiente fuera de las estructuras físicas fijas y permanentes de un laboratorio sofisticado de investigación. Las aplicaciones de la antropometría a nivel de campo incluyen antropología biológica, epidemiológica, clínica e investigación metabólica. La colecta de datos a nivel del campo requiere diferentes niveles de exactitud y precisión; la estandarización debe considerar la variabilidad intra e inter-observadores dada la posibilidad de que mas de un investigador pueda participar en el estudio. Un ambiente de campo, en oposición al de un laboratorio de investigación, representa un reto a la antropometría. El equipo requerido es diferente y las condiciones de la colecta de datos debería considerar una serie de factores que faciliten su interpretación, dado que la rigurosidad podría ser comprometida. Otros aspectos intrínsecos a la población de interés – bajo nivel de educación, asociado a factores culturales y poca sofisticación contemporánea –, podrían limitar la ejecución de encuestas antropométricas a nivel del campo.

Otro aspecto esta relacionado a la interpretación del significado biológico, nutricional y de salud de los hallazgos antropométricos. La incertidumbre con respecto a la edad cronológica, geografía y supervivencia diferencial del anciano, debe ser considerado al planificar y llevar a cabo estudios. Además, debido a que la mayoría de los ancianos viven actualmente en países en desarrollo, el hallazgo de baja estatura debería ser un hallazgo muy común en las poblaciones envejecidas de estas regiones. La baja estatura en poblaciones ancianas de países en desarrollo hace resaltar la limitación de aplicar normas o referencias antropométricas (de peso y talla), derivadas de poblaciones ancianas de países desarrollados.

En conclusión, aunque la aplicación de antropometría en el anciano a nivel de campo es factible, dada la enorme importancia a la biología geronológica, nutrición, y salud, los investigadores deben considerar una serie de factores y parámetros al diseñar y ejecutar encuestas antropométricas a nivel de campo, principalmente en países en desarrollo.
country reference populations is likely to be inappropriate. More to the point for creating reference popula-
ations of short stature, however, is developing a fundamental understanding of the human biology and
physiological imperatives of adult maturity with reduced height. Only then, can appropriate and valid classi-
fications be developed, and only then does screening for deficits, excesses and imbalances of body composition
have a legitimate role. In the final analysis, this is more of a task for an emphasis on body composition
relationships than on normative distribution. Our challenge in field anthropology of the elderly is to
refine the interpretation to physical measures in terms of fat mass, lean tissue, their distribution, their inter-
relationship, and their predictive significance for further function, good health and survival.

References
9 Geissler CA, Miller DS. Problems with the use of 'Weight for Height' tables. J Nutr 1985; 115:1546-9
11 King JE. Nutritional assessment of the elderly of San Pedro Ayampuc, Guatemala: Evaluation of anthropo-
17 Sun-Lai ML. Composition corporal en ancianos: Determina-
tion de agena total, grasa corporal total y masa magra de una poblacion entre 57 y 103 anos. Body composition in the elderly: Determination of total body water, body fat and lean body mass in a population between 57 and 103 years of age. Graduation thesis, Medical School, "San Carlos" University of Guatemala, 1987.

Uses of anthropometry in the elderly in the field setting
Noel W. Solomons, Manolo Mazariereg and Ivan Mendoza.

老年人體測量的應用
摘要
本文介紹了發展中國家老年人口的人體測量及一系列尚未解決的問題。本文並討論了發展中國家老年人測量所需要的基礎性措施，作者試圖再填補醫療的價值及文化屏障對測量數據的影響。第二世界人均身高減少，這是主要的人體測量數據。當發現身體組織低下時，體重和體組織成正

Un ambiente de investigación a nivel de campo puede ser definido como cualquier ambiente fuera de las estructuras físicas fijas y permanentes de un laboratorio sofisticado de investigación. Las aplicaciones de la antropometría a nivel de campo incluyen antropología biológica, epidemiológica, clínica e investigación metabólica. La colección de datos a nivel del campo requiere diferentes niveles de exactitud y precisión; la estandarización debe considerar la variabilidad intra e inter-observadores dada la posibilidad de que mas de un investigador pueda participar en el estudio. Un ambiente de campo, en oposición al de un laboratorio de investigación, representa un reto a la antropometría. El equipo requerido es diferente y las condiciones de la colección de datos debería considerar una serie de factores que faciliten su interpretación, dado que la rigurosidad podría ser comprometida. Otros aspectos intrínsecos a la población de interés – bajo nivel de educación, asociado a factores culturales y poca sofisticación contemporánea –, podrían limitar la ejecución de encuestas antropométricas a nivel del campo.

En conclusión, aunque la aplicación de antropometría al anciano a nivel de campo es factible, dada la enorme importancia a la biología gerontológica, nutrición, y salud, los investigadores deben considerar una serie de factores y parámetros al diseñar y ejecutar encuestas antropométricas a nivel de campo, principalmente en países en desarrollo.
Urinary sodium and potassium in a sample of healthy adults in Sydney, Australia

L. Notowidjojo* and A.S. Truswell

Human Nutrition Unit, University of Sydney, New South Wales 2006, Australia

Introduction

'Salt intake' is one of the dietary guidelines of the Australian federal Department of Health first published in 1979. The report of the National Health and Medical Research Council's (NH&MRC) working party on sodium in the Australian diet (1984) recommended that adult sodium intakes should be under 100 mmol/day with greater restrictions for individuals at risk; sodium intake above 100 mmol/day could increase the risk of hypertension. At about the same time the NH&MRC's working party on recommended dietary intakes published new recommended dietary intakes for sodium of 40 to 100 mmol/day for adults. The 2nd edition (1992) of the Australian dietary guidelines confirm the recommended upper limit of 100 mmol/day in adults and the guideline about lower salt intake has been moved up from eighth position to seventh.

However, a review of sodium intake data for Australian adults in the NH&MRC sodium working party (1984) report showed the average to be around 165 mmol/day. Bullock summarized these different studies in Australia, almost all based on 24-h urine sodium excretions between 1968 and 1980. The average sodium intake for adults in the different studies was between 130 and 200 mmol/day. Since then, there appears to have been no published studies of sodium excretion (reflecting intake) until recently, Beard et al. in Tasmania reported a small but presumably random sample of 22 men and 32 women: the mean 24-h urine sodium were 160 mmol for men and 124 mmol for women. These figures suggest some decrease may be occurring in sodium intake, since Bullock's review, but it is still well above the range recommended by NH&MRC.

Alongside the confirmation and strengthening of official advice to restrict sodium intake a considerable number of reduced and low salt products have appeared in Australian supermarkets in the late 80s and early 90s. The Better Health Commission set national targets for sodium intake of 130 mmol/day by 1995 and 100 mmol/day by the year 2000. The WHO study group and the US National Research Council's Committee on Nutrition and Health, both also advise that healthy adults should eat less than 100 mmol Na or 6.0 g NaCl per day. Thus, it was thought it was time to sample urinary sodium excretions in healthy residents in Sydney to see whether there has been any tendency to reduction in sodium intake from previous studies.

*Present address: Rumah Sakit Umum Ongkomsuyo, Palomak Barat VI, Jakarta Timur, Indonesia.
Correspondence address: Professor A.S. Truswell, Human Nutrition Unit, University of Sydney, New South Wales 2006, Australia.
Fax: +61 2 552 6535