Nutrition and Health Perspectives on Establishing a Food Security Research Agenda: What Can We Learn From the Past to Establish a Framework For the Future?

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Introduction

This paper reviews some advances in the state of our knowledge regarding nutrition and health over the past few decades. It briefly reviews some relevant advances in thinking about food security from a nutritional perspective, and summarizes several developments that are favorable for future progress. Finally, some suggestions for future research on food security are provided.

Historical Background

Recent Advances in Medicine, Health, and Public Health

Appendix 1 (at the end of this paper) presents some recent advances in medicine, health, and public health that have occurred since 1950. These changes have been key influences on the development of nutrition science, which is a biological as well as social science. The application of medical and public health measures has led to continuing improvement in the health and longevity of the American population in many respects over the past few decades. This very success has, however, led to many new challenges.

Advances in our understanding of growth and development, aging, and the etiology and pathogenesis of diet-related diseases and conditions have been enormous (Pollitt, 1994, and accompanying articles). These have done much to clarify the role of nutrition and other environmental factors in disease causation. Moreover, further advances can be expected. While understanding of the human genome is still in its infancy, the stage is set for enhanced understanding of how genetic and environmental factors may interact to enhance or decrease nutritional vulnerability of some individuals. At the same time, changes in health care financing and the health care industry, coupled with a growing proportion of the gross domestic product being devoted to health related expenditures, have put even greater pressure on the health care community to achieve economies in health services delivery (Angell, 1999).

Recent Advances in Nutrition Knowledge

Taking a very long-term perspective, historians trace the modern decline in mortality rates and increases in body size, which began in the 1700s, not only to advances in medicine but to increases in the food supply and other factors in the environment. Vogel and colleagues have coined the phrase “technico-physio” revolution to describe the synergy between technological and physiological improvements in the past few centuries that has produced a form of human evolution that is biological but not genetic; rapid, culturally transmitted changes that are not necessarily stable.

Developments over the last few decades in the nutrition and health sciences have greatly expanded our understanding of the associations between nutrition and health, and have provided the basis for further improvements. These are summarized in appendix 2.

Advances in Understanding by Nutritionists of the Concept of Food Security

Nutrition is a biological science that focuses on improvement of the human condition. Therefore,

nutritionists seek the psychological, social, and economic, as well as the biological determinants of malnutrition; and ways to measure them and to alter them to improve human health and well-being.

Nutritionists have attempted to develop indices of basic nutritional needs that could be used for assessing and assuring the adequacy of diets of individuals, households, and groups within the population for nearly two centuries. The lack of sufficient food or the risk of it, owing to insufficient money to buy food, was recognized early as a major determinant of malnutrition. Appendix 3 provides some historical perspectives on nutritionists' attempts to quantify and describe food insecurity over the past century.

Until the 20th century, so little was known about the nutrients in foods that such efforts focused on amounts of food and food patterns or diets known to be associated with good health and those associated with poor health. In the mid-20th century, as knowledge and quantification of nutrient needs became more secure, efforts turned to building diets from "scratch." These efforts sought to develop descriptions of the nutrient needs of groups that could be used as templates for dietary planning, and an absolute biological floor below which one could not fall and expect to remain healthy.

At the same time, it was recognized that people ate foods, not nutrients, and that if attention were not paid to factors other than nutritional adequacy, diets planned solely on the basis of fulfilling nutrient needs might be socially or culturally unacceptable. Moreover, planners who controlled resources necessary to ensure nutritional adequacy for the population often thought in terms of foods and costs, so that recommendations, while based on nutrients, ultimately had no utility until translated into recommendations for nutritionally adequate food-based dietary patterns.

One common problem that arose was that when nutritional recommendations were for dietary patterns requiring resources in excess of those deemed appropriate for basic needs, nutritionists often found their recommendations rejected or ignored (Mayer, 1969 and 1973). However, occasionally decisionmakers took their advice. Perhaps the most notable example in the 20th century was the adoption of the Recommended Dietary Allowances in this country during World War II as a basis for planning food supplies for the war effort, and the development of food rationing schemes to implement them.

Another problem was to find generally agreed upon ways to connect biological needs for nutrients with economic and social policy indicators. Until the 1980s, progress was inhibited by lack of valid, reliable measures of food security and hunger (Andrews et al., 1998).

The Situation Today

There are many reasons for optimism about the development of a broader view of nutritional status and its many contributions to sound health today.

More Adequate Science Base

The state of science in the relevant fields is sufficient to support valid and reliable indicators of food security and hunger, and to relate these to biological realities. Nutrition scientists with a biological focus, and their more social science-oriented colleagues, respect each others' perspectives and work. Both understand the need for early-warning measures of nutritional risk, and how these may be used in policy and program development to increase returns on critical private and public human capital investments (Anderson, 1990; and Thompson and Byers, 1994).

Holistic Conceptual Frameworks Relating Food Security and Hunger to Nutritional and Health Status are Being Developed and Accepted by the Scientific Research Community

Acceptable unifying conceptual frameworks that link economic and social realities to health and disease are available. The holistic picture of

nutritional needs that unites psychological/social with biological is also being accepted. The concept of food security is gaining increased respect among biomedical scientists, as are quality of life measures and other outcome measures in the health field. Economists and other social scientists are becoming increasingly aware that dietary intakes alone, without other information about the health status of groups, is insufficient. Multidisciplinary teams are working together more productively than ever before to synthesize relevant knowledge from their respective fields, develop and validate standardized indicators of food security, and link them to health and disease (Frank, 1997; and Kleinman et al., 1998).

