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COMMITTEE PRINT

NATIONAL NUTRITION POLICY:

NUTRITION, HEALTH, AND DEVELOPMENT

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A WORKING PAPER

COMPILED BY THE

ANEL ON NUTRITION AND HEALTH SERVICES

OF THE

PANEL ON NUTRITION AND HEALTH

FOR THE

SELECT COMMITTEE ON NUTRITION AND HUMAN NEEDS UNITED STATES SENATE

JUNE 1974

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THE RELATIONSHIP OF NUTRITION TO BRAIN DEVELOPMENT AND BEHAVIOR

A Position Paper of the Food and Nutrition Board

PREPARED BY

THE SUBCOMMITTEE ON NUTRITION, BRAIN DEVELOPMENT AND BEHAVIOR OF THE COMMITTEE ON INTERNATIONAL NUTRITION PROGRAMS

NATIONAL ACADEMY OF SCIENCES
NATIONAL RESEARCH COUNCIL

Washington, D.C., June 1973

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NOTICE

The project that is the subject of this report was approved by the Governing Board of the National Research Council, acting in behalf of the National Academy of Sciences. Such approval reflects the Board's judgment that the project is of national importance and appropriate with respect to both the purposes and resources of the National Research Council.

The members of the committee selected to undertake this project and prepare this report were chosen for recognized scholarly competence and with due consideration for the balance of disciplines appropriate to the project. Responsibility for the detailed aspects of this report rests with that committee.

Each report issuing from a study committee of the National Research Council is reviewed by an independent group of qualified individuals according to procedures established and monitored by the Report Review Committee of the National Academy of Sciences. Distribution of the report is approved, by the President of the Academy, upon satisfactory completion of the review process.

PREFACE

Popularized summaries of results of research on the effects of malnutrition on brain development and behavior of children frequently tend to misinterpret the effects or are overly simplistic in interpretation of cause and effect. This statement—prepared for the Food and Nutrition Board by the Subcommittee on Nutrition, Brain Development, and Behavior of the Board's Committee on International Nutrition Programs—assesses present knowledge of the relationship of nutrition to brain development and behavior in the perspective of the many factors that influence that process.

SUBCOMMITTEE ON NUTRITION, BRAIN DEVELOPMENT AND BEHAVIOR.
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Introduction

The physical, chemical, and physiological development of the brain and consequent behavior in all species of higher animals evolve from the continuous interaction of genetic and numerous environmental factors. Among the latter are nutritional, disease, psychological, learning, and cultural variables. Of these, nutrition is concerned directly with providing energy and nutrients needed for cellular structures and various metabolic systems. Indirectly, food may serve as a stimulus for behavior as well as providing a basis for social interaction.

In most instances, the specific effects of sub-optimal nutrition on brain development in man are inseparable from those of other environmental factors. Adequate nutrition generally is part of a good environment; malnutrition occurs primarily within poor environments in which many other forces may also limit the individual's development. In any event, malnutrition is detrimental in both good and poor environments but not necessarily equivalently so.

In some instances—such as when nutrients are imperfectly utilized owing to inborn errors of metabolism, or when nutrients are lacking, as in specific nutrient deficiencies—malnutrition, *per se*, clearly alters the central nervous system by acutely or chronically limiting its metabolic, structural, and functional capabilities and performance. In other circumstances, malnutrition, reflected in chronic limitation of amounts of food consumed, may result in general stunting of growth accompanied by reduced brain size, decreased brain cell number, and immature or incomplete biochemical organization of the brain.

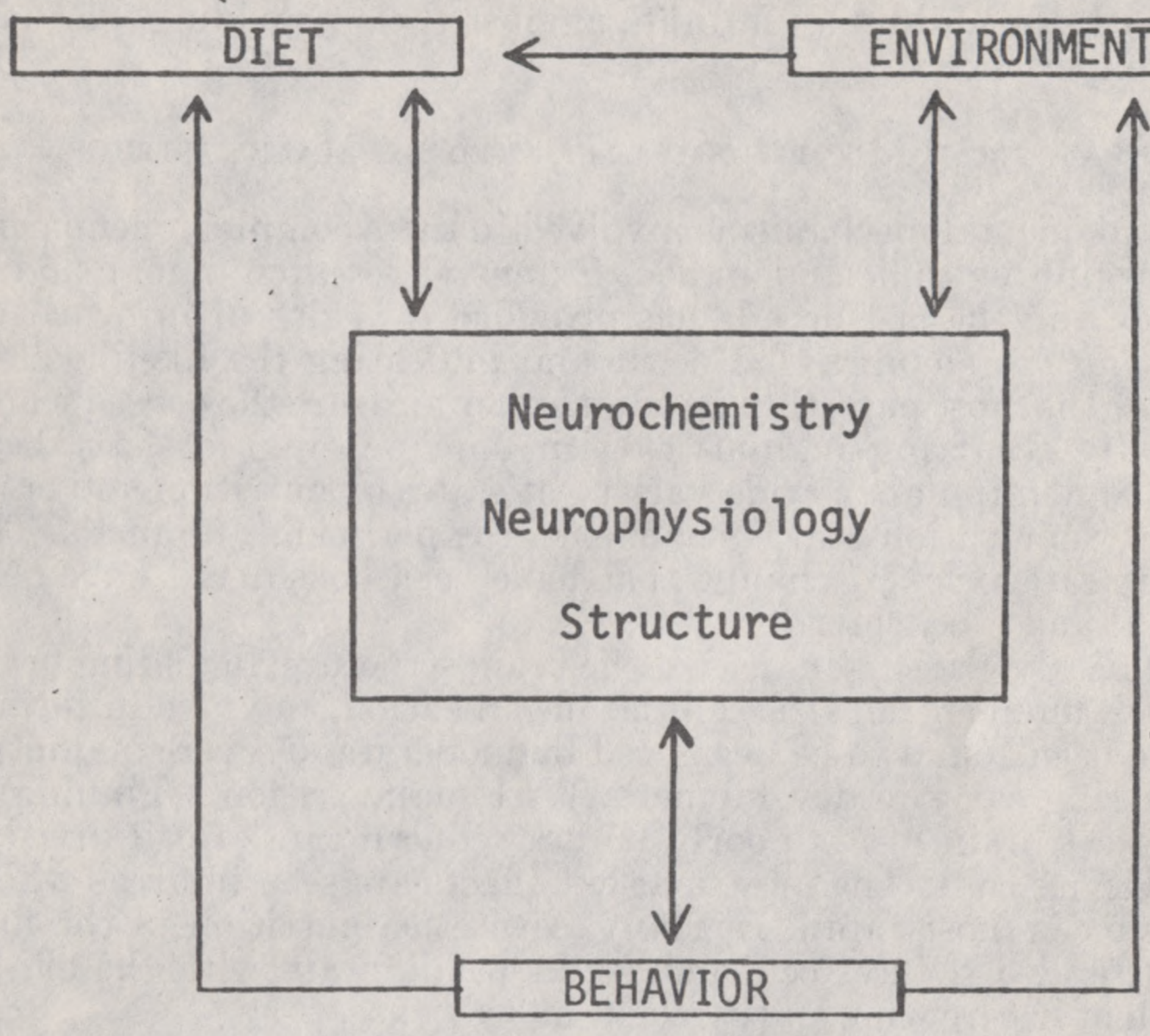
Unified Concept of Factors Affecting Brain and Behavior

A concept unifying these many interrelationships is expressed in Figure 1. The diet provides the nutrients for the metabolism of brain cells. The quality (nutritional content, wholesomeness) and quantity of the diet depend not only upon the availability of foods, but also upon such other factors as appetite appeal, local custom, and purchasing power that may control food use. Furthermore, the individual's health (metabolic disease, dental status, infection, parasitic infestation) may modify nutritional requirements as well as alter the ingestion, digestion, assimilation, and utilization of foods.

The environment, in addition to influencing the composition and acceptability of the diet, has other important effects on the brain. External stimulation from the environment directly affects the neurophysiological activity of the brain. The diagram in Figure 1 shows how these diverse factors are interrelated and interdependent.

The many elements incorporated into this simplistic model may, in fact, occur in a wide variety of combinations. Their cumulative impact on brain and behavior is not simply additive but the interrelationships are multiplicative. Furthermore, there are certain critical or time limited periods in an individual's lifetime when the central nervous system is especially vulnerable, thus, the effect of a specific variable is dependent on the age when it occurs as well as the degree of severity of deprivation and its duration.

FIGURE 1



Gestation provides one example of such a critical period. Fetal development is controlled not only by genetic contributions from both parents but also directly by maternal physical and nutritional status. It is during gestation that neuronal growth is maximal. If the fetus is malnourished, resulting in low birth weight for age at delivery, or delivered prematurely because of maternal disability, his brain growth may be directly affected. Similarly, impaired fetal development may increase the vulnerability of the newborn infant to subsequent poor nutrition and environmental stress. Compared to a child normal at birth, the underdeveloped newborn would grow less well, would be likely to have more illnesses, and probably would have limitations in brain development and behavior.

Possible Modes of Interference With Learning and Behavior by Malnutrition

Nutritional and environmental factors may affect the central nervous system's capability and performance in a variety of ways. First, abnormalities of morphologic, biochemical, and/or psysiological characteristics may so alter normal brain function as to reduce learning abilities. Secondly, the developmental process may be impaired by decreased exposure and responsiveness to environmental stimuli during critical periods when essential sequences of experience must be acquired to provide for continued orderly development. Third, the learning process may be disrupted by adverse changes in personality,

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emotionality, and behavior of the child. These changes may interfere with the interpersonal relationships that are necessary for learning experience. Furthermore, malnutrition among the persons in social contact with the child may militate against their providing adequate learning experience.

Fundamental Mechanisms Affected by Malnutrition

The fundamental mechanisms involved in these complex phenomena are just beginning to be understood. Extensive research in man and in animals during the last decade has provided a wealth of information documenting the changes that occur and indicating the likelihood of others. For the most part, these studies either measure the consequences of naturally occurring malnutrition in human beings or have been designed to manipulate a wide variety of states of nutrition and environmental deprivation and enrichment in experimental animals. The two major categories of change that have been considered have been anatomical and biochemical.

Anatomically, various indices of the brain structure, including brain weight, cell number, cell size, cellular organization, and myelin formation, have been found to be decreased by moderate to severe malnutrition occurring early in development. With malnutrition beginning at birth, the rat brain grows poorly with a reduced rate of cell division in all dividing cells. The most marked effects are seen in areas where cell division is most rapid. In many, severe malnutrition in the first year of life also reduces cell number in whole brain with the effects most evident in cerebrum and cerebellum.

There are now ample data demonstrating that severe general malnutrition during early postnatal life will affect brain structure and disrupt normal chemical development. Numerous biochemical features have been found to be reduced or altered by early malnutrition. This has been shown by measurements of RNA, DNA, proteins, glycosides, lipids, activity of a variety of enzymes, and neurotransmitters.

Myelination of the brain in the rat, pig, and man is also significantly affected by severe early malnutrition with reduction in cholesterol, phospholipid, and ganglioside content. Activity of certain enzymes involved in myelin synthesis is reduced with diminution in the rate of myelin formation. In rats, many of these changes are not reversible if the rehabilitation is begun after the age when normal myelination occurs.

There is evidence in experimental animals and man suggesting that in the prenatal period there are at least two types of intrauterine malnutrition. The first type ensues from a poor maternal diet before and/or during pregnancy which results in a reduction of the number of brain cells in the fetal brain (rats, guinea pigs) and in an increased effect of subsequent postnatal malnutrition (rat) on later brain growth. The second type of intrauterine malnutrition results from placental insufficiency. Although having a lesser effect on the developing brain than does maternal dietary inadequacy, placental insufficiency may nevertheless produce changes in the activity of certain enzymes (rat) and in the DNA, RNA, and protein content of the cerebellum (primate). Further information is necessary to elucidate the mechanisms involved in these changes, the precise conditions necessary to produce them, and their physiological significance.

Environmental Enrichment and Deprivation

Studies of developing organisms have shown that rearing adequately nourished animals under environmental enrichment or isolation significantly influences the ultimate structure, and function, of the brain. In enriched environments, experimental animals have been found to have significant increases in brain weight and nucleic acid content, dendritic arborization, myelination, acetylcholinesterase content, etc. In contrast, isolation has been shown to have a profound and opposite effect on these indices of development.

The conceptual scheme illustrated in Figure 1 diagrams the pathways that account for the similarities between nutritional and environmental deprivation and between nutritional and environmental enrichment. The neurohumoral systems of the body react to conditions of stimulation and stress, mediating alternations in the metabolism of nutrients in brain cells that result in the changes observed. With malnutrition, the nutrient supply available to the brain cells is reduced, producing metabolic abnormalities and decreases in neurochemical activity as well as potentially deranging the neuroendocrine systems that transmit the effects of stress and stimuli to the brain.

Electrophysiological Measurements in Malnutrition

The electrophysiological activity of the nervous system serves to integrate its metabolic and neurochemical processes into functional and performance capabilities. A number of techniques of measurements of electrophysiological activity such as electroencephalogram (EEG), evoked response, electroretinogram, and nerve conduction velocity, have been used in the study of malnourished subjects.

In man and in lower animals, the normal EEG patterns and their developmental sequence have been shown to become abnormal in chronic and acute states of malnutrition suggesting alterations in normal cellular electrical activity. The abnormal electroencephalographic tracings seen in malnourished subjects generally improve toward normal with adequate nutritional therapy. These evaluations have routinely been made by visual inspection of the EEG tracings without the benefit of contemporary quantitative analysis, which might be more informative. Furthermore, no long-term follow-up recordings have been compared with EEG's of normal control subjects.

Effect of Malnutrition on Human Behavioral Development

Early severe malnutrition requiring hospitalization and rehabilitation is consistently associated with deficits in physical and psychological development during early life. Studies of the familial characteristics of severely malnourished children have also revealed significant social-familial pathology among those sampled. Similarly, follow-up studies in which children who were malnourished and rehabilitated early in life were tested at school ages have generally indicated that the previously malnourished children did more poorly than unrelated well-nourished controls. Some studies also have utilized well-nourished siblings to control for genetic and family factors. Again the malnourished child did poorly. However, the data are not consistent. Some studies suggest that the previously malnourished chil-

dren showed little or no deficit in performance after several years of schooling; in other studies, such children appear to remain seriously retarded in test performance. Here again social-familial factors are seen to play an important role.

