# ASSESSING FOOD AND HEALTH RELATIONSHIPS

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### 29.1 INTRODUCTION

Foods are seen in an assortment of points of view among the disciplines of human biology. Food can be defined as those edible elements in the environment that a society includes in its diet. Not all items with potential nutritional value in an environment are consumed by the human inhabitants. Grubs and rodents are rejected in most Western societies, but they represent delicacies for the Orang Asli forest tribes of the Malay Peninsula. Certain pastoral peoples of East Africa would never eat fish or eels, whereas Europeans devour both these swimming creatures with relish. The *Food System* of a culture defines those items considered to be foods. This governs the universe of selection of edibles that are, in fact, eaten.

For the classical nutritionist, foods are seen as the source of fuel, of building blocks, and of metabolically-active or regulatory chemicals, known collectively as nutrients (Harper, 1990) [1]. They include the macronutrients (protein, fat, carbohydrates, dietary fibre, ethanol) and the micronutrients (vitamins, minerals). In this paradigm, a deficit of nutrients relative to their requirements produces undernutrition, whereas an excess of nutrients relative to their requirements produces overnutrition. Both of these practices can lead to ill-health, and even to death.

Implicitly, there is a band of nutritional status in which the required dietary intakes and body-store reserves are in the normative range, one that is considered to embrace adequate nutrition [2]. Although we recognise some genetic variation in the requirements for nutrients, i.e. how much must be consumed or how much must be retained in order to avoid one of the aforementioned extreme conditions, all persons would be seen as potentially susceptible to a deficiency state if the supply reached a certain critical low level, and all would be seen as potentially susceptible to adverse consequences to overload for those nutrients with recognised toxicity [2].

In recent years, the debate has been joined as to whether "adequate" nutrition implies "optimum" or "ideal" nutrition, and whether the "nutrients" in foods utilised in the context of their nutritional functions, are the only chemical constituents of foods - both nutritive and non-nutritive - are examined with respect to their protection of an individual from chronic, degenerative disease or their promotion of the expression of such pathology [3,4]. The noxious effects of sugars for dental enamel (cariogenesis) and of sodium for aggravation of essential hypertension have been long recognised. It was the advent of the study of "dietary fibre" [5,6] as a modifier of disease, however, that really gave impetus to the examination of relation of diet to chronic disease risk. The study of these relationships is now termed "Nutritional Epidemiology" [3].

Unlike the food-as-a-source-of-nutrient paradigm, genetic influences can be absolutely determinant in food: degenerative disease relationships (Childs & Simopolous, 1989) [7]. That is to say that certain individuals are so genetically susceptible to developing a pathological condition that no amount of overly abundant intake of - nor abstinence from - a given food or food constituent would change the outcome. For other people, their genes make them so resistant to a condition that no amount of dietary manipulation can either cause any harm or add any additional protection.

For the remainder of the population, however, the possibilities for expression of a given pathology during one's life-time can be modified by dietary factors and food constituents [3,4]. The methodology of nutritional epidemiology tries to measure the exposure (duration, intensity) to a given food, food constituent, or dietary pattern in relation to the occurrence, or not, of a given pathologic condition or health outcome. To date, it has been largely Western nations and their dietary habits that have been scrutinised for the chronic disease risk of specific dietary intakes and patterns of eating [3,4,8]. Table 29.1 summarises the three most important scenarios for the effect of diet on health.

| Table 29.1. Possible scenarios for the interaction of food and diet on health. | |
|---|---|
| **Dietary pattern & health status** | Selection of major food groups, frequency of meals, preparation style, similarity or deviance from the "traditional" diet. |
| **Dietary substances (presence) & health status** | Protective substance such as dietary fibre or carotene. |
| **Dietary substances (absence) & health status** | Noxious substances such as aluminium or saturated fats. |

Table 29.2 is meant to represent a non-comprehensive list of examples of the kinds of hypotheses about the promotion and prevention of chronic disease by diet that have received widespread speculation and investigative attention in recent years. Disease morbidity is not the only indicator in the definition of health. The Declaration of Alma-Ata states that health is not only the absence of disease, but also includes adequate function and a sense of well-being. Similarly, mortality is not the only outcome variable to be addressed by public health strategies for the ageing population. The motto, "add life to years" (rather than years to life), reflects the theoretical futility of extending the maximum human life-span beyond its "species-specific" 120 year duration, and the higher priority of decreasing disability and enhancing well-being during the later years of life.