Metrics are Available

Now that there are ways to describe and quantify some forms of food insecurity, the problem can be presented in ways that social and biological scientists, as well as policymakers and the public, understand and find useful. These conceptual frameworks also provide a platform for expanding the concept to include other specific forms of food insecurity, such as those often faced by the frail and chronically ill.

Specialized Tools for Target Groups at Special Risk are Being Developed

Specialized food-security measurement tools are being developed for the elderly and children. However, special tools are not yet available for other at-risk groups whose food insecurity has special dimensions not tapped by existing measures. Other groups that may need modified food security measures include non-English-speaking persons, especially recent immigrants, and groups with other special problems or characteristics. For example, children and adults with special developmental and health needs often have unique problems that require specialized tools for measuring the reality of the food insecurity they experience.

The frail and ill also have special characteristics that may call for special food security measurement tools, as do castaway teenagers, current and former welfare recipients, the mentally ill and developmentally delayed living on their own, the homeless, and others with double and triple social or medical disadvantages. There is, therefore, a need for expansion of research to adapt the new measures of food security and hunger to make them more appropriate to these special groups.

National Estimates of Food Insecurity and Hunger Prevalence are Beginning to be Available

Large-scale population-based surveys are also increasingly available. These provide some estimates of the magnitude and severity of food insecurity and hunger problems, and identify groups within society most at risk. Presently, there is also a small but growing literature examining variation in food and nutrient intakes across food sufficiency categories based on the U.S. Department of Agriculture's food sufficiency questions. Food sufficiency status prevalence estimates are available from responses on the Third National Health and Nutrition Examination Survey (NHANES III) interview protocols (based on prevalence of “sometimes or often not enough food”), as well as earlier implementations of the Continuing Survey of Food Intakes by Individuals (CSFII) and Nationwide Food Consumption Survey (NFCS) (Alaimo et al., 1998; Basiotis et al., 1992; Cristofar and Basiotis, 1992; and Rose and Oliveira, 1997). These provide a basis for connecting food security status to nutrient intakes, and health outcome measures of the type available in the NHANES. The NHANES/CSFII combined survey should provide further impetus for such efforts, and enable additional advances in clarifying the nutritional and health correlates of food security status.

State and Local Estimates of Food Insecurity are Being Implemented

Health care and welfare reform are progressing at different rates and taking various forms in the several States. As programs and support levels become more heterogeneous at the State and local levels, there also may be greater heterogeneity in food security, and thus greater need for

standardized and well-validated food security and hunger measures at these levels.

Food security measures are being used to provide additional data in some States and localities that can inform changes in social policies (Kasper et al., 1999; True, 1998; Hunger Action Task Force of Milwaukee, 1998; and Detroit Hunger Action Coalition, 1998). State and local efforts include the work of the Cornell group and others at the State Department of Health in New York, the work of a group at the Boston Medical Center, and groups in North Carolina, Wisconsin, California, Michigan, and elsewhere who are trying to link these concepts and apply them to various at-risk populations. However, much remains to be done, particularly among residents of areas such as rural Alaska, Puerto Rico, the Virgin Islands, and the Asian and Pacific Islands, where special situations may prevail owing to geography, culture, or other factors.

As implementations of the food security measures at State and local levels proliferate, there is a growing need for guidance, care, and oversight from the scientific research community to assure the quality of results and their interpretations. The new food security measures were intentionally designed for ready adaptation and implementation at various levels of geographic aggregation. However, adherence to strict standards of scientific research design, implementation, interpretation, and peer review are crucial to the validity and reliability of the measures at all levels. Moreover, the value of the information provided by the measures at all levels depends on the soundness and openness of their use.

Recommendations for Future Research

Expand Collaborative Efforts and Dialogue

Continued multidisciplinary collaboration among nutrition and health professionals, economists and other social scientists, social welfare and anti-hunger advocates, and policymakers is needed. We need to develop a mutually acceptable conceptual framework that unites social science/economic and biological/medical concerns. Nutrition professionals understand the importance of such measurements, whereas in the past they did not. However, many health professionals are still unaware of the concept of food insecurity and how the phenomenon may influence health outcomes for good or ill.

Expand the Conceptual Framework

Another need is to elaborate the conceptual framework to better relate food insecurity and hunger to other concepts such as economic self-sufficiency and preventive health. Efforts should be made to include individuals and families at especially high medical and/or social risk, and to expand the range of the most severe end of the food security/hunger scale. As more women enter the labor force, especially welfare recipients and women in other poverty groups, this is a matter of considerable policy importance.

The relationships of food security measures and good nutrition to other physical and mental health outcomes also need further study. Such outcomes include associations with:

- early child development (physical, cognitive, and psychological);
- mental health problems (depression, learning disabilities, school failure, learned helplessness, etc.);
- maintenance of independence and positive health outcomes, especially among those suffering from chronic degenerative diseases such as insulin-dependent diabetes, end-stage renal disease, severe cardiovascular disease, and cancer; and
- maintenance of independence in older persons, especially among the frail and sick and those undergoing rehabilitation.

All of these topics require further exploration through multidisciplinary and specialized research activities.

Capture Periodic or Occasional Acute Food Insecurity Problems More Effectively

The time frame for the food security scale is 12 months. This makes the precise nature of periodic or short-term episodes of food insecurity and hunger difficult to measure. The 30-day food security scale can illuminate some aspects of the phenomenon with finer detail, and could be useful in this regard. However, it has a "ceiling" problem; that is, it does not adequately cover the moderate (less severe) end of the food security scale.

National cross-sectional population-based surveys done periodically are not likely to achieve this objective in and of themselves. More frequent measures and specific measures for certain groups at especially high risk need to be considered for serious problems that occur only occasionally or in specific locales. Incorporating the food security measures into longitudinal surveys (e.g., the Survey of Income and Program Participation, or the Panel Study of Income Dynamics) could also address this temporal aspect of food security more effectively.