At present, it is impossible to say whether malnutrition, *per se*, contributes more or less to the depressed cognitive development of previously malnourished children than do unfortunate social and environmental conditions. No investigation has completely addressed the question of the relative importance of malnutrition versus social environmental factors in cognitive development; the findings have consistently been that both are significant.

Nevertheless, in spite of many serious methodological shortcomings in the studies that have been made, the weight of evidence seems to indicate that early and severe malnutrition is an important factor in later intellectual development, above and beyond the effects of social-familial influences.

The effects of mild to moderate protein-calorie malnutrition, or chronic sub-nutrition, on later intellectual development is less clear. Here again, social-familial factors are seen to play an important role. Studies that have attempted to assess the relative contribution of moderate malnutrition (or under-nutrition) and social factors to later intellectual performance have frequently found that malnutrition does play a role apart from factors related to social status. This is a tentative conclusion, however, and confirmation awaits more systematic research.

In addition to such problems of generalized undernutrition are those associated with specific nutrient insufficiencies; anemia is a case in point. Although the data are not entirely clear, the existent studies suggest that anemia in the preschool years adversely affects motivation and ability to concentrate for extended periods of time. The mechanisms moderating these behavioral changes are by no means clear. More research is obviously important.

The Effect on Hunger on Intellectual (School?) Performance

It is surprising that little or no objective, soundly planned research concerning hunger and the behavior of children has been reported. In this context, it is pertinent to note that hunger differs from malnutrition in important ways. Hunger occurs when an individual has insufficient food intake to provide a general sense of wellbeing and to meet immediate energy needs. Although it has both physiologic and psychologic components, hunger does not permanently alter neurological structures. One difficulty in systematically studying hunger is that the more frequently used nutritional standards may not describe or quantify hunger. Furthermore, the outcome variables most probably lie in general behavior patterns rather than in the standard measurement of intelligence (IQ). However, disruption of behavior patterns in learning situations ultimately probably would adversely affect IQ test performance.

One way to assess the impact of hunger on child development is to examine behavior and learning in preschool and school settings. In

all such settings, undernourished or hungry children have been reported to exhibit behavioral alterations—including apathy, lethargy, inability to pay attention, and perhaps over-concern about food—so that responses to educational stimulation do not occur. Hyperactivity or hyperirritability may also accompany hunger and contribute to poor learning ability.

Learning is recognized as progressing in stages, each of which becomes a foundation for the next departmental period. By not responding to early stimulation, a hungry or malnourished child gradually would become less able to benefit from later experiences. Thus he would fail to learn, not because the genetic potential or neurological structures were absent, but because he lacked the experiential foundation. The potential importance of these possibilities are readily apparent.

There is an extensive feeding program for school children in the United States and there are plans to include both breakfast and lunch in many areas and to extend the program to preschool children. These programs are predicated in part on the assumption that they will facilitate learning. And yet, the impact of hunger on school performance has not been documented nor have the comparative results of breakfast, snack, or lunch programs been demonstrated in learning and behavior in school settings.

More careful studies on the physiologic and psychologic aspects of hunger and school performance clearly are needed to provide information to assist in designing the most effective school feeding programs for educational gain.

Behavioral Studies With Experimental Animal Models of Severe Protein-Calorie Malnutrition During Early Life

Studies on experimental animals have contributed a great deal to our knowledge of the interrelationships between nutrition, brain development, and behavior. Rats, mice, pigs, and monkeys have been used most extensively—each species providing clues that have made it possible somewhat realistically to translate findings from the experimental model to man. Even though final conclusions regarding nutritional effects in man must come from studies in man himself, the use of experimental models facilitates the control of nutritional and environmental variables far beyond that which can be achieved in man. Furthermore, the animal model permits a relatively rapid accumulation of knowledge from which specific concepts can be selected for verification in human beings, thus simplifying the experimental design and improving the chances of successful studies in man.

The infant animal subjected to protein-calorie malnutrition exhibits the same characteristics of apathy to its surroundings as those seen in the malnourished infant human being. Even more striking than apathy in the experimental animal is the actual avoidance of a new object introduced into a familiar environment. Because of the potential importance of avoidance behavior to learning and intellectual development, this phenomenon should be examined in studies with malnourished infants.

There is a striking similarity in the behavioral characteristics seen in the experimental animal following rehabilitation from early severe malnutrition and the abnormal behavior of the animal that has recovered from a period of environmental isolation during infancy. When nutrition and environment exposure have been restricted for short periods after birth and the animals are then permitted to grow to adult size under normal conditions, early isolation has exaggerated the behavioral effects of early malnutrition. Conversely, early environmental enrichment greatly decreased the abnormal behavior expected to result from early malnutrition. Preliminary studies in malnourished children suggest that both nutritional supplementation and educational stimulation may be required to overcome the effects of severe deprivation in early life.

Animal studies have also shown that among the long lasting behavioral changes caused by early malnutrition is an elevated or exaggerated emotionality when the animal is exposed to an aversive, painful, or frightening situation. There is also evidence that motivation is altered by such rewards as food and water. These behavioral changes influence the performance of an animal in a learning test.

Some of the long lasting behavioral changes seen in the postnatally deprived rat also have been observed in rats that were nutritionally deprived during *in utero* development as a consequence of malnourishment in the pregnant dam. In order to separate prenatal from postnatal deprivations, pups from malnourished dams were foster-suckled by dams fed normally during their pregnancy. The results of these studies suggested that nutritional deprivations of the mother that exist prior to parturition can have long lasting behavioral effects on her progeny.

The combined effects of early malnutrition and early environmental enrichment on behavior in experimental animals suggest that abnormal behavior and ability to learn are not necessarily permanent consequences of malnutrition but that variable degrees of improvement may be obtained by the appropriate application of environmental enrichment and nutritional rehabilitation.

Finally, early severe protein-calorie malnutrition has been shown in lower animals to result in a long lasting, possibly permanent retardation in the growth of various parts of the body including the brain. This stunting of growth, which reflects a decrease in the total number of cells formed in such tissues as the brain, may be related to an impaired function of that tissue. However, a causal relationship has not yet been established between the smaller brain of the previously malnourished animal and its behavioral development.

Projected Needs

Present evidence indicates that malnutrition, *per se*, and as an integral part of the environmental complex, may adversely affect brain development and behavior both directly and indirectly.

However, continued study in animals and man is needed to identify and document more clearly the interacting effects between nutrition and other environmental factors in terms of brain development and behavior. The subtleties of these interrelationships, their prevalence,

and their consequences for the individual and for both national and international communities need to be defined. We must identify underlying mechanisms and improve means of treatment and prevention of their derangement. These tasks will require major and continuing commitments of money and people to basic research, development of more specific and sensitive testing techniques for both man and animals, and constant improvement in the design and conduct of studies at all levels.

Every effort must be made to disseminate information about what is already known in order to correct and prevent malnutrition even though solutions to these problems are not yet available. If effective measures to do this are not at hand, they should be developed and applied to their fullest extent using the most appropriate means available.

The effectiveness of these approaches, their further improvement, and continued success will depend on ongoing research. Close collaboration among resources from the scientific community, government, and industry will be essential to refine methodologies and to achieve the goals implied in the terms "good nutrition" and "optimal intellectual development."

The American Dietetic Association
Position Paper on
The Nutrition Component of Health Services Delivery Systems

"Nutrition services under the supervision of qualified nutrition personnel should be a component of *all* health and health-related programs and should be designed to reach the total population with priority given to such nutritionally vulnerable groups as infants, children, and youth in the growing years, women in the child-bearing years, and the older age population." (1). The need for the Association to interpret and expand this policy statement is based on a recognition and concern that:

(a) The need and demand for quality health care by the population is not being met by, and is critically straining, the current health care delivery system.

(b) The alarming increase in the cost of medical care mandates a review and evaluation of the present health care delivery system.

The American Dietetic Association's position is that inclusion of nutrition as a component of health care will significantly reduce the number of people requiring sick care service and, therefore, contribute directly to:

(a) A relief of strain on the nation's health care delivery system;

(b) A decrease in the escalating rate of health care costs;

(c) An increase in physical, mental, and social well-being of people so that they may achieve and maintain productive and independent lives.

Nutrition is a critical factor in the promotion of health and prevention of disease and in recovery and rehabilitation from illness or injury. Evidence mounts that Americans who fail to attain a diet optimal for health can be found at every socio-economic level. The reasons are many and complex, but the impact on the health of the nation is seen in the increased risk of complications of pregnancy in the poorly nourished woman, in the chance that her infant may be of low birth weight with accompanying risk of retarded physical and mental development; in the high incidence of overweight and underweight in school-age children and in adults; in the debilitation of the malnourished elderly; in dental disease, widespread in the total population; and in the high

[1]Approved by the Executive Board, February 12, 1971, as Position Paper Number 0000E.

One of the main problems resulting from the lack of nutrition training in the nation's medical schools is that however much individual physicians in the federal or state planning agencies may protest their interest, nutrition almost invariably ends up being left out as a component of health-care delivery systems. Indeed, less than two years after the White House Conference on Food, Nutrition and Health, the two strongest nutrition bureaus at the state health level (New York and California) are threatened with extinction.

With government at all levels responsible for an ever increasing proportion of health expenditures, with these expenditures mounting without appreciable effect on the health statistics of the nation, it is becoming obvious that emphasis must be shifted from purely curative to prevention and rehabilitation. This means that nutrition should assume even more importance than in the past. In terms of money—as in terms of human suffering—one can well argue that every dollar spent on nutrition instruction may save tens of dollars in later medical care.

I am delighted to see that The American Dietetic Association has once again asserted its leadership in human nutrition by preparing and endorsing a position paper which outlines clearly the necessary nutrition services to be included in comprehensive health schemes. The paper also clearly describes the need for nutrition input at the planning stages if nutrition services are to be properly structured. At present, the United States Department of Agriculture is operating a gigantic (over $3 billion) food program with what many think is much too small a nutrition component. Present indications are that the Department of Health, Education and Welfare is similarly casual about nutrition. I commend this position paper to health planners at all levels.—*Jean Mayer, Ph.D., D.Sc., A.M. (hon), M.D. (hon), Professor of Nutrition, Harvard School of Public Health, and Chairman, White House Conference on Food, Nutrition and Health.*

incidence of chronic illnesses that require dietary treatment, monitoring, and follow-up. Since it is apparent that improvements in the nutrition of people will have a direct effect on the level of health and the resulting need for health services The American Dietetic Association recommends that:

I. Nutritional care, as a component of health care, be available to all people on a continuing and coordinated basis. *Nutritional care* is the application of nutrition science to the health care of people. In its broadest sense, nutritional care is provided to the general population through studies of food consumption and nutritional health, mass education, and food assistance programs. As applied to patient care, it has the same components (assessment of food practices and nutritional status, nutrition education, and food assistance) plus dietary counseling and the service of appropriate food. These nutritional care services must be combined and coordinated to meet individual needs.

II. Nutritional care be integrated into preventive, diagnostic, curative, and restorative health services. Any contemplated health services delivery system should include a nutrition component in its preventive as well as remedial services, if the maximum benefits to health are to be achieved. The following example illustrates the application of this recommendation:

HEALTH SERVICES	NUTRITIONAL CARE
Public health service—health promotion	mass nutrition education; supplemental food assistance
Health-testing service (7)	assessment of food intake and other indexes of nutritional status
Health care service	nutrition education and counseling, food assistance, appropriate food service
Preventive, maintenance service	dietary counseling, food assistance, appropriate food service
Sick-care service	for all levels of in-patient care, appropriate food service, diet therapy, dietary counseling

III. The planning and supervision of nutritional care be under the direction of persons professionally educated in nutrition as it relates to human health needs. Dietitians and public health nutritionists, with their educated knowledge of foods and nutrition, are the health professionals who are prepared specifically to help individuals and groups improve their diets and their nutritional status. (In this paper, the term *dietitian* shall be interpreted to mean either a public health nutritionist or a dietitian who is qualified for registration in The American Dietetic Association.) Supportive personnel (dietetic technicians, dietetic assistants) extend the knowledge and skills of dietitians to greater numbers of people.

IV. Dietitians function at the planning and policy-making level of federal, regional, state, and local comprehensive health planning bodies to assure that an appropriate nutritional care component is incorporated into all comprehensive health care planning.

V. Comprehensive health care plans include appropriate administrative placement of the nutrition care component; staffing patterns and qualifications for personnel; identification of nature and extent of nutrition problems; standards of nutritional care; methods to be used for delivery of nutrition services; and evaluation.

VI. To assure that a supply of dietitians is available and accessible to those in need of nutritional care, steps should be taken to:
   A. Support the expansion of existing education and training facilities in nutrition and dietetics and the development of new facilities.
   B. Increase support available to students of education and training in nutrition by means of scholarships, loans, and other financial mechanisms.
   C. Explore and establish new approaches to undergraduate, graduate, and technical education.
   D. Utilize supportive dietetic personnel and improve their career development and status in the health care system.
   E. Explore other means to increase the dietetic manpower supply through such mechanisms as proficiency and equivalency examinations and other recruiting efforts.

VII. Dietitians be eligible for payments as providers of health care services. Future health care legislation should stipulate dietary counseling services as an eligible service for third party payment.

VIII. Adequate funding for preventive as well as curative nutritional care services be provided. Until such time as the nation is geared to deliver comprehensive family health care, nutrition services should be supported in existing specialized programs and services, such as: health services for mothers and children; the elderly; special groups, such as migrant agricultural workers and low-income families; family planning programs; chronic disease control services; home health services, rehabilitation services for drug and alcohol addicts; and group care services in facilities such as hospitals, nursing homes, extended care facilities, day-care centers, and residential institutions; detention. centers, detoxification centers, and prisons.

XI. A careful appraisal be made of the economic benefits of nutritional care in a comprehensive medical care system. Such an appraisal should also include evaluation of the effectiveness of preventive nutritional care, as well as remedial services, on such variables as cost, absenteeism, worker productivity, and so on.

X. Any national health insurance program adopted

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include incentives for the development of preventive health services. Nutritional care should be identified in the legislation as an essential component of preventive health care service.

XI. Standards for nutritional care services be included in all federal and state guidelines and regulations for health care.

