

Studies of the relationship between maternal nutritional supplementation and the behavioral development of offspring have produced inconsistent results. In some studies, no differences in cognitive function occurred among offspring of women who did or did not receive nutritional supplements (Rush, Stein, and Susser 1980a, 1980b; Higgins 1976), but others have reported significant benefits of improving prenatal nutritional status (Villar et al. 1984).

As discussed in the anemia chapter, lower mental and behavioral test scores improved relative to controls among iron-treated iron-deficient infants only when the amount of iron administered corrected both the anemia and biochemical indices of iron deficiency (Lozoff et al. 1987). Short-term studies on the effects of omitting breakfast on cognitive performance have reported that adequate nutrition benefits learning (Pollitt, Leibel, and Greenfield 1981, 1983; Conners and Blouin 1982/83). Well-nourished children ages 9 to 11 who skipped breakfast displayed higher rates of inaccurate responses to problem solving.

Inborn Errors of Metabolism

Early identification and nutrition intervention can help prevent subsequent mental retardation in infants born with many kinds of metabolic disorders. All States have screening programs to detect newborns with inborn metabolic disorders (Infant Metabolic Diagnostic Laboratory 1987). Such children require long-term dietary management. One example of such a disorder is phenylketonuria (PKU) (AAP Committee on Genetics 1982).

PKU results in excessive and potentially toxic blood levels of the amino acid phenylalanine. The goals of therapy are to provide adequate intakes of energy and nutrients but only enough phenylalanine to maintain normal growth and development. Meeting these goals requires special formulas and food products with reduced phenylalanine content, as well as considerable support from health professionals (Trahms 1984). Current recommendations are to continue the phenylalanine-restricted diet throughout the reproductive years, because experience with its discontinuation at ages ranging from 4 to 10 years indicates progressively decreasing cognitive functioning, learning difficulties, poor attention span, and behavioral difficulties (Smith et al. 1978; Koch et al. 1982; Holtzman et al. 1986). Evidence suggests also that phenylalanine restriction during pregnancy improves the outcome for women with PKU and their infants (Mabry, Denniston, and Coldwell 1966; MacCready and Levy 1972; AAP Committee on Genetics 1985; Drogari et al. 1987).

Implications for Public Health Policy

Dietary Guidance

General Public (Including Children and Pregnant Women)

Assessment of nutritional status is an integral part of maternity care at the beginning of pregnancy and periodically throughout pregnancy and lactation to provide continuing monitoring and recommend appropriate intervention.

Evidence related to the role of diet in maternal and child health indicates that well-nourished mothers produce healthier children. Intake of sufficient energy and nutrients to attain optimal nutritional status, including appropriate weight before pregnancy and adequate weight gain during pregnancy, improves infant birth weight and reduces infant mortality and morbidity. Avoiding potentially toxic substances such as alcohol or drugs during pregnancy seems to improve infant birth weight and health, but the evidence regarding low exposures to these agents is not conclusive. Information on appropriate dietary intake, with consideration of ethnic and cultural food habits, should be provided as early as possible to pregnant women and to women expecting to become pregnant.

Evidence related to the role of diet in infancy indicates that breast milk is the optimal food for infants. Whenever possible and as early as possible, health professionals should provide guidance and support to pregnant women and new mothers on the importance of breastfeeding and on methods for its initiation and maintenance. Mothers who cannot or choose not to breastfeed should receive information about appropriate formulas.

Consuming the appropriate amount and form of energy and nutrients for developmental age is important for good health, as is early education about lifelong dietary patterns that help prevent disease. Parents should guide their children in developing positive eating behaviors and on age-appropriate food patterns that meet nutritional requirements but avoid excessive intake of fat, sodium, and sugar. Parents should also help adolescents develop healthy eating habits and should emphasize the importance of including sufficient quantities of low-fat, nutritious foods in meals and snacks.

Special Populations

Some factors present at the onset of pregnancy place women at increased nutritional risk. These include: adolescence, short interconceptional peri-

od, poor reproductive performance, economic deprivation, food faddism, substance use, chronic systemic disease, and inadequate or excessive prepregnant weight (below 85 percent or above 120 percent of standard weight for height). Other nutritional risk factors such as anemia and inadequate or excessive weight gain may develop during pregnancy.

Attaining appropriate prepregnancy body weight and nutritional status, gaining adequate body weight, and avoiding alcohol during pregnancy are important for all women. Qualified health professionals should provide close nutritional monitoring and individualized counseling to women appropriate to their educational level and cultural food habits before and throughout pregnancy.