Present measures may fail to capture important realities of the food insecurity experienced by certain groups. Individuals and families suddenly faced with unemployment, or families that break up, may not show on surveys done once a decade or even once a year, even though they experience considerable hardship. Research to explore the natural histories of these events and their relationships to food insecurity and hunger is also needed.

Improve the Measures' Ability to Capture Severe Food Insecurity and Hunger

The new food security measures, while sufficient to identify household food insecurity, may not suffice for identifying households or individuals in particularly dire situations. For example, they may be too crude to identify important aspects of severe hunger and food insecurity. Items that discriminate severe food insecurity and hunger below the present "floor" in certain respects may be helpful for these purposes. It is important to consider fleshing out the most severe range on the Food Security Scale (food insecurity with severe hunger), especially for children, the elderly, the frail, and other high-risk groups.

Validate the Food Security Scale for Application Throughout North America (Canada, USA, Mexico), and in Other Continents

As we enter the 21st century, the economy is increasingly global in nature. In North America, trade and other ties between Canada, Mexico, and the United States are drawing our nations closer and closer together in many important ways. Canada and the United States share a common dietary standard, and Mexican observers have been invited to join in the development process. Perhaps we also need to think of North American standards for measuring food insecurity and hunger. In North America, Mexico suffers the most from food insecurity. We must not forget our neighbors to the South in our research and development efforts, particularly as we develop indicators of severe food insecurity and hunger.

The U.S. Agency for International Development (USAID) and researchers in other countries have shown interest in validating the food security scale for implementation in developing countries. Limited implementation has been given preliminary approval by USAID, with options available for additional mission-initiated programs. These developments point toward greater possibilities for adapting the scale in a broader range of countries and integrating household-level measures of food security with measures at more aggregated levels.

Explore Uses of Food Insecurity and Hunger as Potential Sentinel Measures

In days gone by, coal miners used canaries in coal mines to detect noxious gases and other dangerous circumstances. It may be possible to develop sentinel indicators that provide early signals of problems related to food insecurity and hunger, and to identify groups that are best to

monitor for detecting these effects. High rates of food insecurity among dependent and highly vulnerable groups such as children in poor families or the ill, frail elderly may serve as such sentinels.

In its seminal report on "Core Indicators of Nutritional State For Difficult-To-Sample Populations," the Life Sciences Research Office of the Federation of American Societies of Experimental Biology (Anderson, 1990) describes the nature and importance of sentinel groups in disease and nutrition surveillance systems. Units considered to have characteristics that make them the first units subject to disease or malnutrition in a population, and thus predictive of future events or conditions in the broader population, are often selected for monitoring. Such sentinel units or groups are clearly not representative of the entire population, but they are useful indicators of the extent of risk in the larger population, and the likelihood of malnutrition-related disease occurring.

Poor Children as a Sentinel Group

Food-insecure young children comprise such a sentinel population, in the epidemiological sense, for malnutrition, morbidity, growth retardation, psychosocial dysfunction, and other problems associated with poverty-related food insecurity and hunger. Previous research also shows that hunger among children is indicative of chronic severe food insecurity and hunger within their families, and that evidence of even moderate hunger among children provides a clear basis for inferring the existence of severe hunger among adults in their households (Hamilton et al., 1997).

There are, however, several extraordinary aspects of the sentinel nature of child hunger and its implications for nutrition and health that amplify concerns normally associated with the phenomenon. These complexities arise out of the special character of growth and development in early childhood and infancy, and the ways adult caretakers in food-insecure households tend to respond to the food and nutrition needs of children through food rationing.

Normal patterns in the managed process of food insecurity at the household level imply that adults usually experience hunger before their children. However, because of the rapid and critical nature of growth and development in early childhood and infancy, hunger tends to cause observable impairment in nutritional status, health, and cognitive and physical development among children prior to emergence of similarly observable impairments among adults in their households. Thus, observation of hunger, malnutrition, and growth impairment in young children not only signals the likelihood of serious health and developmental problems later in their own lives, it also signals the likelihood of physical and mental health problems emerging among adults in the population under consideration. Therefore, young low-income children comprise an extraordinary sentinel group highly indicative of avoidable health problems associated with poverty-related food insecurity, hunger, and malnutrition.

Monitoring Food Security Among Sentinel Poor Children to Assess Impacts of Welfare Reform on Nutrition and Health

The Children's Sentinel Nutrition Assessment Program (C-SNAP) at the Boston Medical Center is an example of food security research focusing on low-income young children. Families of children living in a poor area of South Boston are monitored in the pediatric emergency room for food security and health status and nutrition-related growth retardation. Many families in low-income communities rely on emergency rooms and acute-care facilities for primary care because they have no health insurance and lack time and resources needed for well-child visits (Lino, 1998; and Super et al., 1996). The C-SNAP project is using the Food Security Scale to assess the impacts of welfare policy changes on poor young children's food security, health, and growth (Frank, 1997).

Explore Food Insecurity in Other High-Risk Groups, Especially the Ill and Frail

The American health care system is the most expensive in the world (Angel, 1999). The

growth of managed care has slowed but not stopped the trend of increasing health care expenditures. In 1997, Federal, State, and local governments devoted 46 percent of the $507 billion spent to health care, a percentage that has risen in recent years (Igelhart, 1999). Food insecurity and hunger among the frail and ill can lead to undernutrition, disease, and health complications resulting in medical-care costs that far exceed the costs of preventing the problems in the first place. An example of a sub-population for which this is especially true is frail adults with head/neck cancers, who lack money to buy oral nutritional supplements and secondarily develop protein-calorie malnutrition and dehydration requiring hospitalization. Other examples include diabetic hemodialysis patients who are wheelchair-bound and unattended over long weekends and develop hypoglycemic attacks because of lack of food, and children at emergency rooms or other acute-care facilities who suffer from failure to thrive because their parents cannot regularly afford enough food for them.