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The American Dietetic Association Position Paper on Nutrition and Aging

The American Dietetic Association, in its commitment to the improvement of the health and nutritional status of persons over age sixty, recognizes that aging is a life-long process that begins at conception and that adequate nutritional care for the elderly must be considered in connection with the inter-related economic, social, physiologic, and psychologic changes coincidental with aging (1-5).

In fulfilling this commitment, the Association:

A. Takes the position that the planning and implementation of the food and nutrition components of programs for the elderly should be under the leadership of qualified dietitians (6).

B. Believes that qualified dietitians should be involved in the planning of any food service facility for the aged (6).

C. Endorses, in principle, the recommendations of the White House Conference on Aging, 1971 (7).

D. Supports food and nutrition programs for the elderly which should encompass not only food assistance and group meals in a social setting, but also include:
   1. Adequate transportation for food shopping and to group meals.
   2. Home-delivered meals.
   3. Comprehensive on-going activities directed to the hard-to-reach elderly (8).

E. Advocates the maintenance of high standards of nutritional care through:
   1. Counseling and appropriate education of personnel providing care for the elderly in institutions.
   2. Teaching and counseling both individuals and groups of older persons, in their homes, in community settings, and in institutions, of the importance of an adequate diet.
   3. Interpreting modified diets prescribed by the physician.
   4. Cooperating with other associations in activities related to combating food misinformation and in the preparation of information for distribution through libraries, newspapers, magazines, radio, television, and other mass media.
   5. Cooperating with the Library of Congress by suggesting references on food and nutrition which should be made available to the aging blind in either braille or as talking books (9).

F. Supports continued cooperation and involvement at the local, state, and national levels in establishing public policy and planning legislation to:
   1. Protect the nutritional health of the population throughout the life cycle.
   2. Identify and seek solutions to nutrition-related health problems of the aged.
   3. Provide nutrition education for the elderly.
   4. Conduct research to advance the knowledge of the relation of nutrition to longevity and the aging process.
   5. Promote consumer protection in relation to the safety, cost, quality, and packaging of foods (10, 11).

G. Urges that the food service and feeding practices in nursing and retirement homes, in community settings in institutions and hospitals providing long-term care to the aging be continually surveyed and assessed as to their adequacy (12).

[1]Approved by the Executive Board on October 3, 1972 as Position Paper No. 0000C—R.

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The American Dietetic Association

Position Paper on Nutrition Services in Health Maintenance Organizations[1]

THE AMERICAN DIETETIC ASSOCIATION recognizes the immediacy of the current health care crisis in the United States and the potential impact of innovative efforts that are under way to restructure health care delivery systems to provide equitable, high quality care for all; optimal utilization of health personnel; controlled costs; and consumer satisfaction (1). The dietetic profession is committed to helping meet the challenge of changing patterns of health care. It has taken a constructive position in regard to planning for and implementing the nutritional care component of new health services delivery systems (2).

President Nixon has given support to a flexible health delivery system called an "HMO," or Health Maintenance Organization (3). The U. S. Department of Health, Education, and Welfare describes (4) the basic structure of an HMO as follows:

> It is an organized system of health care which accepts the responsibility to provide or otherwise assure the delivery of an agreed upon set of comprehensive health maintenance and treatment services for a voluntarily enrolled group of persons in a geographic area and is reimbursed through a pre-negotiated and fixed periodic payment made by or on behalf of each person or family unit enrolled in the plan (4).

HMOs may be known by other names and may be expected to show infinite variety in their development and final forms. In common, they are designed to bring together health services which individuals and families are most likely to need, for a fixed premium paid in advance by subscribers. The health services will be provided to an enrolled population in appropriate and accessible out-patient and in-patient settings by physicians and other health personnel. An HMO is dedicated to providing:

(a) Comprehensive care, defined as a full range of health services with emphasis on prevention;

(b) Care continuity, coordinated on a family basis, throughout each member's life cycle and health-sickness cycles;

(c) Care that is organized and carried out to give maximum health service for the consumer dollar.

A keystone of successful HMO operation will be *keeping* people well in order to avoid the more complex and costly services needed to *make* them well (1)

The American Dietetic Association is committed to the principle that the inclusion of nutrition services in comprehensive health care is positively related to the maintenance of health and the reduction of sick care costs and services (2). It supports the concept of HMOs as a potentially effective way to deliver comprehensive care based on a sound patient-centered health delivery system.

The American Dietetic Association proposes, therefore, that nutritional care be identified clearly as a basic service of every HMO program. In support of this position, the Association advocates:

I. Essentiality of nutritional care

Food and nutrition are not synonymous, but are inseparable. Food is a basic biologic need of man, which is influenced quantitatively and qualitatively by a tremendously complex array of internal and external factors. Interrelationships among food, nutritional status, and physical and mental health throughout the life cycle are well documented. Poor nutritional status may be associated with retardation of growth and development, weight loss or excess, increased incidence of chronic illnesses, delayed convalescence from disease or injury, unfavorable intellectual and emotional development, and poor performance in pregnancy (5-8). In addition to its physiologic role, food throughout history has served fundamental psychologic, social, and cultural roles at all levels of civilization. The effect of food on man, in *all* of its ramifications, is the science of nutrition (9).

The term "nutritional care" encompasses the services needed to apply the science of nutrition to the benefit of an individual's health status (10). It includes at least the following essential services, combined and coordinated to meet individual and family needs:

Assessment of food practices and dietary status
Nutrition education and counseling to meet normal and therapeutic needs
Provision of, or referral to, resources for appropriate food service, special feeding equipment, and/or supplemental food assistance

[1]Approved by the Executive Board, February 15, 1972, as Position Paper Number 0000J.

Suggested Pattern of Nutrition Services in an HMO

PHASE OF HMO OPERATION	NUTRITIONAL CARE GOAL	NUTRITIONAL CARE ACTIVITIES*
Health appraisal and referral	To identify potential problems and plan for continuing surveillance or appropriate care	Assessment of food practices and nutritional status Referral for corroboration Data input into patient information systems
Environmental protection and disease prevention; health maintenance	To prepare patients and their families to assume responsibility for their own care and to manage early symptoms to prevent complications	Individual counseling Group teaching Development and/or evaluation of nutrition methods and materials Training and continuing education for medical, dental, and other professional staff; technical consultation Training and continuing education for dietetic supportive personnel Referral to, and liaison with, food assistance and other nutrition-related community programs Leadership in seeking solutions to community-wide nutrition problems Consultation to group care facilities
Acute and intensive care	To develop and implement immediate and long-range individualized nutritional care plans for in- or out-patients	Most of the activities described above On-going participation in health team planning, direct nutritional assessment and counseling, and evaluation Planning and/or supervision of appropriate group food service Health team staff conferences Initial and follow-up counseling in regard to normal and therapeutic nutritional needs Input into clinical records
Restoration and extended care	To assist patients and their families with long-term health problems to attain and maintain adequate diets	Most of the activities described above Assistance in adjusting home environment to maximize independent functioning in activities in and outside the home Liaison with non-contact services or programs helpful in carrying out the nutritional care plan

*Nutritional care activities clearly will overlap and seldom will be restricted to a single phase of operation.

Recent experiences with the implementation of Medicare-Medicaid legislation have suggested that nutrition is such an *integral* part of living that special mention of nutrition services has been overlooked with consequent eroding of the quality and scope of such services. To assure comprehensive, coordinated, quality, total patient care by an HMO, nutritional care should be mandated clearly as a basic component of the services to which a subscriber will be entitled. The quantity and quality of nutritional care should be protected by specific written guidelines and policies for every HMO, adapted to take into account the differing patterns and modules of care that may be anticipated in a delivery system emphasizing flexibility.

II. Appropriate utilization of nutrition care services
Each individual (family) nutritional care plan, determined by a dietitian should utilize an appropriate mix of specific nutrition services, through all phases of HMO patient care. These include: primary, preventive, diagnostic, acute in-patient care, in-patient and out-patient care, and rehabilitation for chronic and disabling conditions. Examples of the range of nutrition services are shown in the box above.

III. Nutritional care planning—early and on-going
Integration of the nutritional care component with medical and multidisciplinary support services begins at the early stages of organization of HMO development. The dietitian/nutritionist[2] should participate with other health team members in overall planning for an HMO. His role should include:
(a) Establishing criteria for identification of "nutritionally vulnerable" subscribers most likely to need services;
(b) Analyzing the food and nutrition needs of the subscriber population as a whole, and identi-

[2]Throughout this paper, the term "dietitian/nutritionist" refers to a person qualified for registration by The American Dietetic Association. Definitions of specialty fields for the dietitian/nutritionist appear in the *Dictionary of Occupational Titles*.

fying and establishing cross-referral relationships with other nutrition resources that may be available to subscribers (such resources may include food assistance programs, homemaker-home health aid programs that offer nutrition and/or food assistance, nutrition education, and dietary counseling;

(c) Determining priorities for implementing a program of nutritional care to assure that a broad range of nutrition services are available to subscribers and that existing services are effectively utilized;

(d) Proposing appropriate staffing patterns for nutrition personnel; preparing job descriptions; outlining program objectives, policies, and procedures that will assure efficient and effective integration of nutritional care services into the total pattern of services for the HMO;

(e) Evaluating the efficiency and effectiveness of the nutrition component of the health care services provided by the HMO.

IV. Adequacy of nutrition personnel

The dietitian should have knowledge of, and experience in, community organization and community health services and resources in order to provide the most helpful consultation and direction in planning and implementing flexible, imaginative nutritional care. The dietitian is responsible for planning functions related to the nutrition component of the HMO program (see preceding section); for training and supervising personnel who carry out primarily nutrition care activities; and for coordinating nutrition with other care components. If an HMO contracts for specialized health services or facilities, the staff of the HMO and the contract program should plan together for continuity of nutritional care and transfer of pertinent information to patient records.

The scope of nutrition services may be extended by the use of supportive personnel. The Association is committed to developing and evaluating education programs to prepare all levels of nutrition personnel for their responsibilities.

V. Financial support for the nutritional care component of the HMO program

It is economical to budget for a nutrition component as one of the basic costs on which per-capita prepayment charges are determined. Nutrition personnel in an HMO can help individuals and families become sufficiently knowledgeable to assume major responsibilities for their *own* health care and avoid the need for most costly kinds of care. Total costs can be reduced by effective use of consultation with other health team members.

It is a relatively new practice to reimburse the dietitian on a fee-for-service basis. The widespread training and ultilization of supportive nutrition personnel is also a recent trend. Projected staffing patterns and costs are, therefore, tentative, and more documentation is needed. Efforts are under way to correct this deficiency (11).

VI. Peer review and research

Nutrition personnel should help to monitor and evaluate the efficiency and effectiveness of the health care provided by an HMO. Research must be undertaken on appropriate, measurable criteria for performance reporting systems.

The American Dietetic Association urges maximal utilization of nutrition science and technology, manpower, and resources at all stages of planning, service, and evaluation of the HMO delivery system to promote the achievement of optimal health for the population at all ages. To achieve these goals, the Association accepts its responsibility to provide professional leadership in advocating quality nutritional care, in stimulating and supporting interest and participation and the delivery of nutrition care, in recommending nutrition policies and practices adapted to changing patterns of health care, and in evaluating the results of its efforts.

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Position Paper on nutrition education for the public

Definition of nutrition education

Nutrition education is the process by which beliefs, attitudes, environmental influences, and understandings about food lead to practices that are scientifically sound, practical, and consistent with individual needs and available food resources.

The American Dietetic Association takes the position that nutrition education should be available to all individuals and families. The fundamental philosophy of nutrition education is that efforts should focus on the establishment and protection of nutritional health rather than on crisis intervention. It is needed, regardless of income, location, or cultural, social, or economic practices or level of education. Nutrition education must be a continuing process through the life cycle as new research brings additional knowledge.

Planned behavioral changes

Eating behavior is psychologically motivated but is culturally and biologically determined. Any effective educational program must recognize this interaction even though it may deal actively with only one part. The solutions to nutrition problems must be diversified in approach if they are to have a significant, overall effect.

Values, attitudes, and beliefs control man's behavior; therefore, planned change is a deliberate effort to improve nutrition through intervention, and it occurs by design. The dietitian educators must understand and respect the personal meaning of these influences in others.

The process of developing planned behavioral change includes five stages:

1. Awareness—helping the individual, family, or group identify problems related to the food consumed.
2. Development of a receptive framework for learning.
   a. Establishing the credibility of the nutrition educator.
   b. Becoming aware of learner's prior perceptions about food and nutrition.
   c. Helping to state desirable changes in food practices and to decide which are feasible.
3. Experimentation—testing ideas, techniques, and programs until acceptable ones are identified.
4. Reinforcement—strengthening the learning gained during the experimentation period.
5. Adoption of change—guiding the decision to accept the change and put it into practice.

The American Dietetic Association recommends that:

1. Nutrition education be identified as a part of every program that educates for personal, family, and community health.
2. Consumers participate in defining their expectations and needs for nutrition information which can be met by nutrition education.
3. Persons who conduct nutrition education should be qualified by specific training in human nutrition and educational techniques.
4. Nutrition education with adequate funding be a regular part of the training of (a) teachers, (b) medical and dental professions, (c) allied health personnel.
5. The Association and members participate in the planning of emerging nutrition education programs and the coordination of existing ones.

Role of the dietitian

Knowledge of food and nutrition qualifies the dietitian as the health professional equipped to help individuals, families, and groups improve their food practices and their nutritional status. The dietitian is a translator of the science of nutrition into the skill of furnishing optimal nourishment to people. As nutrition educator and as trainer of others who conduct nutrition education, the dietitian:

1. Takes leadership in providing nutrition information.
2. Interprets nutrition facts accurately.
3. States them in terminology that people can un-

[1]Approved by the Executive Board, February 14, 1973, as Position Paper Number 0000k. The American Dietetic Association authorizes republication of this Position Paper in its entirety, provided full and proper credit is given. Requests for permission for republication in part should be addressed to the editor.

derstand and apply.