| Table 29.2. A selection of "classical" health food, dietary substances relationships of epidemiological interest. |
|---|
| Saturated fats and cardiovascular disease (promoting) |
| Cholesterol and cardiovascular disease (preventive) |
| Alcohol in moderation and cardiovascular disease (preventive) |
| Complex carbohydrates and diabetes mellitus (preventive) |
| Sodium and essential hypertension (promoting) |
| Calcium and essential hypertension (preventive) |
| Saturated fat and colon cancer incidence (promoting) |
| Dietary fibre and colon cancer incidence (preventive) |
| Carotene-rich foods and colon cancer incidence (promoting) |
| Vitamin A and lung cancer incidence (preventive) |
| Carotene and lung cancer incidence (preventive) |
| Iron storage and total cancer incidence (promoting) |
| Selenium and breast cancer incidence (preventive) |
| Saturated fat and breast cancer incidence (promoting) |
| Alcohol and breast cancer incidence (promoting) |

Nitrosamines and gastric cancer incidence (promoting)
Vitamin C and gastric cancer incidence (preventive)
Folic acid and gynaecological cancers (preventive)
Aluminium and Alzheimer's disease incidence (promoting)

The notion of food: health relationship is obviously bidirectional in its nature. Its study could be restricted to the food and health direction, examining the issues outlined above, that is, of food's supporting adequate nutrition, its conditioning chronic disease occurrence, and its promoting functional capacity and general well-being; there is no reason, however, for the exclusivity of this unidirectional focus. The health and food relationship is also of interest, that is, how does one's state of health, infirmity, function, and well-being condition the diet that one consumes. The roles of satiety/ hunger and nausea and vomiting (physiology) and cultural beliefs about prescriptions and proscriptions in health and illness (anthropology) in shaping food selection and intake are also of intrinsic merit. But beyond the academic interest in this counter-direction in the relationship is the important consideration that, in cross-sectional studies, one is not able to separate and distinguish food: health relationships that are driven by a previous influence of food from those that are determined by prior health. In forming hypotheses and analysing data from transverse observational studies such as "Food Habits in Later Life", it is essential that the potential bidirectional nature of all associations be recognised and acknowledged.

Table 29.3 lists the hypotheses that were the guiding questions that motivated the execution and conditioned the design of the collaborative study by the IUNS Committee on Ageing and Nutrition. As you can see, hypothesis "d" does not consider this bidirectional possibility.

**Table 29.3. Original hypothesis of the "Food Habits in Later Life" multicentre study.**

a) Food habits are predictive of biological and chronological age.
b) Survival to old age is compatible with widely differing food habits.
c) Past and present food habits are predictive ofhealth status in later life.
d) Health status is predictive of food habits.
e) Non-nutritional variables are predictive of health outcomes and food habits in the elderly.
f) Migration has an adverse effect on health if traditional food practices are not kept intact.

We are provided in this volume with the preliminary tabular and descriptive results of a central multicentre study "Food Habits in Later Life", and with data of various methodological comparability - but with some methods such as, anthropometry and diet assessment, which appear to be homologous - from New Zealand, Australia, China and Europe. With this effort the job of learning from the experience has just begun. This paper focuses on the question of to what

extent, and to which of the defining paradigms of food: health relationships, do these data tables lend themselves. This is the next stage of evaluation.

## 29.2 TESTABLE HYPOTHESES IN FOOD: HEALTH RELATIONSHIPS

The European SENECA study has been laid out in a recent monograph of the descriptive findings [9]. It was similar to the IUNS multicentre study, and four of the sites are included in the present volume. With the publication of the present volume, the “Food Habits in Later Life” process is reaching a comparable descriptive analysis to its European counterpart [9]. In the concluding chapter of that monograph on "Summary and recommendations for future analysis", the Steering Committee of the SENECA project comments on further cross-sectional analysis:

The findings described so far will be used in further cross-sectional analyses on the role of differences in dietary habits and nutrition on health, taking into account living habits and life-style. Diet and nutritional status will be analysed further in relation to anthropometric and biochemical parameters, physical activity, living conditions and nutritional awareness. Due attention will also be given to the relation of health (including the use of medicines) and performance and nutritional status. Cluster analyses may reveal specific risk profiles affecting health and nutritional status, for instance atherogenic profiles, social factors, alcohol intake and (im)mobility. In part, it is the purpose of this paper to consider the constraints and possibilities, and to guide the design of more complex analyses in the area of food: health relationships. As discussed below, there are both conceptual and methodological constraints in this area; since we are dealing with cross-sectional data sets in both SENECA and “Food Habits in Later Life”, these constraints bear heavily on the options and the caveats and pitfalls must be respected.

## 29.3 CONCEPTUAL CONSTRAINTS

The degree to which exposures to food are a determinant of health outcomes is not exceptionally powerful [3]. Rather than expecting relative risks beyond 2.0 or 5.0, (i.e. that the exposed group had at least a two-fold greater or lesser affection than the unexposed), nutritional epidemiologists are satisfied to deal within the 1.2 to 0.8 relative-risk boundaries, which represent a 20% greater or lesser disease risk as a result of a given dietary pattern. Clearly, a 20% greater or lesser chance of contracting breast cancer is very significant given the prevalence of the condition.

However, the low order of relative risk modification ascribable to foods and diet illustrates to us two important features for the topic of food: health relationships. One is conceptual; the other is methodological. The obvious conceptual point is that factors other than foods, such as genetic, exposure to other environmental substances, life-style factors and age, can be much more powerful determinants of the emergence, or not, of a given disease or disability. Foods are of interest not so much for the strength of their influence on health outcomes, but rather for the potential to modify one's diet. Changing who one's parents and grandparents were is impossible; modifying some of the adverse consequences of the genes handed down is possible, at times,

however, by opting for a certain pattern of eating. Low-order associations between food and health have methodological implications, as the slightest measurement error can attenuate the association and make it impossible to identify in even a well designed epidemiological study. Comments on the nature of measurement error in relation to the "Food Habits in Later Life" study are extended later in this chapter.

## 29.4 METHODOLOGICAL CONSTRAINTS

The most logically obvious use of the data from a multicentre study is to apply analyses that look at international (transnational) variation in mean dietary intake or nutritional status in relation to across-nation variation in health statistics (incidence; prevalence), all towards the discovery or confirmation of associations between the two major classes of variables. This approach has been termed the "ecological approach" by Willett [3]. He defines and exemplifies its possibilities. When Armstrong and Doll [10] published a positive correlation between daily meat consumption in nations with incidence of colon cancer, or when Carroll [11] demonstrated a positive relation between average fat intake in a society with its breast cancer mortality, they were employing the ecological approach from cross-national studies. When sufficient variance exists in the distribution of dietary intake and health outcomes among different ethnic groups within a nation, one could use the central tendencies and ranges of the distinct subsectors of a nation in a manner analogous to the international approach of the aforementioned epidemiologists.

In Australia, for example, the “Food Habits in Later Life” experience has generated data on Aborigines, Greek migrants, and Anglo-Celts. Were it also to cover a comparable sample of Chinese, Serbian and Croatian elderly, for example, we would wind up with comparisons and contrasts among six ethnicities living on the same continent. The ecological approach uses data from cross-sectional studies. However, the utility and limitations of this approach to advance our epidemiological understanding of food: health relationships has been commented upon by Willett [3]:

The role of correlational studies in nutritional epidemiology is controversial. Clearly, these analyses have stimulated much of the current research on diet and cancer and in particular they have emphasised the major differences in cancer rates among countries. Traditionally, such studies have been considered the weakest form of evidence, primarily due to the potential for confounding by factors that are difficult to measure and control. On balance, ecological studies have been useful, but they are not sufficient to provide conclusions regarding the relationships between dietary factors and disease and may sometimes be completely misleading.

The strongest designs for evaluating health-diet relationships are case-control studies (comparisons of past diet [dietary exposure] between affected and unaffected) or prospective cohort studies (longitudinal follow-up of disease emergence in variation to usual diet). Controlled trials of supplementation or elimination of a dietary factor provide the strongest inference with respect to causality [3]. Given the nature of population-based, transverse,

point-in-time of the former, epidemiologically stronger and less confounded options are available in the data-base of "Food Habits in Later Life".