The proportion of the U.S. population without health insurance is 16.1 percent (Igelhart, 1999). However, 31.6 percent of all poor people in the United States, and 23.8 percent of all poor children have no health insurance (Bennefield, 1998). These groups are especially likely to become food insecure if they are confronted with a medical emergency or even by expenses for chronic and recurrent medical treatment.

List-based surveys focusing on particular high-risk groups sharing common characteristics (e.g., developmental delay, and physical or mental illness, recent discharge from hospitals or institutions) might be useful. For example, surveys of poor, frail persons with diabetes who are unable to afford food needed for prescribed diets and, thus, develop hypoglycemic reactions may be useful. Existing evidence indicates that they are more likely to develop hypoglcyemic reactions than their more food-secure peers (Nelson et al., 1998).

Low-income legal immigrants comprise another subpopulation of particular interest. Many legal permanent residents, among whom food insecurity and hunger prevalence are likely to be high, may have lost eligibility for food stamps and other benefits as a result of welfare-reform changes (Kasper et al., 1999; Cook, 1998; and Cook and Martin, 1995). Health insurance is often not available to this group, and their health status is likely to be fragile for a variety of reasons. As a result, health care costs can be higher among immigrants who are food insecure, putting them and their children (many of whom are U.S. citizens) at even greater risks of nutrition-related health and growth problems. Such hypotheses need to be tested with data from well-designed, carefully implemented empirical studies.

Expand Research to Improve Sensitivity of Condition/Illness Specific Food Security Measures

It may be necessary to adapt recently developed food security measures for use in specific high-risk groups. For example, adapted food security measures may be needed for the elderly, those who are ill, the physically and mentally handicapped, and for other groups with special problems. Additional research is needed to determine how existing measures might be improved to capture data from such high-risk groups, and clarify associations of food insecurity with health outcomes among these groups. To make the Food Security Scale more useful as a screening device for such special contexts, its sensitivity needs to be carefully examined and possibly improved. The Food Security Scale is being or has been used as a screening device in a few contexts (e.g., in a small pilot study for the Special Supplemental Nutrition Program for Women, Infants, and Children, and in the C-SNAP program). The scale might also be effectively adapted for use in the Nutrition Screening Initiative.

Recent research by Nelson et al. (1998) suggests that food insecurity is a significant factor in hypoglycemic reactions among persons who are poor, frail, and suffering from insulin-dependent diabetes. This concern also highlights the need for additional research and analysis of the specificity and sensitivity of the food security scale.

That issue, addressed in another presentation in this conference, needs to include consideration of the applicability of the scale as a screening device, and the implications of its use in this manner.

Develop Studies of Health Outcomes Among the Food Insecure III

Health outcomes associated with varying levels of food insecurity need to be studied in groups with illnesses as well as those in better health. Such groups include individuals of any age recently discharged from acute or chronic health care facilities with disabilities that impair mobility, or with mental or physical limitations that impair their ability to provide for themselves, particularly if they are low-income. The implications of food insecurity for social policy, particularly among those whose health care costs are covered by the Federal Government are considerable. Such groups include frail elders whose health care costs are covered by Medicare or Medicaid and the physically and mentally handicapped covered, in part, by other portions of the Social Security Act amendments.

As mentioned above, frail low-income persons with insulin-dependent diabetes, including those on dialysis, are especially vulnerable to lack of food. Failure to obtain food can lead to morbidity, increased health care costs, and hospital admissions, most or all of which must be covered by public health insurance. Another group especially prone to the ill effects of food insecurity are those with acquired immuno-deficiency syndrome (AIDS). Research on some of these special populations may be possible with data from the combined CSFII/NHANES survey to be implemented in the near future.

A parsimonious approach to studying whether food security is associated with greater severity and/or poorer health outcomes from chronic degenerative diseases or conditions might be to incorporate the Food Security Scale into existing federally funded studies. Appropriate adaptations could be made to large-scale studies of chronic degenerative diseases and their treatments being conducted by the National Institutes of Health. Many of these studies perform periodic followups and measure various health outcomes. Adding food security measures would enrich the data and permit exploration of the extent to which these diseases and conditions are associated with food insecurity.

Examples of such studies include the Polyps Trial, followups to cardiovascular disease studies conducted by the National Heart, Lung and Blood Institute, followups of patients on dialysis in the HEMO study of the National Institute of Diabetes, Digestive and Kidney Diseases, as well as followups of the Child and Adolescent Trials of Cardiovascular Health. Large longitudinal cohort studies of aging and health—such as the Women's Health Initiative (WHI)—would also be appropriate vehicles for food security measures, as would studies of child health and nutrition—such as the Child and Adolescent Trials of Cardiovascular Health (CATCH).

Incorporate Food Security Measures into Screens for Risk of Poor Nutritional Status

Private and volunteer sector groups, such as the Nutrition Screening Initiative, and Federal groups such as the Preventive Health Services Task Force may find it useful to develop nutrition and health screening indicators that include food security. Among those screened and identified as food insecure and hungry, valid and reliable methods for further assessing their dietary intakes and nutritional status need to be applied, and the effects on food security of various interventions need to be considered. Refinements in the sensitivity of the Food Security Scale, as well as research clarifying the relationships between food security and nutritional status will help make this kind of application more effective.