4. Aims to reduce the time lag between the discovery of nutrition knowledge and its application to food practices.

5. Recognizes and utilizes human motivation to bring about change in food practices.

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Association statement on new vitamin A and D regulations

The following statement was submitted to the Hearing Clerk, Department of Health, Education, and Welfare, in response to new regulations concerning vitamins A and D published by the Food and Drug Administration in the Federal Register, *December 14, 1972.*

The American Dietetic Association is in accord with the proposal by the Food and Drug Administration to limit the strength of vitamin A and D products available for over-the-counter sale. The proposed daily limit of 10,000 I.U. for vitamin A and 400 I.U. for vitamin D is at a level which would be assumed to be within safe limits when used as dietary supplements. Documented evidence of fat-soluble vitamin toxicities has been established, and excessively high dosages pose a health hazard. Most importantly, these limitations may help to protect young children from excessive intake of these vitamins through pills given by mothers with the best intent but without adequate knowledge to serve as a basis for selection.

The Association concurs that as long as non-prescription vitamin supplements are freely available and that excessively high levels of intake are even advocated by some faddists, the products should be regulated for consumer protection.

A.D.A. applauds new food labeling regulations

The following letter, sent to FDA *Commissioner Charles C. Edwards in behalf of the Association by Associate Executive Director, Mary Alice Johnson,* R.D., *speaks for itself:*

The American Dietetic Association wishes to commend the Food and Drug Administration for a giant step forward in promulgating the new regulations on food labeling. We concur with the Commissioner that this is an auspicious beginning. With the rapidly accumulating knowledge of food and nutrition, it is to be expected that periodic reviews of the regulations will be in order.

The data being gathered will be of great value as nutrition labeling progresses. The American Dietetic Association hopes that, in the not too distant future, regulations will require declaration on labels of the sources of fat.

Association supports National Diabetes Research and Education Act

Late in February, the Senate Committee on Labor and Public Welfare, under the Chairmanship of Harrison A. Williams, Jr. (D—N.J.), held hearings on S. 17, the proposed National Diabetes Research and Education Act. In support of this Act, A.D.A. *President, Isabelle A. Hallahan,* R.D., *sent the following letter to the Committee for inclusion in the record of hearings:*

There is a need not only for clinical research but also for applied research in developing new methods of educating patients and new methods of educating allied health personnel. There is also a need for research into the area of how allied health personnel can work most effectively with physicians. Enactment of S. 17, with its provisions for coordinated research and programs of public, professional, and patient education, would serve to fill the great needs in these areas.

With passage of this legislation, The American Dietetic Association could:

(a) Mobilize its members who have the expertise to initiate and participate in the necessary research programs;

(b) Disseminate the findings of research and demonstrations to our membership through symposiums, workshops, and annual meetings;

(c) Publish reports of relevant research in the JOURNAL OF THE AMERICAN DIETETIC ASSOCIATION to reach our membership and others in the medical community; and

(d) Develop, publish, and disseminate appropriate educational materials, such as the booklet, "Meal Planning with Exchange Lists" (which was enclosed). It was prepared in cooperation with the American Diabetes Association and the Chronic Disease Program of the Public Health Service, Department of Health, Education, and Welfare.

The American Dietetic Association is prepared to participate in the National Task Force called for in the bill through a representative from this Association, thereby assuring that the discipline of dietetics and nutrition will be adequately represented in the identification and development of the programs called for by this legislation.

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Promoting Optimal Nutritional Health of the Population of the United States

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Policy Statement of
The American Dietetic Association

TO FULFILL the objectives of The American Dietetic Association as stated in its *Constitution*, i.e., "To improve the nutrition of human beings; to advance the science of dietetics and nutrition; and to improve education in these and allied areas," The American Dietetic Association recommends that:

I. Nutritionally adequate food should be available for all individuals and families.

II. Nutrition service under the supervision of qualified nutrition personnel should be a component of *all* health and health related programs and should be designed to reach the total population with priority to such nutritionally vulnerable groups as infants, children and youth in the growing years, women in the child-bearing years, and the older age population.

III. Nutrition education should be available to all individuals and families and, in schools, should be a basic curriculum requirement. School feeding programs in which there is continued application of current nutrition knowledge and coordination with nutrition education in the classroom should be available to all children.

IV. Recruitment and training of professional and supportive nutrition personnel should be accelerated and expanded to fulfill the present and projected needs for manpower to provide the services needed to attain and maintain optimal nutritional health of the population.

V. To assist the states and their communities in improving the health of their residents through nutrition, the federal government should:

(a) Develop and promulgate national nutrition policies;

(b) Recognize the importance of nutrition to health by establishing an organizational unit with responsibility for a comprehensive coordinated nutrition program in all federal agencies administering health services;

(c) Establish at policy-making levels, authority which applies to all departments concerned with developing and implementing a coordinated nutrition program;

(d) Provide financial assistance for nutrition surveillance surveys, applied nutrition research and demonstrations, grants-in-aid to support public health nutrition programs, and consumer protection activities; and

(e) Establish a uniform system for nation-wide reporting of morbidity and mortality of malnutrition which will provide statistics on the magnitude and location of primary, secondary, and tertiary malnutrition.

VI. There be a White House Conference on Nutrition and that nutrition be represented in all White House Conferences with implications for nutritional health.

VII. Participation of the food industry should be solicited in promoting optimal nutritional health of the population.

The American Dietetic Association Position Paper on Nutrition and Aging

THE AMERICAN DIETETIC ASSOCIATION, in its commitment to the improvement of the health and nutritional status of aging people, particularly those over the age of sixty-five years:

A. Recognizes that adequate nutrition for the older citizen must be considered in connection with the inter-related economic, social, physiologic, and psychologic changes coincident with aging (1-3).

B. Recognizes that aging is a life-long process that begins at conception and, therefore, that nutrition services under the supervision of qualified personnel must be a component of all health and health-related programs for all age groups, with priority being given to the nutritionally vulnerable, including those over sixty-five years of age (4,5).

C. Supports the existing Commodity Distribution program and Food Stamp plan, but believes that:
   1. These need to be better geared to the needs of the elderly.
   2. Distribution centers and availability must be made more accessible.
   3. Meal preparation centers designed for group feeding, each with its own delivery systems based on modern technology, need to be developed and put into operation in the near future to provide nutritionally adequate, low-cost meals for the aging in their homes or in restaurants or schools.
   4. The aging should be allowed to purchase prepared meals with Food Stamps they buy at a discount or free, depending on their economic circumstances (6).

D. Actively supports and/or attempts to supply legislative information and public policy related to dietetics and nutrition which will:
   1. Protect the nutritional health of the population through the life cycle.
   2. Identify and seek solutions to nutrition-related health problems of the aging.
   3. Include, expand, and strengthen the nutrition component in such programs as preventive medicine, medical care, rehabilitation, environmental health, education, and welfare, and research.
   4. Provide continual periodic assessment of nutrition programs and food service operations for the aging.
   5. Fund research to advance knowledge about the aging process and the relation of nutrition and dietetics in it.
   6. Increase recruitment and educational opportunities for manpower, both professional and subprofessional, in the field of dietetics so that sufficient qualified personnel will be available for the nutritional care of the aged.
   7. Assure consumer protection in relation to the cost, quality, and packaging of foods (7, 8).

E. Believes in helping the aging to resist being influenced by food faddism and food misinformation by:
   1. Counseling and teaching both individuals and groups of senior citizens, in their homes and in institutions, in the importance and need for eating good food and an adequate diet.
   2. Interpreting modified diets prescribed by the physician for special conditions.
   3. Cooperating with other associations in activities related to combating food misinformation and in the preparation of information for distribution through libraries, newspapers, magazines, radio, television, and other mass media.
   4. Cooperating with the Library of Congress by suggesting books and references on foods and nutrition which should be made available to the aging blind in either braille or as talking books (9).

F. Believes that persons knowledgeable about all needs of the aging, particularly the advantages of particular food and dining arrangements, be involved in the planning of all facilities for housing for the aging (10).

G. Supports and participates in public health nutrition programs for the aging who suffer from chronic diseases, such as heart disease, stroke, diabetes, and arthritis (11).

H. Believes that the food service and feeding practices in nursing and retirement homes and in institutions and hospitals providing long-term care to the aging need to be continually surveyed and assessed as to their adequacy (11).

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Evaluation of small-scale nutrition programs

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Many nutrition programs are not systematically evaluated (1). Most people associated with them usually feel what they are doing is worthwhile, that the value is clear to all observers, and that the best has been accomplished with the resources at hand. Some nutrition program directors feel they should be doing more evaluation but are not certain how to proceed or they feel that a specialized staff is constantly required.

This article is written with the overburdened nutrition program director in mind, who usually, among many other duties, has the responsibility of organizing and evaluating a local nutrition program. How to accomplish such a task with limited resources, money, materials, and manpower is the subject of this paper. Some useful references to evaluation in general, to specific aspects such as records, and to representative projects are given (2–8).

Useful evaluation can be done on small-scale projects. Evaluation properly done enables the program director to ascertain what is being accomplished, to determine the effectiveness of inputs, and to maximize the likelihood of continued financing of the program by indicating clearly the value of what is being accomplished. Continuous evaluation *1*) will act as an early warning system and may indicate the cause of difficulties, and *2*) may demonstrate how a midcourse correction could be made.

What follows is intended as a practical guide to the evaluation of nutrition projects; it includes basic evaluation concepts drawn from the literature and modified by observation of many programs and our own experience. Terms, concepts, and steps to be taken, fundamental to any evaluation effort, will be presented (9, 10).

Goal(s)

A statement of goals, an essential first step in evaluation, orients the observer to the general purpose of the program, which is given in broad terms. It is long-range in nature, e.g., to reduce morbidity and mortality of mothers and children by improving their nutritional status.

A statement of goals implies that a need has been recognized and documented. For example, in one area, age-specific morbidity and mortality statistics, height and weight data, and hemoglobin values deviating significantly in an adverse direction from the norm have been documented. Such information serves as the essential base line from which future progress is measured.

By its nature, a statement of goals is general and requires further definition, for it does not include how the goal is to be attained. Such clarification is contained in a statement of specific objectives.

Specific objectives

This is a statement of specific, measurable, anticipated targets for a certain population to be attained within a given period of time. These must be reviewed periodically because sometimes precise effects of a given set of inputs in a particular ecology cannot be determined beforehand. They are more specific and short-term in nature than goals, e.g.: *1*) to reduce severe protein–calorie malnutrition of 2-year-old children from 10 to 2% in 18 months; *2*) to reduce infant mortality from 150 per 1,000 to 75 per 1,000 in 24 months; *3*) to raise hemoglobin in pregnant mothers from 6 to 11 g in 12 months; and *4*) to pre-

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vent iron-deficiency anemia in the 1st year of life. In each case, the target population must be clearly defined by age, sex, geographic location, and size of group.

Measurable criteria

Following the statement of specific objectives, one must consider precisely what is going to be measured, if it relates to the objective(s) established, and if the tasks involved can be carried out under field conditions. Practical constraints include availability of personnel and their level of proficiency, and also availability of equipment. In this regard, basic assumptions should be stated. Continuing with the examples above, the following might be measurable criteria for the study group involved: *a*) edema rate (this is the prevalence of edema in a specific age group in a defined population, usually the sign elicited by pitting when digital pressure is applied to the dorsum of the foot); *b*) height/weight gain and arm circumference of children (indicate equipment, procedures, and standards to be used); and *c*) hemoglobin and possibly hematocrit for the pregnant mothers (indicate equipment, materials, and procedures to be used).

Anticipated outputs

At the very onset of a project, during the planning stage, it is highly desirable to think through the proposed project in as much detail as possible. This includes a clear statement in quantitative and qualitative terms of anticipated accomplishments. It is a companion statement to the Specific objectives section. For example, the anticipated output may be reduction of protein–calorie malnutrition in 10,000 2-year-old children, to save 750 young children's lives, to raise the hemoglobin of 5,000 mothers and 5,000 children under 2 years of age, et cetera. This section logically leads to consideration of what will be required in the way of men and matériel.

Inputs

Included in the plan must be a statement of means, e.g., using only those foods available locally, or encouraging and stimulating local production and consumption of protein-rich foods, or introducing a food supplementation program specifying inputs. Also needed is an estimation of the kinds and numbers of staff, transport, general logistic support, and, of course, the budget needed.

Timetable

The next step in the planning that will also help the execution of the project and its evaluation is a detailed timetable which may be best presented in the form of a PERT diagram (Program Evaluation and Review Technique) (11), which forces one to consider overall timing and time relationships between component steps.

Records

Data collection indicates a need for a records system and a simple form will usually suffice. A variety of effective, easy-to-use forms have been devised that can be hand-tabulated or tabulated with only the simplest type of equipment (12). One of the standard growth and development cards available would be useful for the purposes of our example. On it could be recorded all data pertaining to the children. A second form would serve to record information for pregnant women. Forms can be devised so that they are self-coding. Use of edge-marked cards facilitates analyses of data and is particularly useful when the number of subjects is approximately 1,000. Also, no equipment more complex than a simple hand-punch and long needle is required (13, 14).

Input/output analysis

It is important to realize that some evaluations focus primarily on inputs or process analysis, i.e., on what is being done and how it is being done. A more fruitful approach is to evaluate the outputs, outcomes, or consequences of the program. In the examples given thus far in this paper, the emphasis would be upon evaluating the results of a program in terms of changes in height, weight, hemoglobin, and edema rate, et cetera.

Input or process analysis by itself may yield misleading information. For example, large amounts of food supplements delivered to a country or even to the village level may

never reach the group for which they are intended. There are cases on record in which food intended as food supplements became merely food substitutes, i.e., food items normally present in the diet were given to someone else, and the sole source of nutrition for the target group was the externally provided food supplements. Somewhat similarly, there have been cases reported in which the food provided as part of a supplementation program was added to the diet of the target group but was inappropriate. For example, where protein and vitamin A were needed, only calories and poor quality protein were provided. In both cases the "supplementation" program was essentially wasted effort and may well have had negative value. Superficial analysis of inputs could lead one to believe the nutritional status of a population must have improved because of the supplements received, whereas output analysis could show little, if any, improvement in the nutritional status of the target population. Examination of both inputs (what is done) and of outputs (what has been accomplished) are essential to proper evaluation.

In summary, the best evaluation involves objectively measuring changes in the health status of the target group. Even so, the possibility of fallacious conclusions exists unless one takes care to show that any desirable changes in the target population are due to the specific nutritional program (the special inputs) rather than to some extraneous effects. Controls are necessary to help prove that observed changes are taking place as a result of the nutrition inputs if, indeed, that is the case.