## 29.5 VARIABLES OF INTEREST IN RELATION TO CONCEPTUAL, METHODOLOGICAL AND LOGISTICAL CONSTRAINTS

Given the six countries (Australia, Sweden, Greece, China, Japan, Philippines) and eleven overall populations involved in the formal protocol, along with sources of the comparable questions form the Australia-New Zealand and SENECA studies, the cross-national consistency and validity of the variables become a point of central importance. We have stated that the first principles of nutritional epidemiology are with relation to the intrinsic determinant power of diet on health and the relative weakness of cross-sectional data and the derivative associations. It thus becomes important to assess the variables in the Food Habits study for their utility and contributions, while seeking other formats that might be even more valuable in future surveys.

## 29.6 THE STABILITY, STANDARDISATION AND VALIDITY OF THE VARIABLES

For any data-set that proposes to test hypotheses, the ruling in or out of an association among variables is the fundamental process. The stability and the standardisation of the measurements are the major determinants to the finding of any true association that might exist [12]. The issues of measurement error that impinge on research are precision and accuracy. To the extent that a measurement is repeatable by the same observer, and that the same answer is obtained in the same subjects on the replicate occasions defines its precision. We do not have estimates of precision for many of the variables in Food Habits of the Elderly, especially the interview variables. The consequence for seeking association with imprecise variables is most evident in looking for contrasts within a given region in which each individual's food pattern was correlated with a functional index.

Only if a stable measure of food pattern, one that reflects the long-term reality of that person, and an equally representative value for the function of interest are entered into the regression will any change or findings of the true association prevail. For some indices multiple measures are needed to achieve the needed stability [12]. Getting the correct answer - or at least to get an equivalently biased answer - across projects is the purview of standardisation. The instruction manual for the protocol of this project is very clear and well written. However, unlike other multinational projects, the investigators did not meet in one place for the standardising session. For anthropometric variables, this could mean that there is a systematic bias among centres. For a hypothesis trying to relate stature to a health outcome or dietary practice, if one centre overmeasured by 3 cm and another undermeasured by a similar amount, the population that was truly taller may appear shorter and vice versa. This would certainly attenuate the finding of an association with height. In a related manner, in the Food Habits study, some centres had the capacity to measure or to interpret their measurements in ways that other sites could not duplicate. The Swedish food composition tables provide data-bases for minerals like magnesium,

whereas in China, this nutrient cannot be estimated. To the extent that less than the full complement of study centres contribute the same datum, the ability to construct correlations and to seek associations is intrinsically reduced.

The cross-validity of the meaning of measures is also crucial. The validity of measurement is the extent to which the variable measures what we think it assesses or what we claim that it means. The number of microscopic grooves and actinic changes under a dissecting microscope [13] may be both a precisely and accurately measured index. Whether it is a valid index of ageing, per se, has not been established. But the validity of certain seemingly straightforward survey questions can also be poor. With respect to age, for instance, in China the chronological countdown begins at conception, whereas in Greece it begins at birth. The accuracy of the responses - with the distinct systems - may be perfect, but, by convention, a Chinese is one year older than a Greek of the same chronological age in *self-reported* age. This error is easily recognised and equally easily adjusted for mathematically.

## 29.7 FUNCTIONAL OUTCOME VARIABLES IN THE ELDERLY

In nutritional epidemiology, the questions go beyond the conventional paradigm of nutrients filling the nutrient pool and the tissue sites, to questions of food and health. If one reanalyses the possibilities, they resolve to three broad levels (Table 29.1). Nutritional epidemiology has, to date, been concerned with specific chronic disease diagnoses (myocardial infarction, breast cancer, benign prostatic hypertrophy, etc.) or metabolic conditions (hyperlipidaemia, glucose intolerance). However, all of the aforegoing issues are related to function as well. That is, one can be interested in:

1) dietary pattern and functional capacity;
2) presence of (protective) dietary substance and functional capacity; and
3) absence of (noxious) dietary substances and functional capacity.