Specialized professional counseling on feeding should be provided to parents of LBW infants, other infants at high risk, and infants who require special formulas. Parents of children who are at high risk because of developmental disorders, inborn errors of metabolism, physical disabilities, or chronic disease should also receive ongoing professional advice on appropriate diets and feeding methods. Because children from families with a history of diet-related chronic disease have a high risk for such conditions, they should be evaluated for these conditions. Children of families whose blood cholesterol, blood sugar, or blood pressure exceed appropriate levels should be advised on dietary and other means to reduce these risk factors.

Physicians, nurses, and other health professionals caring for children and women of childbearing age should receive education and training in nutrition assessment, nutrition intervention for prevention of disease, and promotion of maternal and child health.

Nutrition Programs and Services

Nutrition Services

Evidence related to the role of nutrition in maternal, infant, and child health suggests that all health care programs for these groups should provide nutrition services, especially to those people at special health or economic risk. Such services include nutrition assessment, dietary counseling, nutrition education, and referral.

Food Products

Evidence related to the role of dietary factors in maternal and child health suggests that food manufacturers should develop nutritious, low-fat, low-

salt, low-sugar snack food products for children and adolescents. Quality and safety of infant formulas and other infant foods require continued monitoring to prevent untoward health consequences.


Special Populations

Pregnant women, infants, and children with diet-related disease conditions and physical disabilities that impair food intake should receive counseling and assistance in dietary management. Low-income families should have access to an adequate diet. Those with poor education, limited understanding of English, and different cultural patterns require nutrition education approaches appropriate to their needs.

Research and Surveillance

Research and surveillance issues of special priority related to the role of diet in maternal, infant, and child health should include investigations into:

- The amounts of energy and essential nutrients pregnant women must consume to achieve optimal birth outcome and promote long-term maternal health.
- The optimal weight gain during pregnancy.
- The diet during pregnancy that best prevents complications of chronic disease conditions in the mother.
- The effects of potentially toxic dietary factors such as alcohol on fetal health.
- The optimal feeding methods and diet for improving growth and development of LBW infants.
- The diet in childhood that will best prevent later development of chronic disease conditions.
- The influence of nutritional status on teratogenic outcomes, particularly neural tube defects.
- Nutritional care for optimal development of infants and children with special health care needs due to chronic illness or developmental disorders.
- Effective educational methods to teach parents how to develop good dietary practices for themselves and their children.
- Effective educational methods for teaching good nutritional practices to children and adolescents.

 Nutrition and Health

- Effective strategies to integrate nutrition screening, education, and intervention services into health care programs.
- The impact of social changes on nutritional status, including those related to meal sources and eating patterns.

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Chapter 16

Aging

. . . If thou well observe
The rule of not too much, by temperance taught
In what thou eat and drink, seeking from thence
Due nourishment, not gluttonous delight,
Till many years over thy head return:
So may thou live, till like ripe Fruit thou drop
Into thy Mother's lap, or be with ease
Gathered, not harshly plucked, for death mature.
John Milton
Paradise Lost, Book XI (1667)

Introduction

Life expectancy at birth is now 75 years, compared with about 47 years at the beginning of this century (NCHS 1988). The average age and the proportion of the older population are also increasing. Individuals over age 65 now comprise 12 percent of the population, compared with 4 percent in 1900. This percentage is expected to rise to 21 percent by the year 2030. People who survive to old age are living longer. For example, persons reaching age 65 in 1984 had an average life expectancy of an additional 17 years (19 years for women and 14.5 years for men), and life expectancy at age 65 has increased 2.5 years just since 1960 (NCHS 1986). This increased life expectancy for older Americans is resulting in an even more rapid growth in the populations over age 75 and over age 85.

The lack of a satisfactory definition of old is a problem. What is old? Who is old? When does one become old? Clearly, physiologic age is not the same as chronologic age. On the other hand, numerous attempts to find a simple and accurate indicator of physiologic age have not yet yielded a satisfactory instrument. This discussion employs simple chronologic cutoffs, recognizing, however, that there is tremendous heterogeneity within the populations over 65, over 75, and over 85. The general term *older* will refer to Americans over age 65.

Historical Perspective

Nutritional issues are prominent in the history of gerontology, and dietary advice for the aged can be traced back as far as recorded history. The field of nutrition and aging can be divided into studies in humans on dietary adequacy, requirements, guidelines, etc. and studies in animal models aimed at retarding the aging rate via diet. This chapter discusses the human studies but does not examine in detail the large amount of literature on animals.