A control population is similar to the target group receiving special services, instruction, or food supplements and serves as a comparison for that group. The practical difficulties in setting up an effective control are in finding and identifying a group similar to the program's target group. If the control group is located too close to the study group, it may learn of the special inputs provided the study population and demand the same. If it is too far removed, logistic problems may become insurmountable, and the character of the population may be significantly different. The solution may be to identify a village not ordinarily served by the health center where the program is based, but not too far away, and to provide them with a placebo if the target group is receiving a medication. The control group should not be aware of the special program conducted for the benefit of the target group. Finally, it must be willing to undergo the same testing or measuring procedures to which the target group is subject. Frequently, cooperation is obtained from the control group through good public relations or by providing some additional services that will not significantly change the group in those aspects under evaluation. Controls are essential to enable one to say with confidence that changes in the target population are taking place because of the nutrition program and not because of other factors affecting the population.

Program design

The statement of goals and objectives, delineation of measurable criteria, identification of a target group, or groups, and a control group, test procedures, and work plan, including timetable, comprise the program design (15). It is simply the overall plan governing the work underway and indicates to the observer that the nutrition field program is being undertaken on a planned, systematic basis and that those involved will be able to clearly indicate results and to make recommendations for the future.

In the case of pediatric nutrition in which the value of a protein-rich diet, especially in the postweaning period, has long been demonstrated, the question is sometimes asked why one needs to "prove" the value of a program that has already shown its worth many times in many different settings. Why bother with evaluation, study designs, et cetera? Why not just "get on with the job?" One must remember, however, that in developing countries, those in political power who allocate funds are subject to many and recurring pressures for allotment of scarce monies. Faced with the prospect of having funds diverted from a nutrition program to capital investments or a myriad of other demands, one is often called upon to prove anew the value of a specific nutrition field program. And one can only effectively demonstrate the

validity of a given program if accurate and statistically significant information exists, not only about the population served by the program, but also about comparable (control) populations not receiving the service in question. Also, the disconcerting, nagging question always arises as to alternative programs that could have better or more economically dealt with the identical problem or goal.

Cross-sectional versus longitudinal studies

For the purposes of ascertaining the health and nutritional status of a population and changes in that status from time to time, cross-sectional studies, for practical purposes, are the easiest and the most useful. If the staff attached to the health center or teaching program is of sufficient size in relationship to the target population served, it may be possible to examine everyone in the predetermined geographic area at intervals and thus measure changes in the population. If the target population is relatively large, then it becomes necessary to take a representative random sample. As a rule of thumb, one usually prefers at least 100 subjects in the sample in each of the major cells. For the purposes of our example, this would be 100 2-year-old children and 100 pregnant women.

Longitudinal analysis in its simplest form involves identifying a specific group of individuals at the beginning of the program period, following them over a period of time, and identifying the changes in each individual in the target group over that period of time. The practical difficulty of such an approach is ensuring that the information about a particular individual added to the previously obtained data about that person is, indeed, data from the same person and that the population is stable. In the vernacular of the records experts, this is referred to as a "linkage" problem. One of the simplest ways to overcome this problem is to let those in the target group be responsible for their own records. Evidence shows that the loss of publicly held records is less than the loss (temporary and permanent) of those records filed in hospitals or health center record rooms. In the case of large families with many children, the records of siblings or cousins, especially of those close in age and of the same sex, may become interchanged. This is one of the hazards of the longitudinal approach, and as a precaution, one should obtain as much identifying or linkage information about a given individual as possible. The handling and analyses of longitudinal study data are more difficult than the relatively simple and straightforward cross-sectional approach. However, although the cross-sectional approach is simple and less costly, the longitudinal approach may yield more valid data not subject to periodic variation or fortuitous events.

Cost analysis

Whereas cost analysis (16) can become complex, it is, nonetheless, important, and simplified analysis using common sense still has value. Some of the concepts and terms involved in cost analysis are presented below:

1) Input costs. These are the total costs of running the program, and in the case of an educational and nutritional supplementation program, would include the cost of the staff time involved, the cost of the actual food products distributed, and, if they have been contributed, an estimate should be calculated of what they or comparable goods would cost if purchased on the open market. Also included are transport costs, rent, electricity, stationery, postage, as well as other operating expenses. A gross cost figure in itself has little meaning, and therefore, input costs should be expressed on a per capita basis of the gross population served or preferably on a per target unit basis, e.g., the cost of helping a child for a year or a pregnant mother per pregnancy.

2) Output costs. a) Direct: This could be expressed as the cost of successfully treating kwashiorkor, i.e., the cost per 100 children in the target population of reducing third degree malnutrition from 10 to 2%, or, to cite another example, the average cost of raising hemoglobin of fertile females in a given target group 5 g per 100 women in a 2-year period. *b)* Indirect: This is more difficult to calculate than direct costs, but when it can be documented that the hospitalization rate in the target population has diminished or mortality has decreased as a result of the field nutrition program, one can estimate the

cost of preventing the predicted number of cases that did not occur but which would have occurred in the absence of the program.

3) Cost/benefit analysis. This is merely a ratio of the monetary cost of inputs divided by the estimated monetary value of benefits accruing as a result of the inputs. In practice it may be difficult to measure benefits, but an effort must be made to do so. Usually, a good approach is to ask the population aided by the nutrition program to describe the benefit. The description is usually divided into psychic benefits and stories of increased usefulness or productivity of someone who had been malnourished. This gives one a key to further calculations. It is usually desirable to enlist the help of economists. One should attempt to calculate the productivity of those who can reasonably be expected to have died and those who would have been disabled in the absence of the program. In some cultures a husband will report the saving of a new "bride price" when a wife's life has been saved by a program. Along with cost/benefit analysis, one often also carries out cost-effectiveness analysis.

4) Cost-effectiveness analysis. This is defined as the ratio of the cost of inputs divided by nonmonetary benefit units. For example, one may calculate the number of patient days not utilized in hospitals and the number of deaths that did not occur because of the program.

5) Cost of alternatives. A good administrator will do his best to consider the cost of alternatives to the field nutrition program. For example, he may be challenged with the argument that a sum equivalent to the cost of the nutrition program could be invested in a public works project or some other form of employment-creating endeavor that would produce superior results in enhancing the nutritional status of the people (families affected would use the increased income to provide more and better food for the family, including children and mothers). In the case of a rural agricultural economy, the argument might be made that providing improved seeds, irrigation, or fertilizer to a population would improve the nutritional level, although such efforts might not have the desired effect at all. The point is that if an adequate evaluation resulting in hard facts has not been done, it may be difficult to gather support for continuation of the program.

Staffing

Adequate evaluation can be carried out without a highly trained staff. A decision must be made on the information needed and design mechanisms for obtaining and recording it. Recording of the information on an ongoing basis must be established, and periodically the information must be analyzed. The critical aspect of program evaluation comes in the planning and organization of the evaluation scheme and the selection or design of adequate record forms. This must be done at the onset and is a skilled activity. This is the time to call in short-term, outside consultant assistance. Then, it is a matter of collecting the information accurately with spot checks to ensure the validity of the data. Carrying out the service aspect of a nutrition project is a relatively familiar task as is the routine collection of data. Supervision of the field work, including collection of data, while exacting, is a relatively familiar activity and competent staff are usually at hand and can be trained to the specifics of the project. Analysis of the data according to procedures determined at the onset of the project may be done by project staff, if available, or, given a clear plan, can be contracted out to another group in a statistical institute, university, foundation, or appropriate government agency.

Another useful guideline facilitating evaluation of nutrition programs is to ascertain what skilled human resources are available. A few letters to those who have struggled with similar problems outlining the proposed plan will yield rich results.

Built-in evaluation

Evaluation is best built into a program at its inception, although it can be introduced after that point. It is best if done internally by the project staff, and also periodically by an external assessor. Internal evaluation should be an ongoing activity, and all the staff should understand that competent evaluation on a day-to-day basis is ultimately in the best interests of the program and of all

those connected with it. Performance of those engaged in providing the nutrition services must be standardized and periodically assessed. Good performance coupled with immediate recognition and rewards contributes to a high level of staff morale which, in turn, contributes to a high level of functioning and a program that maximizes the likelihood of meeting established goals and objectives and thus, ensuring continuation or expansion.

That component of evaluation which relates to staff must be handled with great care. It must be made clear that it is designed to help them in their work and in the completion of the program. Staff, however junior, deserve feedback, and criticism must be constructive. Even rewards must be handled with care lest their selectivity imply criticism of other personnel not so recognized, or lead to falsification of data. Overall, one must be sensitive to staff and take care lest they become paranoid and self-justificatory and, in the process, lose sight of the objectives of the project.

External evaluation is a highly desirable cross-check by objective individuals not emotionally involved with the program or the project. It can serve as a vital element in the obtaining of additional funds for the continuation of a good endeavor.

Discussion

However good the intentions are of those planning, organizing, and implementing a nutrition program, one cannot be satisfied with the assumption that certain results will follow as a result of program inputs. It is possible to carry out a proper evaluation without a large specialized staff. The secret of success is to design the evaluation when the program is in the earliest planning stage and to seek advice at that point.

A sound evaluation will help improve a program and can be a great morale booster for staff. In this age of budget cuts and operations research, the touching testimonial as a means of ensuring continuation of a program is giving way to carefully documented, hard facts. Good evaluation, which may spell the difference between death of a program and its life, can be done relatively easily and is stimulating to do. We urge those of you who have neglected this kind of activity to undertake it.

Summary

An approach to evaluation has been presented which is simple and well within the capabilities of the average nutrition program staff using techniques, records, and personnel already available to the program director. The need for clearly stated goals, specific objectives, and measurable criteria, as well as functional concepts, has been set forth. Above all, the desirability of building evaluation into programs from the beginning as an ongoing activity to ensure and promote program effectiveness, staff morale, and to help guarantee continuing validity and viability of the program has been stressed.

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ECONOMIC BENEFITS FROM THE ELIMINATION OF HUNGER IN AMERICA

by

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Barry M. Popkin is a researcher with the Institute for Research on Poverty. This study was based on material developed for the U.S. Senate Committee on Nutrition and Human Needs in July, 1969. This study was financed by the Institute for Research on Poverty at the University of Wisconsin pursuant to the Economic Opportunity Act of 1964. Special thanks go to Professors Ralph Andreano and W. Lee Hansen of the University of Wisconsin, and Nancy Amidei of the Senate Committee and Professor R. Lidman of Oberlin for their assistance. Economics graduate student Stephen Gold was the research assistant for this study.

ABSTRACT

The relationship between the elimination of malnutrition and improved mental and physical performance, and lowered mortality and morbidity rates are examined.

These relationships are used to determine the economic benefits which will accrue to this society and the poverty population if malnutrition is eliminated. These benefits can also be viewed as social costs of continued malnutrition.

Traditional human capital framework is utilized to determine the present value of the benefits which will accrue over the lifetime of the present malnourished poverty population. The most significant gain is from higher educational achievement. In this area, the elimination of malnutrition among 3.3 million poor children will produce a $6.3 to $18.8 billion increase in GNP over the lifetime of these children. The range of total economic benefits from the elimination of malnutrition will be between $14.4 and $50.3 billion.

INTRODUCTION

Hunger and malnutrition have been a key concern for many in this nation. Accompanying this concern about hunger's causes and effects have been a myriad of proposals and programs dealing with the perceived problems.

Any program which attempts to deal seriously with this problem will be costly. On the other hand, it is costly not to take action against hunger. The cost of such inaction can be viewed as the potential economic benefits from the elimination of malnutrition.

This paper examines certain of these benefits which may come from the elimination of malnutrition among America's population under the poverty line. Only the effects on economic performance of the poverty population were calculated in this study. These benefits can be broken down into five categories. Excluded are the external benefits to the nonpoverty population and numerous nonquantifiable benefits to the poverty population.

These categories are presented below with their cumulative economic benefits in parentheses.[1]

1. Education—Improved nutrition improves learning through what we believe are structural changes in the brain, prevents an interruption of cognitive development, and increases the ability to concentrate and work ($6.4 - $19.2 billion).
2. --Physical Performance--Improved nutrition increase the capacity for prolonged physical work, raises the productivity of workers and increases the motivation to work ($6.4 - $25.8 billion).

3. Morbidity--Improved nutrition results in higher resistance to disease, and lowers the severity of disease ($201-$502 million).

4. Mortality--Improved nutrition decreases fetal, infant, child and certain types of maternal mortality ($68-$157 million).

5. Intergenerational Effects--Improved nutrition makes healthy mothers who have healthy children. Also, better educated parents lead to better educated children ($1.3-$4.5 billion).

These computation indicate that if malnutrition among members of the poverty population were eliminated, the present value increase of national product, conservatively estimated, would be between $14.4 and $50.3 billion, assuming that motivation, training level, need achievement, and time horizons would remain the same. It should be noted that although all these relationships between the various categories such as physical and mental performance are quite clear, many of the specific interrelationships have not been examined for their effects on large populations. These relationships are mainly based on small studies and interferences drawn from laboratory and clinical findings.

This study consists of three parts, first, estimation of the number malnourished; second, determination of the economic effects if malnutrition were eliminated; and third, evaluation of the biases of the analysis.

I. Estimation of the "Malnourished Population"

Nutritional status tends to be closely linked with income. Thus the highest concentration of malnourished people is found in the poverty

popualtion below the poverty line. In fact, the poverty line is based on an income level necessary to avoid severe malnutrition. However, the amount indicated is not adequate for urban families where a family of four with an income of $5,500, or $1,000-$2,000 above "poverty," probably would not be able to purchase enough foods. Actually, these families should be classified as poor under a poverty budget based on a realistic food plan.

Biochemical studies of blood and urine were used to determine the percent malnourished in various age-race-geographical groupings. In general, biochemical findings are quite valid as a measure of nutritional status.

As no comprehensive national study has been made to determine the percent of malnutrition among the poverty population, the data used here to provide a picture have been put together from many sources.[2] Among these are small scale studies such as those done by OEO on Head Start mothers and children. Much of the data used is taken from unpublished reports made by OEO or the Senate Committee on Nutrition and Human Needs. Table 1 shows the poverty population; Table 2, the percent malnourished; and Table 3, the malnourished population.