The area of "functional capacity" of the elderly is nowhere nearly as well defined conceptually, nor as well validated in terms of measurement instruments, as the more medical paradigm of "chronic disease". It also has an inherent interaction with the issue of biological age. Since this field is in the exploratory phase of development, lessons can be learned from minute and detailed attention to some of the functional indicators in the "Food Habits in Later Life" protocol. These would include exercise and activities of daily living variables in the "Food Habits in Later Life" questionnaire. Concern for their cross-cultural validity, however, remains an unresolved issue.

## 29.8 FOOD PATTERNS AS FOOD HEALTH VARIABLES

The way we eat, and the way we select our food - rather than the chemicals that pass our lips - may be better correlates or predictors of health. As many alternative and creative options for classifying dietary patterns as can be conceived are welcome. In the present and future analyses

of the multicentre data from "Food Habits in Later Life". Table 29.4 lists a series of potential options and alternatives for viewing how the behaviour of eating - as distinct to the intake of nutrients - might interact with health and functional capacity.

**Table 29.4. Formats for examining the dietary intake variable in food health relationships that go beyond the paradigm of quantifying nutrients.**

- Frequency of meals throughout the day
- Portion-sizes served at meals
- Combinations of foods served together at meals
- Blended dishes (soups, casseroles) versus discrete items
- Physical state of foods (solid, semi-solid, beverage)
- Partition between cooked and uncooked foods
- Distribution of consumption from the traditional "four food groups"
- Partition of diet between "traditional" and "modern" items
- Simple diversity score (number of different items)
- Weighted diversity score (number of different items x frequency of their consumption)
- Computerised cluster or discriminant-function classification of subjects' dietary patterns

Some of these approaches are currently being used at some centres in the collaboration. Despite this first cut at creativity, however, the limitations of intra-subject stability still represent a constraint on our ability to uncover food-health relationships by associating the data within a given ethnic group. Moreover, the constraints of the across-nation ecological approach, both in its limited number of groups enrolled herein and in its intrinsic limitations (Willet, 1990), as well as our incipient understanding of how dietary patterns are combined to describe the "average" for an elderly group, will limit the use of the "Food Habits in Later Life" data-base to generate firm, universal conclusions. Getting a feeling for the creation and management of innovative variables in the area of food patterns, however, is a worthwhile objective at the present stage of the conceptual development.

## 29.9 PARADOXICAL RELATIONS BETWEEN DIET AND HEALTH IN THIRD WORLD SOCIETIES

If we examine Table 29.3, which presents the original panel of hypotheses that guided the "Food Habits in Later Life" project, we find two hypotheses of almost intuitive obviousness. These are: 1) "survival to old age is compatible with widely differing food habits"; and 2) "past and present food habits are predictive of health status". It is patently obvious that there are surviving old persons, at least a few, in almost every culture across the globe. The second hypothesis is the underpinning concept of nutritional epidemiology as we have defined it herein. However, as we

examine how the latter hypothesis actually might operate differentially between more economically advanced and less developed nations, we can isolate some paradoxical and counterintuitive possibilities that are worthy of bearing in mind.

It is conventional wisdom, that better food and better eating patterns throughout life will be conducive to better health and function in later life. However, in developing countries, in which selective pressures of survival condition the population that lives to advanced age, a probable paradox in the food: health relation must be openly addressed. This is the paradox that the *worse* the food or eating pattern, the healthier will be the elderly survivors. To better understand the logic of this paradox, we need examine, by analogy, a system of ecological stresses and strong survival pressures. Take the "law of the jungle", (or better stated, the law of the savannah), for example, in which lions are predators and zebras are prey. In any given moment of survey or census, the zebras in the herd represent the survivors of the pressures of accidents, disease, parasitism and predation. It is conventionally taught that the lionesses prey on the old, the young, and the infirm among the ungulates of the savannah, as these are the easiest prey to catch. Thus, the surviving zebras are the stronger, healthier or "fitter" (faster, more alert) animals, who do not fall into any of these categories. However, the larger and hungrier the lion population, the stronger, more alert, and healthier must be the zebras to survive. Thus, in the "natural" state, i.e. without the intervention of technology, the greater the adverse pressure, the better is the median status of the survivors.