Expand Research on Age and Life Cycle-Specific Food Insecurity Measurement

Children

Food security concerns related to growth and development in infants and young children differ in important respects from those related to later

periods in the life cycle; e.g., adolescence, pregnancy, lactation, and old age (Pollitt, 1994, and accompanying articles). Meaningful associations of food security with other outcome measures may also vary across the life cycle. For example, food insecurity in children may not be related solely to impairment of physical health and growth but also to psychological and mental health problems. Food insecurity is clearly associated with family economic stress and thus may influence the quantity and quality of parent-child interactions during infancy and early childhood. These, in turn, set the stage for a host of developmental achievements necessary for success later in life. Kleinman et al. (1998) provide recent evidence that food insecurity and hunger are associated with several kinds of psychosocial dysfunctionality among children. Additional research is needed to investigate the relationships of food insecurity and hunger to other mental-health problems among adult household members such as depression, alcoholism, and domestic violence.

Childhood Obesity

Another important child health issue is the association of food insecurity with development of obesity in childhood and adolescence. Dietz (1998 and 1995) summarizes the present and future health implications of this condition for children, and hypothesizes that childhood obesity may be caused in part by weight cycling resulting from periodic or chronic food shortages. Dietz (1995) also notes that increased fat content of low-cost foods eaten to prevent hunger at times when families lack money to buy food is also a likely factor in child obesity. Greenwood et al. (in Karp, 1993) discuss some psychological/emotional problems associated with obesity in low-income children and patterns of interaction among economic, cultural, and cross-generational factors that lead to its development. Further research is needed to clarify the role of food security in this increasingly prevalent child health problem. In such studies it will be important to examine food security and hunger along with other environmental factors that may be involved (e.g., physical inactivity, dieting behavior).

Among children and adolescents, food insecurity measures might also be used as a basis for ascertaining need for food assistance programs or other school-based interventions. Food security measures may be related to participation or lack of participation in school meals programs and children's views and attitudes about schools and school programs.

The Elderly

Very little research has been done on food security among the elderly since the seminal work of Burt and Cohen at the Urban Institute in the early 1990s (Burt, 1993). Additional questions about elderly people's responses to food insecurity still need to be addressed. As suggested above, food security measures may be useful to include in nutrition and health screening programs for the elderly. Associations between food insecurity and decreased intakes of calories and other nutrients, decline in sensory-specific satiety, loss of olfactory and gustatory sense acuity, decreased dietary variety, decreased relative weight or weight loss, and adverse changes in functional status need to be examined further.

According to Census Bureau projections, the number of elderly persons 65 years and older in the U.S. population will more than double between 1995 and 2030. Over this same time period, the number of elderly age 85 and older will increase by nearly 150 percent, and the number for age 100 and over will be more than eight times greater in 2030 than it was in 1995. Due to differential survival rates between males and females, elderly women make up a larger proportion of the elderly population at each higher age interval. In 2030, for example, women are projected to comprise 55 percent of the population age 65 and over, but 65 percent of those age 85 and over. Moreover, a larger proportion of elderly persons in each higher age interval live alone. According to Census Bureau estimates, in 1998, 23 percent of all persons age 65 to 74 lived alone, while 38 percent of those ages 75 to 84 lived alone, and 52 percent of all those age 85 and over (Lugaila, 1998). Together, these trends imply that the increasing elderly population resulting from aging of the "baby boom genera-

tion" will involve dramatically larger numbers of elderly women, many of whom will be living alone.

The Food Security Measurement Study of the U.S. Department of Agriculture and the U.S. Department of Health and Human Services' National Center for Health Statistics (Hamilton et al., 1997a) found that households with elderly persons and no children had the lowest prevalences of food insecurity and hunger of all household types in 1995 (5.9 percent food insecure overall, and 1.9 percent with some level of hunger). However, the prevalence of food insecurity and hunger among such households in which people lived alone were much higher. Nearly 1 of every 10 single-person elderly households (8.2 percent) was food insecure and 2.8 percent experienced hunger. These food insecurity and hunger prevalence rates are 39 and 47 percent higher, respectively, than those for all households with elderly but no children. As the number of elderly people in the population continues to increase, elderly persons living alone (especially elderly women) will present increasingly difficult challenges for nutrition and health professionals, and an increasing need for more careful measurement of food security among the elderly population.

It is, therefore, important to refine and target measures of food insecurity for the elderly, and to concentrate especially on elders who live alone and are at higher risk of food insecurity (almost 40 percent higher) than the elderly in general. These special concerns for food security measurement among the elderly are even more critical among those with chronic degenerative diseases such as end-stage renal disease, diabetes, and heart failure.

With respect to social policy, poverty thresholds for Americans age 65 and older are lower in general than those for younger persons. As a result, the numbers and proportions of elderly in poverty are underestimated (Rogers et al., 1994). This and other social, cultural, and physiological peculiarities of the elderly population suggest that the Food Security Scale may underestimate the prevalence of food insecurity among the elderly. Studies to refine estimates of the prevalence of food insecurity among the elderly might determine the extent to which this is the case. They may also clarify the associations of food insecurity with physical or mental health outcomes among the elderly, and their patterns of use of health care and other social and public services.

Among the frail elderly especially, food insecurity may be associated not only with physical health but also with mental health status and the ability to live independently. Functional status, as measured by activities of daily living and instrumental activities of daily living, is likely to interact in important ways with food security status among the elderly, both as a cause of food insecurity and as a consequence of it. In addition, food insecurity among the elderly may be related in important ways to admissions to acute or chronic care facilities.

Similar to young at-risk children, the frail elderly may be a sentinel group for many nutrition and health problems. Yet little work has been done on the elderly as sentinels for larger societal problems. The large and growing number of very old adults, e.g., over age 85, who are living in our communities may be an important group to examine. For many of these "older old," social and medical infrastructures are fragile or inconsistently available, and food insecurity is likely to be especially apparent and problematic for them.