TABLE 1

Poverty Population

Age	Non-South				South			
	Urban		Rural		Urban		Rural	
	White	Non-White	White	Non-White	White	Non-White	White	Non-White
786,000 0-1	180,810	183,520	141,120	2,960	53,900	44,992	114,170	64,528
3,657,686 1-5	665,173	1,150,621	519,551	19,654	198,433	281,591	418,824	403,839
7,387,327 6-17	1,650,610	937,870	1,166,022	64,398	570,102	607,625	1,248,728	1,141,972
*14-65+ Working Males	1,444,000	348,516	1,053,192	42,339	562,522	288,106	1,150,208	602,571
*14-65+ Working Females	2,007,796	505,787	896,074	42,209	547,103	313,090	679,049	363,150
Pregnant Women 14-44	559,341	299,649	203,265	16,683	144,630	146,556	149,840	100,348

Source: 1967 Current Population Survey with poverty level based on the USDA's lowest priced food plan (economy plan).

*Few men and women age 14-17 work. Most of this age group are included in the age 6-17 group.

TABLE 2

POVERTY POPULATION MALNOURISHED

Percent Malnourished

	Non-South				South			
Age	Urban		Rural		Urban		Rural	
	W*	NW**	W	NW	W	NW	W	NW
0-2	30	57	38	25	33	54	30	60
2-5	28	45	19	19	21	40	20	20
5-16	15	40	20	35	30	46	17	25
16-59	30	50	22	65	35	60	20	40
Pregnant Women	35	65	40	63	60	70	70	60

Source: Popkin, Barry M., Economic Benefits from the Elimination of Malnutrition, study prepared for the U.S. Senate Committee on Nutritional and Human Needs, July 1969.

*W - White

**NW - Non-White

TABLE 3

MALNOURISHED POPULATION

AGE	NON-SOUTH				SOUTH				TOTAL
	URBAN		RURAL		URBAN		RURAL		
	White	Non-White	White	Non-White	White	Non-White	White	Non-White	
0-1	54,243	104,606	53,625	740	17,787	24,296	34,251	38,717	328,265
1-5	186,248	517,779	98,715	3,734	41,671	112,636	83,765	121,152	1,165,700
6-17	247,592	375,148	233,204	22,539	171,031	279,508	212,284	285,493	1,826,799
14-65+ Working Males	433,200	174,258	231,702	27,845	196,883	172,864	230,042	241,028	1,707,822
14-65+ Working Females	602,339	252,894	197,136	27,436	191,486	187,854	135,810	145,260	1,740,215
Pregnant Women	195,769	194,722	81,306	10,510	86,778	102,589	104,888	60,209	836,771
TOTAL	1,719,391	1,619,407	895,688	92,804	705,636	879,747	801,040	891,859	
								GRAND TOTAL	7,605,572

Source: Combination of Tables 1 and 2.

II. Calculation of Economic Benefits

Quantifiable, economic benefits from the elimination of malnutrition may be realized in the areas of mental performance, physical performance, morbidity, mortality, and intergenerational effects.[3] All of these effects can be estimated. Each aspect will be taken up separately.

A few points must be kept in mind. First, the malnourished who are hospitalized include not only the patients, almost all young children, of course, who are classified in hospital records as suffering from malnutrition but also many of those who are classified under other headings, with illnesses to which mild, moderate, or severe malnutrition contributed to a lesser or greater degree, although their immediate need for aid was precipitated by an intercurrent illness. Just as a man with terminal carcinoma of the bronchus dying of pneumonia should be considered as dying not of pneumonia but of the underlying causes, so a child with moderate or severe malnutrition who dies from gastroenteritis should be considered as dying from malnutrition. In a well nourished child, the gastroenteritis probably would not have been fatal or would not have occurred at all. Second, many economic benefits from the elimination of malnutrition will be excluded from consideration in this study. The major exclusion is the cost incurred in connection with the treatment of the malnourished. Described briefly, that is the cost of medical services including the cost to hospital of in-patient treatment of malnutrition and related diseases and the cost of out-patient and health centers and other clinic treatment, plus the cost to parents or person involved, including the cost of treatment by private doctor, the cost of transport to and from treatment and for

hospital visiting, and the cost to responsible relatives of time lost from work for all these actions.[4]

A. Mental Performance--Education Achievement

If malnutrition among poor children were eliminated, economic benefits would come about because these children would be capable of 10-30 percent higher mental achievement. This higher achievement would result in both a 10-30 percent higher performance in each grade and a 10-30 percent reduction in the number of grades repeated by these same children. The causative relationship between the higher achievement and improved nutritional status is based upon a detailed analysis of the clinical nutrition literature and discussions with many nutritionists. A few of the more significant studies are referred to in this paper.

There are 3.3 million malnourished children living in poverty. The total gain in higher mental performance would produce a gain in lifetime earnings of $6.4 to $19.2 billion, mainly in higher achievement. These figures are present values.

1. Relationship

There are three aspects to this relationship. First, malnutrition increases the incidence of permanent brain damage significantly among children aged 0-4 years.[5] If the under nutrition occurs after the age of three years, there probably will be no permanent damage.

Second, malnourished children even if they have not suffered brain damage, may suffer retarded cognitive development. The apathy of nutritional deprivation (especially anemia and protein deficiency) results in poorly developed inter-sensory integrative performance. Often the results

of this apathy and listlessness is questionable but Dr. Joaquin Cravioto sees these aspects of the infant's behavior leading to a progressive withdrawal from the environment.[6] The inactive child does not deal enough with visual and tactile sensations and has fewer contacts with other persons. In total, he does not utilize the stimuli around him. This leads to either a delay in the conditioning or the effective production of conditioned reflexes. "Evidence already exists that the lag in the development of certain varieties of inter-sensory integrations have a high correlation with backwardness in learning to read," and . . . "can interfere with a second primary educational skill--learning to write."[7]

Third, children aged 6-18 cannot utilize fully the potential to concentrate and work displayed by well-nourished children of the same background. Hungry students are unable to concentrate, have poor judgment, are irritable, moody and unable to sustain mental application. Controlled studies done in Asia, Africa and the U.S. have shown that increased food intake produces changes in mental performance.[8]

Two highly, significant and suggestive studies within the U.S. were done, one in rural areas, the other in an urban area. During a three-year study in isolated and stable Kentucky county school districts, children of the experimental schools with improved nutrition gained 30 months in mental age, compared to 15.5 months gained by the children of the control schools--a difference of 14.5 months (a performance 94 percent better than the control group).[9] In 1944, Kugelmass, Poull, and Samuel conducted a study on nutritional performance in normal and mentally retarded children in New York City.[10] Fifty of the children classified as normal malnourished and 50 as normal well-nourished were matched

for chronological age, I.Q., and interval between Kuhlman-Binet or Stanford-Binet tests. Following a period of observation which varied between one, and three and one-half years, the malnourished group with the nutritional supplements showed an average I.Q. increase of +18 points in contrast with an average of 0.9 for the well-nourished group.

2. Economic Benefits'

The pertinent economic benefits from higher mental performance were calculated by using the lifetime income differential between high-school drop-outs and high-school graduates.[11] There are two basic assumptions which justify this: First, gains in yearly achievement have the same implication for future earnings as do gains in knowledge resulting from more years of schooling. Second, short-term gains in educational achievement can be maintained over time. Some children with better nutrition will attend school for an extra year while others will gain in achievement. The extra year in school and the gain in yearly achievement will be assumed to have the same impact on a person's earning potential. Among malnourished children aged 0-5 and 6-18, 10-30 percent higher achievement will be gained by eliminating malnutrition.

The income differential between high-school graduates and drop-outs is fairly representative of what additional schooling (or an increase in achievement) is worth in economic terms. ". . . why the drop-out-graduate differential is more appropriate is that average educational attainment for under-privileged children falls within the tenth to twelfth grade range. If more is learned in earlier years and is maintained, it would seem most akin to lengthening the average period in high school, moving it closer to the twelfth grade level . . . ."[12]

In Table 4 the results of those calculations of higher performance can be found. The percentages discussed earlier were used here. The total impact of increased educational achievement from the elimination of malnutrition ranges from $6.3 billion to $18.8 billion. These lower and upper bounds give the range of benefits attributed to higher achievement.

TABLE 4

ECONOMIC BENEFITS OF EDUCATION ($)
Educational Achievement - Children (0-17)

	NON-SOUTH		SOUTH		TOTAL
	URBAN	RURAL	URBAN	RURAL	
White	922,769,720- 2,768,309,159	728,909,486- 2,186,728,459	435,762,503- 1,307,287,510	624,465,180- 1,873,395,540	
Non-White	1,885,935,890- 5,657,807,669	51,070,778- 153,212,333	787,321,464- 2,361,964,392	842,001,397- 2,526,004,192	
Top number corresponds to lower limit. Bottom number corresponds to upper limit. Numbers may not be exact due to rounding.					6,278,236,418 18,834,709,254

Also, there will be a 10-30 percent reduction in the rate of grades repeated by these same children. Table 5 contains the repeating (flunk) rates for the poverty population. The economic benefits received for lowering the failure rate are found in Table 6. The results are determined by taking the number of malnourished children of from 6 to 17 years of age (the school population) and multiplying this by the respective failure rates to determine the number of children who fail at least one year of school. The percentage reduction in this rate was then

applied and, finally, the current income for 18-years old was used to determine economic benefits. It is assumed that the reduction of failure rates means those children who will no longer repeat a grade will now receive income at least one year sooner and, thus, income at age 18 was used. The range of benefits would be between $122,889,901 and $368,669,703.

TABLE 5

RATE FOR REPEATING GRADES AMONG LOW INCOME CHILDREN

	White		Non-white	
	Rural	Urban	Rural	Urban
Male	.2244	.2213	.2730	.2699
Female	.1801	.1770	.2288	.2271

Source: John Conlisk, "Determinants of School Enrollment and School Performance," The Journal of Human Resources, Vol. 4, No. 2, Spring 1969.

The failure rate used is for boys and girls age 10-13. This is approximately the median for the ages 7-9, 10-13, and 14-15. Data were not available for the ages 16-17 when the failure rates tend to be higher.

TABLE 6

ECONOMIC BENEFITS OF EDUCATION
Failure rate reduction (6-17) ($)

	NON-SOUTH		SOUTH		TOTAL
	URBAN	RURAL	URBAN	RURAL	
White	14,637,187- 43,911,561	14,517,143- 43,551,429	10,111,040- 30,333,119	13,214,856- 39,644,568	
Non-White	27,137,673- 81,413,019	1,686,794- 5,060,381	20,219,211- 60,657,632	21,365,997- 64,097,991	
Top number corresponds to lower limit. Bottom number corresponds to upper limit. Numbers may not be exact due to rounding.					122,889,901 368,669,703

B. Physical Performance--Worker Productivity

Economic benefit from the elimination of malnutrition will affect worker productivity. Malnourished working people in poverty (1.71 million men and 1.74 million women) will experience a 10-40 percent increase in their productivity. The resultant lifetime economic benefits to this society from this productivity-gain will range from $6.5 to $25.9 billion.

I. Relationships

Caloric requirements for work are one of the three major requirements that must be satisfied by the energy produced from food. The other two are basal metabolism requirements to keep up the life processes (1600-1800 calories) and growth requirements for children, adolescents, and expectant mothers. There is a close correlation between adequacy of work calories and work productivity. If the work calories are below

the required amount for the activity being undertaken, two things will happen. First, the body will adapt somewhat to this lower food intake by avoiding effort. Second, the body will lose weight.

Numerous studies done in the U.S. and other Western industrial countries illustrate the significance of this relationship between improved nutrition and physical performance.[13] One of the best controlled studies was done with aircraft workers in Southern California. "One group of workers was given large doses of several vitamins five days a week for 9-13 months; a control group was given placebo. During the last six months the vitamin group showed statistically significant superiority over the placebo group in absenteeism (3.90 days compared with 4.79 days), in turnover of labor force (8.4 per 100 as compared with 13.5), and in merit ratings based on a careful appraisal of efficiency."[14]

Table 7 shows the relationship between additional protein intake and an improved capacity for work. These studies had poor controls and leave much doubt of the significance of this relationship.

TABLE 7
PROTEIN INTAKE AND CAPACITY FOR WORK[15]

Year	Occupational Groups	Intake of cal/day	Intake of g protein/kg	"performance capacity"
1939-41	miners (Germany)	3,800	1.0-1.2 below 1.0	rising falling
1942	gardeners (England)	3,000	1.0 0.7	unchanged falling
1946	scientists (United States)	3,000	0.8 1.6	unchanged steep rise after 6 weeks
1951	students (United States)	4,000	2.0	doubling of muscle power in 12 weeks' training period
			1.0	slight increase in 12 weeks
			0.8	no change in 8 weeks

2. Economic Benefits

The pertinent economic benefits were calculated only for the malnourished working population between the ages of 14 and 64. The increase in worker performance of 10-40 percent depends on the degree of labor intensity and the previous nutritional status of the worker.

The calculation of benefits is based on one assumption: The employment picture of each worker from each race-sex-region cohort is assumed to be constant. Thus, his productivity will increase but his job and salary will not change so each worker will not capture his increase in productivity.

Then, the benefits to society for each workers' improved productivity are the 10-40 percent increase in productivity, times the present value of lifetime earnings for his sex-race-region-group. Benefits of $6.5 to $25.9 billion will necessarily accrue to society in terms of increased productivity. These benefits are calculated in Table 8.

TABLE 8
ECONOMIC BENEFITS PHYSICAL PERFORMANCE ($)
Workers 14-65+

		NON-SOUTH		SOUTH		TOTAL
		URBAN	RURAL	URBAN	RURAL	
Male	White	$ 873,634,440- $3,494,537,760	$ 477,931,715- $1,911,726,862	$ 432,866,964 $1,731,467,855	$ 488,632,212 $1,954,528,848	
	Non-White	$ 459,710,030- $1,838,840,119	$ 64,940,109- $ 259,760,436	$ 430,569,651- $1,722,278,604	$ 582,998,526- $2,331,994,106	
Female	White	$ 787,377,540- $3,149,510,163	$ 242,496,994- $ 969,987,974	$ 227,542,814- $ 910,171,255	$ 152,283,753- $ 609,135,021	
	Non-White	$ 610,637,852- $2,442,551,410	$ 51,184,602- $ 204,738,406	$ 363,722,915- $1,454,891,659	$ 216,350,244- $ 865,400,976	
						6,462,880,361 25,851,521,454

Top number corresponds to lower limit. Bottom number corresponds to upper limit. Numbers may not be exact due to rounding.