In the perspective of food and health relationships in preindustrialised countries, and specifically in the peasant, tribal or pastoral communities, the quality and quantity of food can be seen as another environmental stress, ever poised to prune the weakest members of the society. Thus, exposed to what conventional wisdom would consider a "poor" diet, those who have a better genetic constitution would survive the adverse consequences better, thriftier than the less well suited. This would be the exercise of "natural selection" in which food would act as yet another (noxious) challenge factor to help weed out the less fit; one might therefore expect to find no evidence for a "healthier" (more "healthful") lifelong diet among the elderly survivors examined in a poor, developing country.

Technology, hence, becomes the key determinant in food: health relationships, and this means technology going back to the early life of the presently aged. Thus, in the more industrialised countries, technology - in the form of public health measures and medical sciences - could modify the relation of diet to health. The technology is going to pressure life in the genetically less fit. However, for the genetically weak to maintain not only life, but reasonable health and freedom from disease, the restorative or protective agency of a "healthier" diet must be exercised. In studies of advanced western societies, therefore, it is not unreasonable to plant the hypothesis of better diet and better health in the life experience of surviving elderly. The crucial question is whether this proposition, or that of "natural selection", is the more useful hypothesis to advance in the context of preindustrialised societies.

Another potential paradox relates to the suspicion that the maintenance of "traditional" dietary practices into older age will be more salutary than the adoption of more "modern" practices. It is well recognised that rural diets are generally higher in dietary fibre, complex carbohydrates, vegetable oils and lower in separated fats, sugars, sodium, meat. However, despite the exposure issues, observation may find an association of better health outcomes with elderly consuming a less traditional diet. What would mediate this apparently paradoxical finding would again be a type of selection process. The rural-to-urban migrants that are most "fit", or who are most aware of other health-protective practices, may be those who are more modern in their mode of adaptation. If those with better survival potential or better constitutional make-up are also those who respond to novel cultural influences through change - rather than resistance - then the maintenance of the traditional food selection and preparation practices of a nation may be a marker for those of less successful ageing. Such a mechanism would explain the counterintuitive finding of better health with a "less healthful" diet. What is needed is more empirical analysis of data to test the hypothesis about traditional diet: health outcome relationships.

## 29.10 NORMALISING FOR "BIOLOGICAL" AGE

The issue of chronological versus biological ageing is implied in the first hypothesis underpinning the study (Table 29.3). Persons of the same *chronological* longevity may not be comparable, and the inevitable selective mortality process with ageing of a cohort have raised questions about how to normalise or establish age-equivalent comparisons. In the Food Habits in Later Life, the "skin wrinkle index" [13] has been advanced as a biological marker of ageing, but its validity has yet to be established. Another approach would be to look at the age-pyramid and to select a certain "cap", such as the upper decile of population, from each of the comparative groups that are to be studied. In this situation, all people over 70 years of age might be the superior decile for Swedish, whereas all people over 45 years may be the top decile for Australian Aborigines. However, it is not only what is happening after age 40 that influences that shape of the age-pyramid, but also the forces that are characterising the width at the base.

In societies with high birth rates, the level of the upper decile is pushed ever higher, whereas an equally poor and underprivileged nation, but one with advanced population control programs, the upper decile would fall at a lower age. However, persons of the same chronological age may, in fact, be age-equivalent in these circumstances, since the forces for the contemporary distribution of population were put into play after the oldest cohorts had experienced their health-related exposures. Another possible normalising approach would take a perspective related more directly to the older segment of the population itself. In Costa Rica [14], from a longitudinal study, the expected survival curve for a given age, i.e. the number of expected years of remaining life, were computed. In a crude sense, one can derive projected survival curves from the peak of the age-pyramid itself. Thus, from country to country, one could compare age-cohorts with the median expectancy of additional years of life. For Thailand and France, for instance, women of Bangkok of 65 years may have a median remaining life expectancy of 10 years, whereas this might be shared by 73 year olds in Lyon. A first approximation on the

validity of this proposition can be made by age-specific comparisons in the data-base of "Food Habits in Later Life", coupled to the best projection for survival.