Certain theories about the basic causes of aging are related directly to nutrition. One theory proposed at the beginning of this century, for example, was that the gradual accumulation of toxins secreted by intestinal bacteria caused aging and that eating certain types of yogurt could prevent this accumulation (Mechnikova 1921). Aldous Huxley satirized this theory in his novel *After Many a Summer Dies the Swan*, in which a character eats raw carp in an attempt to populate his intestines with the “good” microorganisms of this long-lived fish. More recent theories attribute aging to the gradual oxidation of membrane lipids throughout life and promote consumption of compounds with antioxidant properties (Harman 1982). Dietary caloric restriction without malnutrition in rodents and other diverse animals substantially prolongs lifespan and retards most aspects of biologic aging (Masoro 1985; Weindruch and Walford 1988). Dietary restriction is effective in rodents when started in early life or mid-adulthood. This result has been reproduced many times since it was first described in the 1930's (McCay, Crowell, and Maynard 1935), but underlying mechanisms remain vague. Dietary restriction is attracting broad attention because it provides the best model now available to study the biology of decelerated aging. How calorie-restricted regimens affect aging in primates is not well known.

Older persons are susceptible to extravagant claims for the effects of nutritional manipulations and supplements. Nutritional science provides an important service by evaluating these claims and limiting the damage resulting from such quackery (see chapter on dietary fads and frauds).

In the past two decades, the scientific community has increased attention on the nutritional status of older people. Although specific nutritional problems have been documented among older Americans, the relationship of diet to morbidity and mortality in this age group is not always clear. What is clear is that prevention of many of the health problems of old age must necessarily begin much earlier in life.

This chapter reviews age-related physiologic, psychologic, and socioeconomic changes that can influence nutritional status of older Americans; discusses issues related to the nutritional requirements of older persons; and describes the effects of nutritional deficiencies on the health of the older population.

Significance for Public Health

Although not inevitable, health and mobility often change and decline with advancing age. The increasing life expectancy at age 65 observed throughout this century suggests that diet, exercise, and other personal and socioeconomic factors can help prolong good health for most people (Rowe and Kahn 1987). Nevertheless, the chances are great that an individual in the eighth or ninth decade of life will be limited in activity and require health and social services. Many older Americans suffer from arthritis, heart disease, hypertension, hearing loss, diabetes, obesity, gastrointestinal conditions, liver disease, and cancer and other chronic diseases. More than 60 percent of people over age 65 have high blood pressure and approximately 30 percent have heart disease. Heart disease, cancer, and stroke account for over three-quarters of the deaths among older persons and 50 percent of all days of bed confinement (U.S. Senate 1987/88; NCHS 1986).

Such chronic conditions as well as dementia prevent functional independence and increase the need for dietary and other long-term care services. In 1985, for example, more than 5 million persons over age 65 needed special care to remain independent, and this figure is expected to exceed 7 million by the year 2000. Nearly 3 million older Americans residing outside institutions have been estimated to require assistance with basic activities related to food consumption such as shopping, meal preparation, or eating (Posner and Krachenfels 1987). One survey has estimated that three-fourths of all patients receiving home health care require therapeutic diets and could benefit from the services of trained nutrition professionals (Gaffney and Singer 1985).

The total costs of health care for older persons are not known precisely. In 1986, health expenditures made up 29 percent of the nearly \$270 billion paid by the Government for programs and services for the older population, but older Americans still disbursed an estimated average of 15 percent of their personal income for health care (U.S. Senate 1987/88).

One difficulty in determining the effect of nutrition on the health of older Americans is that there are no recent national food consumption and

nutritional status data on this group, and hence no data on national trends. Currently available national data come from the Nationwide Food Consumption Survey (NFCS) conducted in 1977–78 and the National Health and Nutrition Examination Surveys (NHANES I and II) conducted from 1971–74 and 1976–80 (see chapter on dietary patterns and practices). Some of this information will be discussed below in the section on energy and nutrient status of the older population. New national data on food consumption and/or nutritional status of older individuals will be provided by the U.S. Department of Agriculture's (USDA's) 1988 NFCS and DHHS's NHANES III, which began data collection in 1988. In addition, plans are being developed to conduct a special survey of food consumption of older persons as part of USDA's Continuing Survey of Food Intakes by Individuals.

Policy Background

Nutrition Services and Programs

Until the early 1970's, nutrition services for the older population, with the exception of food stamps, were based almost exclusively in hospitals and long-term care facilities and included routine dietary screening, nutritional status assessment, dietary counseling, oral or intravenous nutritional support, and food service. These services continue to be provided. Because they are not usually reimbursable under current cost-containment guidelines, they are especially vulnerable to fiscal constraints (Posner and Krachenfels 1987).