C. Morbidity and Resistance to Disease

As a result of better nutrition, fewer work days will be missed due to illness by the 3.45 million working poor. The days lost from work (morbidity rate) will be reduced 10-25 percent. The economic benefits from this will be $200 to $500 million.

1. Relationships

R. J. Williams summarizes this relationship when he states that "every amino acid, mineral, and vitamin which contributes to the health and vigor of one's body is in a sense an anti-infective agency because resistance to disease is a sine qua non of continued existence, and resistance is the highest in those in which the cells and tissues most intimately involved in disease-resistance processes are nourished at the highest level of excellence."[16]

Poor nutrition can lead to a greater incidence of bacterial, viral, richettsial and protozoal infections. Some of the mechanisms of this synergism are interference with antibody response, alternation of tissue integrity, interference with non-specific protective substances, non-specific destruction of bacterial toxins, and nutritional alteration of endocrine balance.[17] Protein, iron, vitamins B and C are key nutrients. The following are examples of these relationships.

a. Leithch has called attention to the Tronhein Naval Training School in which over a period of many years one-third of the cadets developed tuberculosis, a rate which was not lowered by better housing but which promptly dropped to less than that for the country as a whole, when fresh milk, meat and fruit were added to the diet. Downes divided 194 Negro families exposed to reinfection with tuberculosis into two groups

matched for family size and supplied one group with vitamins and minerals for five years. The rate per 100 person years was 0.91 in the control group and 0.16 in the group receiving regular vitamin and mineral therapy. Since the numbers were small the difference was barely significant at the 5 percent level. Getz, el al. reports serum levels of vitamin A and C to be lower in 28 persons subsequently developing tuberculosis than in over 1,000 individuals who did not develop this disease.[18]

b. Keller reviewed some of the experiments done with vitamin C. He found that although most of the studies have shown a relationship between vitamin C intake and absences from work, different studies have indicated different doses of this vitamin are needed. Schuenert "saw effects only on doses of as much as 1,000 mg. ascorbic acid per day, while Baker and Winckler (1955) found a reduction in the number of short absences from work on daily supplements of 100 mg. of vitamin C."[19]

c. The International Labor Organization provides an excellent example of the influence of a good lunch on accidents. The UN Food and Agriculture nutrition committee interpreted these results as a reflection of the relation between nutrition and morbidity. In this Canadian study the results before and after the opening of the lunch room per million man/hours worked were determined.[20]

	Number Before	Number After
First Aid Treatment	3,000	2,130
Lost Time Accidents	49	42
	Three years average	

2. Economic Benefits

As with physical performance, economic benefits were calculated only for the working poor although school attendance will increase, also. Table 9 gives morbidity rates for males and females in the overall work force for age groupings, rates less than those for the poor population. A reduction in these rates will produce gains to society which may accrue to the individual or to the corporation. The increase in productive time will produce gains between $200 and $500 million. These benefits are shown in Table 10.

TABLE 9

MORBIDITY RATE

Percentage Days Lost from Work Per Person Per Year

AGE	MALE	FEMALE
17-24	.0132	.0164
25-44	.0256	.0384
45-64	.0532	.0248

Source: U.S. Department of Health Education, and Welfare. Disability Days: U.S. July, 1965 - June 1966. Vital and Health Statistics, Series 10, No. 47, GPO, October 1968.

TABLE 10
ECONOMIC BENEFITS MORBIDITY ($) (14-65+)

		NON-SOUTH		SOUTH		TOTAL
		URBAN	RURAL	URBAN	RURAL	
Male	White	29,528,844 73,822,110	16,154,092- 40,385,230	14,630,903- 36,577,258	16,515,769 41,289,422	
	Non-White	15,538,199- 38,845,498	2,194,976- 5,487,440	14,553,254- 36,383,136	19,705,350- 49,263,375	
Female	White	21,337,931- 53,344,828	6,571,669- 16,429,171	6,166,410- 15,416,026	4,126,890- 10,317,224	
	Non-White	16,548,286- 41,370,714	1,387,103- 3,467,757	9,856,891- 24,642,227	5,863,092- 14,657,729	
						200,679,659- 501,699,148

Top numb[er] corresponds to lower limit. Bottom number corres[ponds to] upper limit. Numbers may not be exact due to [rounding].

D. Mortality

The loss of years of productive life through premature death results in a significant economic loss to society.[21] The elimination of malnutrition will reduce mortality mainly among two groups, the 328,000 poor malnourished infants and the 837,000 poor malnourished pregnant women. The range of economic benefits from this reduction in malnutrition is between $66 and $156 million.

1. Relationships

Malnutrition directly increases the mortality rate for pregnant women and, indirectly, for infants. During pregnancy, the fetus drains the mother of many nutrients which in malnourished mothers leads to a higher incidence of maternal mortality. Also, maternal malnutrition is a major cause of immaturity and prematurity, both frequently recurring factors in infant deaths.[22] Between one-half and three-fourths of all children who die in the first four weeks of life are premature.[23]

Numerous studies have validated this relationship between improved nutrition, especially increased iron and protein, and reduced mortality in less industrialized countries, but few conclusive studies have been completed in the Western industrialized countries.[24] However, one exemplary study was done in Oslo, Norway, by a famous researcher Toverud.[25] Over six years he showed that improved nutrition caused 50 percent decrease in stillbirths, premature births, and infant mortality.

2. Economic Benefits

The impact of improved nutrition upon maternal mortality will reduce the number of deaths 30-60 percent. Among infants aged 0-1, the

mortality rate reduction will be 20-50 percent. The present infant and age-specific maternal mortality rates are found in Table 11 and 12, respectively.

The range of total economic benefits in present value terms is between $66 and $156 million. This is the income which will accrue to these women and children over their lifetimes. Table 13 gives the benefits for each age-sex-race-region cohort for each category.

TABLE 11

Infant Mortality Rate per 1000 Live Births in 1966

Age	White	Non-White
0-1	20.15	38.8

TABLE 12

Female Mortality Rate per 1000 Women

Age	White	Non-White
14-24	.6	1.0
25-34	.9	2.5
35-44	1.9	5.3

Source: U.S. Department of Health, Education, and Welfare. Infant & Post Natal Mortality in the United States, Vital & Health Statistics, National Center for Health Statistics, Series 3, No. 4, GPO, October 1965

U.S. Department of Health, Education, and Welfare, Selected Family Characteristics & Health Measures, Vital and Health Statistics, National Center for Health Statistics, Series 3, No. 7, GPO, January 1967.

TABLE 13

ECONOMIC BENEFITS MORTALITY

a) Infant Mortality (0-1) ($)

	NON-SOUTH		SOUTH		TOTAL
	URBAN	RURAL	URBAN	RURAL	
White	4,034,225- 10,085,560	4,443,281- 11,108,202	1,419,776- 3,549,439	3,089,504- 7,723,760	
Non-White	19,475,037- 48,687,592	70,592- 176,481	3,841,516- 9,603,792	6,372,958- 15,932,395	
					42,746,889- 106,867,223

b) Maternal Mortality (14-44) ($)

White	4,902,049- 9,804,098	1,636,225- 3,272,450	1,111,187 2,222,375	1,177,888- 2,355,775	
Non-White	9,211,128- 18,422,257	496,824- 993,647	3,709,904- 7,419,808	2,714,339- 5,428,679	
					24,959,544- 49,919,088

Top number corresponds to lower limit. Bottom number corresponds to upper limit. Number may not be exact due to rounding.

E. Intergenerational Effects

The benefits from eliminating malnutrition have been calculated for the poverty population for 1967. It has been assumed that these malnourished persons will be well nourished throughout their lifetimes and significant economic benefits of $13.1 to $45.7 billion will accrue to society. The effects of better health will benefit future generations, as well, in three ways.

1. The children of healthy parents will be healthier and better motivated.
2. Healthy mothers will have an easier time raising children.
3. The children of the better educated will be better educated through informal education which children receive at home.[26]

The financial gains from better income now have been estimated to be at least 14 percent of this generation's financial gains. For this study, the effects are merely assumed to be 10 percent of the total economic benefits received from better mental and physical performance, and lower morbidity and mortality rates. The range of these benefits associated with intergenerational effect is between $1.3 and $4.5 billion. Table 14 sums up all the economic benefits.

TABLE 14
TOTAL ECONOMIC BENEFITS FROM ELIMINATION OF MALNUTRITION
(in dollars 1966)

SOURCE	LOWER LIMIT		UPPER LIMIT	
1. Education				
a. Higher achievement	6,278,236,418		18,834,709,254	
b. Lower flunk rates	122,889,901		368,669,703	
		6,401,126,319		19,203,378,957
2. Physical Performance		6,462,880,361		25,851,521,444
3. Morbidity		200,679,659		501,699,148
4. Mortality				
a. Infant mortality	42,746,889		106,867,223	
b. Materal mortality	24,959,544		49,919,088	
		67,706,433		156,786,311
SUBTOTAL		13,132,392,772		45,713,385,860
5. Intergenerational Effects		1,313,239,277		4,571,338,586
TOTAL ECONOMIC GAIN		14,445,632,049		50,284,724,446

F. Total Benefits

The total economic gain to American society from the elimination of malnutrition as quantified, even by the conservative measures used in this paper, ranges from $14.5 billion to $50.3 billion. Of course, quantifiable benefits are by no means the only benefits accruing to a well-nourished society, or even the most important ones. The fact that by eliminating malnutrition millions more people could live healthy, normal lives involves countless socio-psychological benefits both to the individual and the larger society.

Not all of these economic benefits will accrue to healthy poor people. These economic benefits are the returns to society in general. A secondary question exists regarding the extent to which the value of any welfare program which eliminates malnutrition among the poor will be reflected in income, and, thereby, in private returns to the poor. Improved productivity from higher physical performance and lowered days missed from work will result partially in gains by the worker and partially by corporate America. Benefits from improved education and lowered mortality will accrue first to the poor.

III. Downward Bias of Economic Gains--Realism of Analysis

As was indicated earlier, any study of this kind must be viewed as part science, part speculation. In the case of this paper, the projections may reflect, even at the higher levels, conservative bias on several counts. First, the size of the poor population will necessarily be too small (the OEO figures for poverty in 1967 adjust the Current Population Survey data used here upward by some 7.4 million persons). Second,

there are severe problems inherent in the method used to derive our national poverty figures as indicated early in the article. Even the Bureau of Labor Statistics estimates that an urban family of four requires $7,000 to live decently. Finally, morbidity and mortality rates are taken from Department of Health, Education, and Welfare data and reflect the general population rather than the specificially poor population which will experience higher rates.

In addition to the above, it was assumed in this study that the gains to the society and to individuals would be measured by the present value of lifetime earnings for the poverty population. That is, the gains from increased productivity, lower morbidity and mortality etc., would be measured by assuming that the respective population subgroups would continue to function in the same labor markets and to earn only a poverty income.[27] No assumption was made that better-fed people would be better able to break out of poverty. This reflects the socio-economic conditions of the presently malnourished population. Naturally, this may bias total economic benefits downward tremendously.

While no exact numbers can be given for the extent of these biases, a reasonable estimate of their impact seems in order. For the typical benefits analysis, our results must be viewed as minimum (both lower and upper bounds). These results probably underestimate the true economic gains to the society by at least 20-50 percent. This downward bias would suggest that actual benefits from eliminating malnutrition would prove much greater than those presented here.

The reduced costs incurred in connection with treatment of the malnourished are the most important excluded benefits. The reduced costs to schools from lower failure rates would be included in that group. Psychic benefits resulting from better health and education and reduced dependency relationships by a well-fed person also exist.

In addition, external benefits were not discussed. Nutrition programs which would affect millions of people will benefit significantly individuals other than the direct recipients. For example, the well nourished have a lower tendency to transmit communicable diseases and parasites. Adequate nutrition will help to break the chain of many infections.

A positive bias in the results comes from consideration of political economy. The well known existence of racial and class discrimination greatly handicaps the solution to problems of malnutrition and limits the gains which can be made.

CONCLUSION

This study has laid out the potential economic gains from eliminating malnutrition in America. By necessity, this analysis is tentative. The lack of adequate information has necessitated a broad estimation ($14.4-$50.3 billion) of the possible dollar benefits. Given the biases discussed, I suspect the actual dollar benefits would be closer to the top of the range. Even ignoring humanitarian considerations, the elimination of malnutrition would probably be more beneficial to this country than many other types of projects competing for public funds.

FOOTNOTES

[1]The less tangible effects of hunger and malnutrition--listlessness, irritability, depression--were not valuated but cannot be dismissed. Structual problems such as weight, height, fragile bones, and the trainability of muscles were not valuated.

[2]The National Nutrition Survey in 10 states, while completed for purposes of data collection, has not been analyzed and has been only partially released. It is generally accepted that HEW does not want to publish the results because the incidence of malnutrition was found to be so widespread.

[3]Some of the sources are contained in the following section. A detailed 12-page bibliography is available from the author upon request. Medical and clinical nutrition journals and books provided most of the information required for this analysis.

[4]R. Cook, "The Financial Cost of Malnutrition in the 'Commonwealth Caribbean'," The Journal of Tropical Pediatrics, (June 1968):60, 61.

[5]Cravioto and DeLicardie qualify their findings by the duration of the untreated malnutrition and the period of infancy. Also they feel the question of permanent retardation remains open. Also they feel it is difficult to "distinguish the particular contributions of early severe malnutrition, adequate environment, and experimental opportunities to defective cognitive function."

J. Cravioto and E. R. DeLicardie, "The Long-Term Consequences of Protein-Calorie Malnutrition," Nutrition Reviews, 29, No. 5 (May 1971): 111. Also, Joaquin Cravioto, "Malnutrition and Behavioral Development in the Preschool Child," from Pre-School Child Malnutrition, National Academy of Sciences--National Research Council, Publication 1282, Washington, D.C. 1966.

George B. Graham, "Effect of Infantile Malnutrition on Growth," Federation Proceedings, 26, (January-February 1967):139.