A corollary is of our present difficulty with defining "biological age". The most revealing answers to the issues of the process of ageing may come from the study of adult populations of relatively younger ages, such as the sixth and seventh decades in deference to the oldest old. The cross-national design, such as that of "Food Habits of the Elderly", takes its strength from juxtaposing differences in exposures, unique to a society, with difference in health outcome. When one gets to the highest echelons of age, one has the ultimate survivors of each society, the elite survivors. Cross-national comparisons among other elite sectors gives some instruction. For example, although the median standard of living might differ enormously between Monaco and Brazil, the super-elite (the rich and famous) of both nations may be comparable. Similarly, the average skills in soccer among schoolchildren are very different in Latin America as compared to USA and Canada, but the World Cup-level national teams of the North American elite soccer players can hold their own with their neighbours to the south. To bring the national differences into relief, one has to go to the more "typical" situation below the elite level. By analogy, transnational and cross-cultural co-operative ageing research should focus more on the ageing process in the earlier decades of adult maturity, i.e. before all of the "vulnerable" individuals have disappeared from the cohort leaving only the hardiest elite survivors. In summary, disadvantages of comparative studies of the very old may exist, insofar as any inter-subject and inter-society contrasts begin to meld and merge. It may be better to study persons who are still in the dynamic process of selection, and hence to concentrate on the seventh and eighth decades of life, we might even consider beginning transnational ageing studies with persons in their 40s and 50s.

## 27.11 PROJECTIONS TO FUTURE FOOD-HEALTH RESEARCH IN THE AGED

One of the assumptions or conditions that has been sought in the epidemiological ageing research on elderly diets and health has been a certain stability throughout the life-span. Given the events (wars, natural disasters, political changes) that have been part of the history of all regions, and given the march of "modernisation" and technological change - there are no groups that have been absolutely static over the past 70 years. However, geographic stability has been called for in some studies, notably the SENECA study, in which long-term or life-long residents of a specific township were to compose the sample. Even there, we have the operation of selectivity as, doubtlessly, other members of the cohort have migrated to other regions of the country or the world.

For the immediate future, especially in Africa and Asia, we are due to see a transition to urbanisation in which elderly residents of urban populations will more often than not have been born in the countryside. That is to say, that urban elderly populations will be composed more of migrants than of city-born persons. Migration is a paradigm of change in terms of exposures, habits, diet, values. The partition of one's seventy years between countryside and city will be of

importance. Among 70 year-olds, people who spent their first 10 years in a rural hamlet and their last 60 in a metropolis will not be the same elders who lived 60 years in the countryside and have moved with their adult children to the city in the past decade.

As has been emphasised throughout this book, selective survival is a major confounder in the design and interpretation of ageing research [15]. Changes in the influences on selective mortality must be monitored in the design and interpretation of diet and ageing studies. For industrialised nations, early life mortality was low even seven decades ago. In Europe, wars between 1914-1919 and 1938-1945 were major "pruners" of some of the ageing cohorts in adolescents and mid-life. Chronic diseases such as cardiovascular and neoplasic diseases would have been the sources of mortality in the fifth decade and beyond. In Third World, childhood infections and accidents would have produced selective loss of life in the early years. Obstetrical mortality in young adulthood would have trimmed the cohorts of female members. It is obvious that life-expectancy at birth is advancing in both developed and developing nations, although a differential still exists.

Mortality rates are traditionally greatest at the extremes of life, with several decades from late childhood to middle-age showing robust survival in all parts of the world. New health situations not seen until the recent years, however, may impact significantly on the selective mortality. Specifically, new epidemics portend an increase in mortality in the middle years of life, and their selective pressure will shape the composition of the cohorts that will survive into the seventh decade in the next millennium. The advent of the human immunodeficiency virus (HIV) and its lethal consequences, AIDS, and that of chemotherapy-resistant tuberculosis and advancing hepatitis B virus pose the threat of ravaging adults younger than 50 years. In both industrialised and pre-industrialised societies, people who would have been expected to survive into later life will now disappear. Those factors that confer susceptibility to the aforementioned lethal infections for adults will shape the selectivity of the survival patterns for the elderly of the early 21st century.