In 1973, in response to the growing population of older Americans, to rising health care costs, and to greater interest in preventive health care, the Nutrition Program for the Elderly was established under the Administration on Aging to expand food and nutrition services from the hospital to include communities and homes. Current Federal programs support the functional independence of older individuals in ambulatory care centers, adult day care centers, hospices, and home settings. These food and nutrition activities include the USDA's Food Stamp Program, which serves more than 2 million older Americans, and two programs administered by the Nutrition Program for Older Americans—Congregate Meals, which also serves about 2 million individuals, and Home-Delivered Meals, which serves 0.5 million. Despite limitations in size and scope, these programs have been demonstrated to improve the dietary intake and nutritional status of participants (Czajka-Narins et al. 1987).

Surgeon General's Workshop on Health Promotion and Aging

The 1988 Surgeon General's Workshop on Health Promotion and Aging addressed nutrition and aging issues (DHHS 1988). The workshop report regarding nutrition and aging was based on the premise that "good nutritional status is essential for a high quality of life and food contributes to the quality of life through psychological, social, as well as physical mechanisms." This premise is based on the assumptions that older people vary greatly in their social, economic, and lifestyle situations, functional capacity, and physical conditions; that nutrition policy should be crafted from a multidisciplinary framework; that a critical shortage of knowledgeable personnel in the areas of nutrition education, research, and service now exists; and that because the research base for nutrition of older Americans is evolving, specific recommendations must be periodically reviewed and updated.

The workshop report identified priorities related to (1) sound public education tailored to the special concerns of old age, such as multiple drug regimens, appropriate energy intakes, and the effects of existing chronic diseases on nutritional status; (2) professional education on geriatric concerns integrated into the core curriculum, inservice training, and continuing education of dietitians and other health care professionals; (3) counseling provided by credentialed nutrition professionals in institutional or community-based programs providing health services to older adults; and (4) appropriate financing for nutrition services delivered to older people as part of routine and long-term care.

Key Scientific Issues

- Effects of Aging on Nutritional Status
- Evaluation of the Nutritional Status of the Older Population
- Effects of Nutritional Deficiencies on the Older Population

Effects of Aging on Nutritional Status

Aging is accompanied by a variety of physiologic, psychologic, economic, and social changes that may compromise nutritional status. All of these changes do not necessarily occur in all individuals, however, and many older people remain in excellent health until very old age. Older persons have a high prevalence of chronic disease, use medications heavily, and are relatively sedentary. Many of the seemingly inevitable consequences of aging may actually be caused by these other factors (Letsov and Price

1987). The role of exercise in the health of older persons has been reviewed recently (Smith, Smith, and Gilligan 1988).

Physiologic Changes

Many physiologic functions, including the senses of smell and possibly taste, decrease with age (Schiffman, Mors, and Erickson 1976; Kamath 1982; Smith, Smith, and Gilligan 1988; Chauhan et al. 1987). These changes may result in decreased appetite as well as impaired utilization of nutrients and limitations of function.

Dental problems, common in old age, decrease the ability to chew certain foods (Albanese 1978). Physical disabilities such as diminution of vision may make eating less pleasant (Roe 1985). Although the decreases in basal metabolic rate and physical activity noted with increasing age in some studies reduce nutrient needs, older people may still consume insufficient calories and essential nutrients (McGandy et al. 1966; McGandy 1986). Decreased physical activity also may predispose individuals to the development of osteoporosis (see chapter on skeletal diseases).

Changes such as osteoarthritis, which affects 16 million people in this country, can affect mobility and decrease an older person's ability to purchase and prepare food (Garetz 1976). Another possible hindrance to adequate nutrition in the aged is malabsorption, which can be caused by a decrease or absence of gastric acid secretion and by interactions with medications commonly prescribed for older persons (Butler and Lewis 1977; Russell 1986; Roe 1985; Hathcock 1987). Whether these changes contribute to nutrient deficiencies in older people has not been established, nor is it known whether such changes are related more to the use of medications, to poor health, or to sedentary lifestyle than to age itself (Letsov and Price 1987). Recent studies, for example, have demonstrated that exercise prevents or delays the onset of musculoskeletal disabilities in older adults (Lane et al. 1987).

Psychologic Changes

The most common psychologic factor affecting nutrition is depression (Garetz 1976). Of all psychiatric diagnoses, depression is most strongly correlated with increased morbidity and mortality, regardless of the age of the subjects (Widgor and Morris 1977; Nielsen, Homma, and Bjorn-Henriksen 1977), and is most often related to chronic disease and to poverty, which are common among older persons. At least 30 percent of noninstitutionalized men and women over the age of 65 live alone (Todhunter 1976; AARP 1985). Neither institutionalization nor solitary