Determine if Food Insecurity/Hunger Measures Have Predictive Value in Determining Health Outcomes in Longitudinal Studies

The new food security measures need to be validated in a wider variety of contexts. Including them in longitudinal studies may help to determine if they can function effectively as early warning signals or harbingers of later biological, psychological, or social perils. If so, it will also be important to determine whether and how interventions to improve household food security actually alleviate the potential ill effects of food insecurity and hunger on nutritional, mental, and physical health status.

The cumulative effects of food insecurity, as can best be measured in longitudinal studies, require additional attention. Food insecurity is probably an indicator of many other stresses in people's lives. However, it is possible that rather than simply being associated with adverse outcomes, food insecurity may be a critical part of the causal chain. Chronic food insecurity, assessed longitudinally, may either cause or simply be associated with adverse health or social outcomes. It is our understanding that the Food Security Scale, or a subscale of the overall scale, has been considered for inclusion in the Survey of Program Dynamics. If it has not yet been, we urge that it be included in the future.

Many unresolved research questions related to food security and hunger deserve further investigation using longitudinal or time-series designs. For example, is chronic food insecurity among children associated with poor academic achievement, even after taking other factors into account? Do children who are chronically food-insecure and who participate in school meal programs have fewer problems with school and greater academic achievement than those who do not? Do school meal program participants from food insecure families have more positive attitudes about school and themselves than nonparticipants from food insecure households?

Among adolescents and young adults, are food insecurity and hunger linked to greater or lesser likelihood of developing severe obesity? While it might seem counterintuitive, one hypothesis suggests that chronic or episodic food insecurity and hunger lead to excessive consumption when food is available, and thus that they are associated with higher risk of obesity. Another hypothesis notes that when households become food insecure, they rely on diets with less variety and more low-cost foods, which also tend to be higher in fat. These and other coping strategies pursued by food-insecure households may contribute to higher risk of obesity. Moreover, as Dietz (1995) and Greenwood et al. (1993) point out, poverty and food insecurity involve extreme stresses for all members of affected families, and these often aggravate emotional and psychological problems that contribute to overeating and obesity.

Is chronic or recurrent food insecurity or hunger among poor, frail, or ill homebound adults with such chronic conditions as renal disease, insulin-dependent diabetes mellitus, or chronic lung disease associated with increased hospital admissions? Is chronic food insecurity among elderly persons associated with institutionalization and decreased functional status, e.g., decreased Index of Independence of Activities in Daily Living (ADL) and Instrumental Activity of Daily Living (IADL)? Food insecurity measures may be useful in questionnaires used to evaluate the quality of care in board and care and other types of long-term care facilities that house the frail elderly (Burt, 1993).

Should we study food insecurity among very obese, homebound elderly persons living in rural areas? Such individuals usually have limited mobility, and when support systems are inadequate, it might be expected that they will incur major nutritional and health risks (Burt, 1993; and Greenwood et al., 1993).

"Piggy Back" Food Security Items Onto Existing Studies

It is important to "piggy back" food security measures onto existing studies so that the natural history of food insecurity among those theoretically at risk from either or both the biological and social standpoints (e.g., poor with disabilities and frail homebound) can be identified.

The newly combined NHANES/CSFII survey offers new potential for achieving a synthesis between food security measures and biological markers. The new combined survey will repeatedly sample the population on a consistent basis, so that nationally at least, timely information can be obtained if food security measures are included. However, the sampling frame for the combined survey, while nationally representative, is not so geographically. Food insecurity problems may be present in one part of the country and absent in another. Incorporation of food

security measures into additional surveys conducted at both the Federal and State levels is also needed.

To capture changes in conditions from one region to the next, either new sampling frames must be developed that are geographically representative, or substudies with State/local samples must be implemented including the Food Security Scale with other measures. When specific age/sex/health status groups, such as frail elders, are thought to be at special risk owing to changes in programs or opportunities, specific list-based samples may be needed.

Develop Standardized Methods and Tools for Measuring Food Security and Hunger that are Portable for Use in State and Local as well as National Efforts

Today, restructuring of health and social welfare infrastructure is accelerating. Yet the type and amount of changes involved vary from State to State, and from one substate locality to another. Some program changes being implemented are likely to have adverse effects on food security and hunger, while others may have positive effects. There is a need for policymakers to have early warning indicators of food insecurity so that they do not have to operate in the dark, and can take remedial actions when program changes have unanticipated negative effects.

Relate Food Security Measures to the New Dietary Standards for Nutrients, the Dietary Reference Intakes, and to Population Assessments

The Food and Nutrition Board, National Academy of Sciences, has just begun work on a series of reports on macronutrient intakes, including caloric intakes. In tandem with these efforts to revise and update the Dietary Reference Intakes (DRI), there is a parallel effort to develop guidance on the uses of the DRI. Food security measures need to be related to these concepts, since the paradigm adopted by the Board is likely to dominate thinking in nutritional biology for the early part of the 21st century. The work of other Institute of Medicine Committees may also be helpful in clarifying questions that need to be asked relevant to the associations of food security measures with other variables.

Explore Associations of Food Security Measures with Other Indices

The associations between food security measures, functional status—as measured by the ADL, IADL and disability indices—and quality of life measures, such as the Health Survey (SF-36) of the Medical Outcomes Trust, among groups such as the elderly and the ill are of interest.