## 29.12 CONCLUSIONS

The "Food Habits in Later Life" project involves a creative, innovative, and pioneering effort at the design and co-ordination of multicentre collaborative research project which looks at ageing in populations (Australian Aborigines, Chinese) in which maternal child health has been the dominant theme, and in populations (Swedish, Greeks, Australian Anglo-Celts, Japanese) which have large aged populations. In the context of Greek-speaking populations in Spata and Melbourne, it was able to approach a focus on the dietary impact of migration. Opportunities to learn about ageing, and to learn how to study ageing abound in the data-bases, and in those of similar diet, health and ageing data-sets compiled from Europe, New Zealand and Adelaide in the present volume. An important alternative paradigm is firmly recognised and asserted in this study. The traditional view of food only as a source of nutrients for nutritional balance is broadened to look at ways of selecting food and eating as potential health-related variables.

The study confirmed its first hypothesis, the rather obvious one, that people can reach old age satisfying their dietary need with diversely different diets. So far, the description of this variation with intra-site tabulation of data, and some initial cross-tabulation is published in this volume. How the data can be mobilised for exploring some of the other original hypotheses is now a concern for the further, secondary analyses of the present data, and the incorporation of new data-sets that are being gathered in additional countries. Since we do not yet have a valid indicator of biological age, the conceptual distinction from chronological age - and the influences of diet - cannot be addressed. With a whole series of variables that may not have cross-cultural validity caution must be exercised in the pooling of data or the cross-nation comparison. The greatest limitations for a contribution to new conclusions about food: health relationships, however, are the intrinsic problems related to cross-sectional surveys and the attenuation and confounding of associations between diet and health outcomes [3]. These pitfalls apply here as they do in any such transverse epidemiological study.

Having recognised these limitations, the recommendation would be to use the findings to generate new hypotheses that might be placed into prospective or case-control formats to provide more robust conclusions. At the same time, we can take maximal advantage of the data to assess new approaches to analyse food behaviour findings across countries. We can also focus on the subsets of questions and their chronological age-groups that appear to provide the greatest differentiation among populations. These hypotheses on food: health relations were gathered from various sources. If the hypothesis is that higher intake will be associated with decreased incidence, the term "preventive" has been ascribed to the dietary factor; if the hypothesis is that higher intake will be associated with increase incidence, the term "promoting" has been assigned.

## 29.13 SUMMARY

- This chapter addresses:
  a) the limitations of the IUNS data base with respect to the study of food: health relationships
  b) the design of future complex statistical analyses for the study of such relationships.

- In cross-sectional studies, such as the IUNS study, one is not able to separate and distinguish food: health relationships that are driven by a previous influence of food from those that are determined by prior health. It is essential that the potential bi-directional nature of all associations be recognised and acknowledged.

- Low-order associations between food and health have methodological implications, as the slightest measurement error can attenuate the association and make it impossible to identify in even a well designed epidemiological study.

- Some of the limitations of the IUNS data base are as follows:
  a) the investigators could not meet in one place for the standardising session
  b) some centres had the capacity to measure or to interpret their measurements in ways that other sites could not duplicate
  c) estimates of precision and cross-cultural validity for many of the interview variables, were not available.

- Given the methodological limitations of the IUNS data set, the ability to construct correlations and to seek associations is intrinsically reduced. This will limit the use of the data-base to generate firm, universal conclusions in future analyses. However, the value of the data set as 'hypothesis generating' and its contribution to the 'description' of elderly people should not be underestimated.

- When interpreting food: health relationships, the following paradoxes can exist:
  a) The worse the food or eating pattern, the healthier will be the elderly survivors. In developing countries selective pressures of survival, condition the population that lives to advanced age. For example, those who have a better genetic constitution would survive exposure to a "poor" diet better, than the less well suited.

     In developed countries, technology can pressure life in the genetically weak to maintain not only life, but reasonable health and freedom from disease, by exercising the restorative or protective agency of a "healthier" diet.

  b) "Traditional" dietary practices into older age may result in worse health than the adoption of more "modern" practices. If those with better survival potential or better constitutional make-up are also those who respond to novel cultural influences through change, rather than resistance, then the maintenance of the

traditional food selection and preparation practices of a nation may be a marker for those of less successful ageing.

- Cross-cultural co-operative ageing research should focus more on the ageing process in the earlier decades of adult maturity, i.e. before all of the "vulnerable" individuals have disappeared from the cohort leaving only the hardiest elite survivors.

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**CHAPTER 29**

**ASSESSING FOOD AND HEALTH RELATIONSHIPS**