MINERAL NEEDS OF THE ELDERLY:
DEVELOPING A RESEARCH AGENDA FOR THE 1990s

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ABSTRACT
Increasing attention is being paid to the relationship between nutrition and health, particularly in regard to the possible linkage between nutrition and the development of chronic disease. The elderly are likely to suffer from one or more chronic diseases. The impact of these diseases on mineral status of the elderly population is poorly understood. In addition, little information is available about the mineral requirements of this population. The focus of this paper is to review the reasons why the elderly population is at increased risk of developing mineral deficiencies, our current understanding of the mineral requirements of this vulnerable group, and a consideration of recommendations for future research needs in this area. For illustrative purposes, special attention has been given to three selected mineral nutrients: phosphorus, magnesium and zinc. Research priorities include studies to: improve methods for assessing mineral status; investigate the relation of habitual mineral intake and status; assess the impact of dietary change on mineral bioavailability in the elderly; determine the effect of hypochlorhydria on intestinal mineral absorption; and assess the effects of aging on the adaptive response to low mineral intakes. Studies such as these will help to provide a stronger research data base for estimating Recommended Dietary Allowances for these mineral nutrients in the elderly.

INTRODUCTION
Increasing attention is being paid to the relationship between nutrition and health, particularly in regard to the possible linkages between nutrition and the development of chronic disease (1). The elderly are a rapidly growing part of our population. In 1960, 9.2% of the population was over 65 years old, while in 1985, 12% of the population was over 65 (2). By the year 2030, the elderly will double its present size (3). Moreover, the most rapidly growing segment of this population is the group over 75 years old (4). It is important, therefore, that we strive to understand the nature of the relationship between nutritional status and health and to better understand the nutrient requirements of the elderly population. Disease and disability are commonplace in the elderly population. Figure 1 illustrates three population pyramids for the U.S. population in 1960, 1970 and 1980 and the proportion of the population suffering from a chronic disease. As can be readily seen, as age increases the proportion of individuals suffering from a chronic diseases increases. As might be expected, older individuals are more likely to require visits to the physician (5) and account for a large portion of prescription and over-the-counter drug sales. Those over 65, who constitute about 12% of the population, consume more than 25% of the national total of prescribed drugs (6). The focus

of this paper will be to review the reasons why the elderly are at increased risk of developing mineral deficiencies, our current understanding of the mineral requirements of this vulnerable group, and a consideration of recommendations for future research needs in this area. For illustrative purposes, special attention has been given to three selected mineral nutrients: phosphorus, magnesium and zinc.

Who Are the "Elderly": A Need for Biomarkers of Aging

The obvious marker of having entered the "golden years" of senior citizenship is a sociological one — retirement from the workplace. This benchmark that we all are so familiar with now was arbitrarily set in the 1880s by the German Chancellor Otto von Bismarck as part of the first social insurance legislation (5). Bismarck set the age of eligibility for retirement at 70 years (which was later lowered to 65). The magic number of 65 or 70 years old, however, has no specific basis in physiology for marking one's entrance into the "old" category. Equally unsatisfying is the classification of "51+ years old" used by the Food and Nutrition Board of the National Academy of Sciences in setting dietary guidelines for our older adults (7). What is needed is a set of biomarkers of aging (8) that define the physiological stages of aging in an individual. Such a panel of measurements should be fairly precise and provide meaningful functional information concerning the physiological state of the various organ systems. Unfortunately, these standards have yet to be adequately quantified and shown to be of general predictive utility. Figure 2 illustrates some of the marked changes which occur with age of various measures of cardiovascular, pulmonary and renal function that have been collected in a cross-sectional study of the Baltimore Longitudinal Study of Aging (9). Clear differences in the effects of aging on various physiological parameters are evident. The molecular basis for these different functional sensitivities to the aging process are poorly understood.

Aging of an individual is a continuum — beginning at conception and ending at death. This continuum, viewed from a physiological perspective, represents a succession of events marking our individual physiological development and eventual decline. However, as individuals we each "age" at a different rate. This developmental heterogeneity within the population can be easily appreciated in young people when we measure the chronological age at which a certain developmental benchmark is reached. For example, typical mileposts of development are the age at which a very young child first crawls, stands upright, walks or talks; or when the adolescent ends his/her pubertal growth spurt, or a girl begins menstruation. However, once adulthood is reached and these obvious developmental markers are attained, the clear demarcation of the physiological aging process becomes more tenuous, except for the menopause in women. It is difficult, then, to clearly define at what point a person becomes "elderly." Moreover, we know little about what genetic and environmental factors determine who will age "successfully," and who will not (10).

Recommended Dietary Allowance (RDA) for the Elderly

The Food and Nutrition Board of the National Academy of Sciences has established Recommended Dietary Allowances (RDA) since 1943 for a variety of nutrients where they felt an adequate data base of information existed. In addition, it has recently established recommended ranges of dietary nutrient intake, the so-called ESAlS (estimated safe and adequate intakes), for some other nutrients where the information base was less complete. Table 1 lists the current (1989) RDA levels for young and older adult males and females for all the mineral nutrients for which a specific RDA has been established (Ca, P, Mg, Fe, Zn, I and Se). Except for the sole exception of lower recommended iron levels in older women, the RDAs are the same within each gender classification for younger (25-50 years old) and elderly (51+ years old) individuals. The justification for this parity is however tenuous, since the recommendations for the elderly are based on information generated almost exclusively in younger adults. However, does it seem reasonable that the nutrient needs of a 100-year-old person are the same as those of a 25-year-old? It also becomes difficult to define RDAs for the elderly population in the same way that is done for the younger groups. The RDAs are designed to address the nutritional needs of healthy persons. How do we realistically define RDAs for the elderly population when most of them suffer from one