Conclusions

The past is instructive. It teaches the utility of conjoint efforts, use of standardized and well-validated measures, appropriate sampling, and development of measures of social and biological manifestations of food security. Similar efforts as those devoted to groups at risk by virtue of their age now need to be extended to groups at risk owing to their physical or mental health status, or other particular circumstances that place them at high risk for both increased food insecurity and poor nutritional status. Now that valid and reliable measures of food security and hunger are available, they need to be related to other outcomes, both on cross-sectional and longitudinal bases. In addition, the effectiveness of intervention efforts to alleviate the effect of food insecurity on short- and long-term outcomes needs to be carefully assessed.

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Appendix 1— Some Relevant Advances in the Health Sciences Since 1960

Concepts of Disease and Health:

- Solidification of the concept of disease as involving more than the presence of overt disease to one that includes environmental and social risk factors for disease.
- Broadening of the concept of health to include functional status (e.g., activities of daily living and instrumental activities of daily living) and subjectively determined indices of well-being and quality of life.
- Broadening of concepts of disease causation from a unitary focus on being predominantly genetic or environmental in their origins to one that includes interactions between multiple factors, especially in chronic degenerative diseases (e.g., BRCA1, obesity and breast cancer risk).
- Understanding that various types of disease (e.g., infectious and chronic) can occur together or lead to each other (e.g., H. pylori leading to chronic gastric ulcer disease, certain infections and thrombus formation, possibly infection and later insulin-dependent diabetes).
- Elucidation of the role of the long-lasting effects of disease and insults not only on child development but in predisposing individuals to later developmental problems (e.g., very low birth weight infants and later developmental disabilities, untreated phenylketonuria and intellectual deficits in adulthood).
- Recognition of the recursive relationships between various coexisting diseases in worsening disease severity or duration and in determining ultimate outcomes and quality of life.

Knowledge of Disease Causation and Health Promotion:

- Understanding that most chronic degenerative diseases are multifactoral, develop over years or decades, and that their prevention and control require long-term interventions.
- Recognition that some diseases that appear later in life have genetic origins, and that others have their origins during fetal life or early infancy.
- Recognition that the diseases associated with aging can be delayed with appropriate preventive measures earlier in life.
- Further clarification and quantification of disease risk factors, how they affect various bodily functions and processes, and how they vary by age, stage of life, and health status (e.g., Healthy People 2000, Preventive Health Task Force).
- Growing recognition of special vulnerabilities of cells, organs, and organ systems to specific environmental or genetic insults.
- Clarification of the special preventively oriented needs of certain age, sex, and life stage groups (e.g., Preventive Health Services Task Force Recommendations).

- Expansion of a focus that was solely on biological determinants of disease to one that includes nutritional, economic, educational, sociocultural and physical environmental factors, and the importance of interventions outside the health sector in preventing and controlling disease.

- Greater understanding of the importance of lifestyle in disease causation and health promotion (e.g., sedentary life styles, risky behaviors).

- Recognition of the importance of physical activity to health.

- Development, implementation, and refinement of randomized clinical trials for evaluating and testing preventive and curative strategies.

- Elaboration of evidence-based algorithms for the prevention and treatment of disease (e.g., Consensus Conferences of National Institutes of Health, Preventive Health Services Task Force Recommendations, Healthy People 2010, disease-specific recommendations from the work of the Agency for Health Care Policy and Research).

Greater Application of Systems for Determining the Prevalence of Disease, and Implementing Risk Factor Surveillance and Monitoring:

- Growing availability of population-based estimates of the prevalence of risk factors for disease.

- Further development of national health monitoring and surveillance programs (e.g., NHANES I, II, III, Behavior Risk Factor Surveillance Programs, National Center for Health Statistics).

- Improved surveillance and monitoring of high-risk groups and populations (e.g., people with human immunodeficiency virus (HIV), nursing home residents, etc.)

- Evolution of generally agreed upon preventively oriented national health objectives (e.g., Promoting Health, Preventing Disease, Objectives for the Nation 1980; Healthy People 1990, Healthy People 2000, and Healthy People 2010).

Continuing Progress in Age-Specific Morbidity and Mortality:

- Improved survival of the very young (e.g., low birth weight infants), pregnant women, those with chronic diseases (e.g., coronary heart disease, stroke, and certain cancers), and the elderly.

- Decreased age-specific mortality rates among many demographically vulnerable groups (e.g., very young infants, and the elderly).

Changes in Health Care Delivery Systems:

- Increased emphasis on primary prevention.

- Decreases in length of stay in acute care facilities for many acute illnesses, with increases in therapies provided on an outpatient basis or at home.

- Community treatment and care for the mentally ill, developmentally delayed, and those with many chronic diseases.

- Increasing diversification of roles among health professionals (e.g., nurse practitioners and physician assistants making diagnoses and prescribing treatments).

- Continued increases in health care costs.

- Increasing reliance on managed care.

- Increasing consolidation of institutions and facilities (e.g., within the insurance and the health care industries).

Appendix 2—
Some Relevant Advances in Nutrition Science Since 1950

Concept of Nutritional Status and Malnutrition:

- Solidification of the concept of nutritional status as a multidimensional concept measured by anthropometry, biochemical measurements, clinical observations, dietary intake, and functional measures.

- Broadening of the concept of malnutrition from a focus on deficiency disease and undernutrition to one that includes imbalances and excesses of nutrients that also contribute to chronic degenerative diseases and conditions such as obesity (e.g., coronary artery disease, hypertension, and possibly certain hormone dependent cancers).

- Understanding that various forms of malnutrition can occur together (e.g., dietary deficiency disease, diet-related chronic degenerative diseases such as noninsulin-dependent diabetes and obesity).

- Elucidation of the role of the long-lasting effects of malnutrition not only on child development, but in predisposing individuals to chronic and infectious diseases, and in age-associated illness and disease later in life.

- Recognition of the recursive relationships between malnutrition and disease; acute and chronic diseases may cause secondary undernutrition and malnutrition, which in turn may worsen disease severity or duration.

Knowledge of Nutrients and their Functions in Health and Disease:

- Further clarification and quantification of nutrient needs for bodily functions and processes, and how these needs vary depending on the function of interest, by age, stage of life, and health status. (e.g., dietary reference intakes).

- Growing recognition of special nutrient needs of cells, organs or organ systems for specific nutrients (e.g., glutamine and fiber and gastrointestinal function).

- Clarification of the special nutrient needs of certain age, sex, and life stage groups (e.g., premature and low birth weight infants, the elderly, pregnant, and lactating women).

- Discovery of new links between nutrient deficiency and disease (e.g., folic acid deficiency and neural tube defects); nutrient excesses and adverse outcomes (e.g., vitamin B-6 excess and peripheral neuropathy).

- Expansion of a focus solely on nutrients to one that includes other food constituents with healthful or harmful biological effects (e.g., dietary fiber, glutamine, and carnitine).

- Greater understanding of the importance of dietary patterns and dietary quality and interactions between nutrients on health (e.g., atherogenic dietary patterns).

- Recognition of the importance of physical activity on metabolism of nutrients and on nutritional status.

Prevalence of Malnutrition, Nutrition Monitoring, and Risk Factor Surveillance:

- Growing availability of population-based estimates of the prevalence of risk factors for malnutrition and indicators of overt malnutrition.

- Development of national nutritional status monitoring programs (e.g., NHANES I, II, and III) and dietary status monitoring (e.g., CSFII and others).

- Development of evidence-based dietary information and guidance for Americans (e.g., Dietary Guidelines, USDA Food Pyramid, and nutrient labels on foods).

- Evolution of generally agreed upon preventive-oriented national health and nutrition objectives (e.g., Promoting Health, Preventing Disease, Objectives for the Nation 1980; Healthy People 1990, Healthy People 2000, and Healthy People 2010).

Appendix 3—
Some Relevant Advances in Nutritionists' Thinking About Food Security

19th Century

British famine handbook used in Colonial India in the 19th century for very acute food insecurity. In Europe, recognition of lesser degrees of food insecurity not yet reflected in stark biology of death rates rose dramatically due to starvation was also recognized as important. In the 19th century, British and German social and public welfare concepts of food insecurity based on income was always highly charged politically, chiefly a notion of social reformers; then later piqued interests of nutrition scientists.

Early 20th Century

Early efforts in this country in the 20th century included the President's Homes Commission but no specific standards for measuring it. Rationing in World War I was somewhat of a programmatic attempt to deal with food insecurity.

Great Depression

The Great Depression, clearly the worst time in the century, and poverty food insecurity was widespread enough to concern everyone.

World War II

National food security was a concern in World War II, especially in Europe, and the U.S. rationing was a food security attempt.

Post-World War II

Food programs in post-1950 were directed against lack of food security but relied on poverty measures to determine need.

Kennedy/Johnson Great Society

Adelson's estimate based on the notion that food should be a third of total expenditures emerged in 1960s.

Nixon Administration

White House Conference on Food Nutrition and Health, 1969. Food stamps were established in place of minimal income. The Senate Select Committee on Nutrition and Hunger Needs replaced the health-related criteria (infant mortality) used by the Citizens' Board of Inquiry in 1968 to designate 280 counties as "hunger counties" with criteria based only on income.

Carter Administration

Sympathy with idea but no specific measures other than above.

Reagan and Bush Administrations

Not favorable to notion of categorical programs; attempts to block grant and consolidate programs, to give States more discretion; no specific means for monitoring progress adopted. Congressional pressure opposed to dismantling food programs. Concept of better food security measures gained momentum in the 1980's; nutrition science organizations adopted the general concept from work in international development; some States (NY and others), private advocacy groups (Food Research and Action Center) and universities tried to refine, validate and replicate measures. U.S. Department of Agriculture's Food and Consumer Service (FCS) and the National Center for Health Statistics (NCHS) were concerned about developing better measures. In the late 1980s, FCS and NCHS began to consider better ways to measure food security; then basic food security measures were developed separately by Wehler and Radimer.

Clinton Administration

The 1990s need for more specific food security measures for specific target groups became recognized in nutrition community. The Life Science Research Office's expert panel codifies consensus conceptual definitions of food security, food insecurity, and hunger under a cooperative agreement involving the American Institute of Nutrition and the U.S. Department of Health and Human Services' Office of Disease Prevention

and Health Promotion, published in the November 1990 supplement to the Journal of Nutrition as "Core Indicators of Nutritional State for Difficult-to-Sample Populations." National Nutrition Monitoring and Related Research (NNMRR) Act of 1992 mandated "a standardized mechanism and instrument(s) for defining and obtaining data on the prevalence of "food insecurity" or "food insufficiency" in the U.S. and methodologies that can be used across the NNMRR Program and at State and local levels." The responsibility for developing food security and hunger measures was jointly assigned to FCS and NCHS, which began the Food Security Measurement Project. The congressional restructuring and reinventing government efforts, with respect to food and other categorical programs, and new federalism efforts to devolve welfare programs and other programs such as health to State- and local-level added impetus to development efforts. FCS and NCHS convened the first Conference on Food Security Measurement and Research in January 1994; a consensus "Food Security Measurement Questionnaire" was developed and refined over the following year, and implemented by the Census Bureau in the April 1995 Current Population Survey.

Today

Growing acceptance of measures of food security was a result of the Food Security Measurement Study and the reports released by USDA/FCS in September 1997.

Food security and hunger measures similar to measures for poverty and quality of life, once thought to be nothing more than rhetoric, or basically impossible, are now available. Now it is recognized that reliable and valid food security and hunger measures are not only possible, but have been developed.