[6]Joaquin Cravioto, "Malnutrition and Behavioral Development in the Preschool Child," from Pre-School Child Malnutrition, National Academy of Sciences--National Research Council, Publication 1282, Washington, D.C. 1966.

Joaquin Cravioto, Elsa DeLicardie and Herbert G. Birch, "Nutrition, Growth, and Neurointegrative Development: An Experimental and Ecologic Study," Pediatrics, 38, No. 2, part II (August 1966).

[7]Both of these quotes are taken from Cravioto, el al., "Nutritional Growth," p. 359.

[8]Ethel Austin Martin, Nutrition in Action (New York: Holt, Rinehard, and Winston, Inc., 1963):213.

Nevin S. Scrimshaw, "Nutrition and Mental Development" (Paper delivered at the Twenty-Fifth Anniversary Commemoration of the Nutrition Foundation, Inc., November 17, 1966):13, 14.

Roger J. Williams, Nutrition in a Nutshell (New York: Doubleday and Company, Inc., 1962).

[9]Maurice F. Seay and Leonard E. Meece, "Sloane Experiment in Kentucky," Bulletin of the Bureau of Social Service, College of Education, V. 16 (University of Kentucky, June 1944):68.

[10]Scrimshaw, "Nutrition and Mental Development."

[11]Income data was available for each grouping from the Current Population Survey. Present values were calculated using standard rates of survival, a 6 percent interest rate and a 2 percent growth rate (4 percent discount rate). An explanation of the present value concept and the tables of present values for various education levels can be obtained from the author.

[12]Thomas I. Ribich, Education and Poverty, (Washington, D.C.: The Brookings Institution, 1968):68-70.

For a further discussion of this subject see chapters 1 and 4. This income differential was calculated from the Current Population Reports. Series P-60, No. 56 which gives the present value of lifetime incomes for a normal population and the present value for the poor.

The poverty population values were not used due to peculiarity of the data for high-school graduates and above. Much research has indicated the difficulty with education and poverty linkages. These values were then deflated by about 20 percent. The reasons for this are straight-forward. The income differential between dropouts and graduates for the normal population must overstate this differential since persons in the poverty subgroup would have lower average and lifetime income. It is the ratio of the high school graduate differential for people with less than $3,000 income versus people with income of $3,000-$6,000. Due to the fact that education is less important for poor people, their differential will peak earlier than the normal population. Thus, the results of the deflation are somewhat conservative. The 20 percent figure was obtained from unpublished research by Professor Robinson Hollister, formerly of the University of Wisconsin, now a visiting professor at Princeton University. The conclusions of Lester Thurow's Brookings publication, Poverty and Discrimination, reinforce this technique.

[13]The Keller and Kraut and the UNFAO articles summarize many of these studies.

W. D. Keller and H. A. Kraut, "Work and Nutrition," Geoffrey H. Bourne, ed., World Review of Nutrition and Dietetics, V. 3,(New York: Hafner, 1962).

W. W. Tuttle and Edward Herbert, "Work Capacity with No Breakfast and a Mid-Morning Break," Journal American Dietetic Association, 37, (August 1960).

United Nations Food and Agriculture Organization, Nutrition and Working Efficiency (Rome: UNFAO, 1962).

C.E.A. Winslow, The Cost of Sickness and the Price of Health, World Health Organization (Geneva, 1951).

[14]Winslow, The Cost of Sickness, p. 35.

[15]Keller and Kraut, "Work and Nutrition," p. 73.

[16]Williams, Nutrition in a Nutshell, p. 49.

[17]Dr. Nevin Scrimshaw, one of the leading American nutritionists, has written extensively on this subject. For example,

Nevin S. Scrimshaw, "Nutrition and Infection," in J. F. Brock, ed., Recent Advances in Human Nutrition, (Boston: Little Brown and Company, 1961).

[18]Ibid., p. 376.

[19]Keller and Kraut, "Work and Nutrition," p. 75.

[20]UNFAO, p. 26 from ILO Studies and Reports, New Series, N. 4, Nutrition in Industry, 1946, p. 41.

[21]There is a large literature on this subject. For example, see

Dorothy P. Rice, Estimating the Cost of Illness, U.S. Department of HEW Public Health Service, Health Economic Series #6, (Washington, D.C.: G.P.O., 1966).

Another way of valuating the benefits from reduced mortality looks at the waste of money invested in the education, training, clothing, feeding, and health care of the individual. For less developed economies where each individual's future is more doubtful, this "what's put in" approach is more relevant.

[22]Mark Abramowicz and Edward H. Kass, "Pathogenesis and Prognosis of Prematurity," The New England Journal of Medicine, 275, (1966):878.

A premature infant is born with a weight of less than 2500 grams.

[23]Ibid., p. 880.

[24]For example,

Report of a Study Group on Iron Deficiency Anemia, World Health Organization Technical Report Series No. 182, (Geneva, 1959).

W. A. Krehl, "A Concept of Optimal Nutrition," The American Journal of Clinical Nutrition, 4, No. 6, (1956).

[25]Williams, Nutrition in a Nutshell, p. 48.

[26]Theodore Schultz and Burton Weisbrod have written on this subject.

T. W. Schultz, "Education and Economic Growth," Social Forces Influencing American Education, (Chicago: University of Chicago Press, 1961):74, 75.

Burton A. Weisbrod, "Education and Investment in Human Capital," The Journal of Political Economy, 19, Supplement, No. 5, part 2 (October 1962):117-118.

[27]Structually different labor markets fact the poor and nonpoor in our dual economy.

For example,

Piore, Michael J., "Manpower Policy" in S. Beer and R. Barringer, eds. The State and the Poor, (Cambridge: Winthrop Publishing, 1970).

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PHYSICIAN-INDUCED MALNUTRITION?

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As awareness of the role of nutrition in recovery from disease increases, physicians are becoming alarmed by the frequency with which patients in our hospitals are being malnourished and even starved. One authority regards physician-induced malnutrition as one of the most serious nutritional problems of our time.

In recent years there has been growing concern over the rapidly mounting costs of hospitalization. In 1968, for example, short- and long-term hospital care costs were $20,751,000,000 in a total national health expenditure of $57,103,000,000, according to the Office of Research and Statistics of the Social Security Administration. Obviously, enormous savings could be achieved if hospital stays could be shortened by even a day, or prevented altogether. Under these circumstances it seems strange that so little attention has been paid to the essential role of good nutrition in the maintenance of health, and particularly in recovery from acute illness or injury. Stranger still, however, is how frequently one sees the hospital stay prolonged and the patients' suffering made worse by what we are now recognizing as frank mismanagement, if not downright neglect, of the patients' nutritional health in our hospitals.

I am convinced that iatrogenic malnutrition has become a significant factor in determining the outcome of illness for many patients. (Since "iatrogenic" is merely a euphemism for "physician-induced," perhaps it would be better to speak forthrightly and refer to the condition as "physician-induced malnutrition." I suspect, as a matter of fact, that one of the largest pockets of unrecognized malnutrition in America, and Canada, too, exists not in rural slums or urban ghettos, but in the private rooms and wards of big city hospitals.

Having patients in our hospitals who are malnourished or starving only because they are there may be nothing new. Perhaps it has always been so. Perhaps it's getting worse because of the rapid depersonalization of patient care. One thing seems certain, and that is that any physician who can recognize the signs and symptoms of malnutrition and starvation will have plenty to observe if he'll look around any large, city hospital.

Surely, the general public, most physicians, dietitians, nurses and others involved in patient care share the conviction that when a sick person commits himself to the total, unquestioning care of his doctor, his nutritional health, at least, should be assured. Entering a hospital and placing oneself in the hands of doctors engenders a feeling of security akin to that experienced by a fugitive when he reached the sanctuary of the cathedral doors in legendary times. Certainly one doesn't expect to suffer because of the experience. Yet, there is evidence that many people do, as I will show shortly with case histories.

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I believe that we are beginning to see the inevitable consequences of the neglect of nutrition education in our medical schools. While the principles of good nutrition are practiced in some institutions and by some individuals, this seems to be the exception rather than the rule. It is, therefore, fallacious for either the public or the medical fraternity to assume that good nutrition is automatically provided to hospitalized patients in this country.

I find this situation particularly tragic in the face of the technological advances that have been made in some highly specialized areas of medical, nursing, and dietetic care. It is well known, for example, that malnutrition interferes with wound healing and increases susceptibility to infection. It thus becomes imperative to ensure that preventable malnutrition does not contribute to the mortality, morbidity, and prolonged bed-occupancy rates of our hospital population. So it's time to swing open the door and have a look at this skeleton in the hospital closet.

During the last several years I have been involved in the training of medical students and house officers, as well as in the evaluation and care of hospitalized patients. This has given me the opportunity to observe the actual practices as they are carried out under a physician's orders. Some of the patients I observed were desperately ill with complicated illnesses; others had relatively minor or straightforward problems. I have been concerned that not enough attention is being given to the overall nutrition needs of many patients. A patient entering the hospital should know that he is served by people with understanding and willingness to put into practice the basic nutrition principles, *i.e.*, to look to such matters as caloric requirements, vitamin and mineral equilibrium, and protein requirements under the stress of injury or infection. Somehow the fulfillment of these needs seems to be regarded as divinely assured, simply because the patient had reached the sanctuary of a hospital.

I am not speaking of any one hospital in these observations. I have had the opportunity to visit a number of hospitals, and to discuss the situation with many physicians and nutrition scientists. As a result, I am convinced that the problem of hospital malnutrition is serious and nationwide.

Let me cite a few cases from my own experience which I think are representative of a national problem.

Case Number One

An 80-year-old white male was admitted to the hospital because of ischemic gangrene of the left foot and toes. During the previous year a diagnosis had been made of multiple, small brain-stem infarctions caused by arteriosclerosis. As a result, he had had difficulty in swallowing, and his food intake had been limited for several months prior to his admission. There had been an unspecified loss of weight, but he did not appear to be grossly undernourished. He was mentally clear and alert.

The day after he reached the hospital, he was operated upon. A distal aortic prosthesis was implanted and, through a separate incision, a segment of femoral artery was replaced in the left mid-thigh. Recovery and wound-healing were uneventful, although he did require some ventilatory assistance from time to time.

Five weeks later an elective gastrostomy was performed to facilitate feeding. On the eighth day after the opening was made in his stomach, the sutures were removed, a few hours later the wound opened, exposing and spilling the abdominal contents. The incision was resutured at once under general anesthesia. At the time of this repair, the surgeon commented that, from the look of its edges, the incision appeared to have been freshly made and showed no evidence of healing.

Four days later, on the 50th hospital day, the patient was started on an injectable multiple vitamin preparation. *Prior to this time he had received no oral or parenteral vitamin supplement of any kind.* He had been maintained primarily with infusions of glucose and saline, limited quantities of food taken orally, and small feedings through the gastrostomy. The chart indicated a low level of serum folate (1.48 mg/ml) at this time by the *L. casei* method. But note this crucial fact: the multivitamin supplement ordered did not contain folic acid—the *only* vitamin in which the patient was then proved deficient.

A nutrition consultation was requested on the 51st day. Only then was it discovered that the patient's body height and weight had not been recorded at any time during his hospital stay. There was evidence of a great deal of recent weight loss, excessive capillary fragility, and a suggestion of perifollicular petechiac. Blood levels of ascorbate [vitamin C] and other vitamins were not measured because he had received two injections of the multivitamin preparation, and it was considered more important to continue therapy than to attempt further diagnostic procedures. It was our impression, based on clinical grounds, that this man was suffering from protein-caloric malnutrition and scurvy. A program of tube-feedings with a balanced commercial product was started, along with a comprehensive program of parenteral vitamins, including high doses of vitamin C. The wound healed uneventfully. The patient became partially ambulatory. And he was discharged almost a well man about two weeks later.

COMMENT

Notable among the deficiencies known to inhibit wound healing are protein, zinc, and vitamin C. There was no clinical or laboratory evidence of zinc deficiency, and he apparently had been able to mobilize enough protein from tissue stores to maintain serum protein at a normal level. Robert Hodges and his associates, then at the State University of Iowa, have shown that vitamin C depletion can occur within forty days in normal human subjects on an ascorbate-free diet.

The patient described above had probably been on a low ascorbate diet for many weeks prior to admission, because of his difficulty in swallowing. It is of incidental interest that vitamin C and folate tend to occur together, for example, in orange juice and certain fresh vegetables. It is also of interest to note that vitamin C tends to protect animals from stress, probably because it plays a role in the formation of adrenal corticosteroids. The adrenals contain ascorbic acid in higher concentration than any other body tissue. In addition, there is evidence that many drugs commonly given to hospitalized patients increase vitamin C requirements. Among these are aspirin, barbiturates, paraldehyde, diphenylhydantoin, and ether. Thus, a patient whose stores of vitamin C are marginal could become frankly deficient in that vitamin by the stress of illness, by the requirements of wound-healing, and by

the administration of drugs or anesthetics that require ascorbate for detoxification and excretion. It seems likely that in the case described above, nutrients were mobilized to permit adequate wound healing after the first surgical procedure, but tissue stores were exhausted by the time the second operation was carried out.

Case Number Two

Some twenty years before he was admitted to the hospital, a 52-year-old man learned that he had aortic and mitral valvular heart disease. Three years before admission, he developed progressive cardiac failure which could not be satisfactorily controlled by conventional medical measures. At the time of admission for elective open-heart surgery, he was described as "emaciated." His body weight was 90 kg (120 lbs.) compared with his usual weight of 105.4 kg (135 lbs.) He was found to have a bicuspid aortic valve and a ruptured *chorda tendinae* of the anterior leaf of the mitral valve. Each was replaced with a Starr-Edwards ball-valve plastic prosthesis.

Postoperative management was complicated by pleural effusion, a contamination of the mouth and esophagus with a candida fungus, fever, bloodstream infection with an opportunistic organism (*Serratia marcescens*), anorexia, and anemia, with low levels of serum iron. Eight weeks after the surgical procedure, he weighed only 40 kg [88 lbs.]. This represented a loss of 14.5 kg (32 lbs.) from the pre-operative weight. It was more than 40 percent below his usual weight. During this time he had been given regular low-salt meals, but a great deal of the time, he had been unable to eat. Review of the record indicated that, with the exception of small doses of folic acid given because of hemolytic anemia, he had not received any oral vitamin supplementation, for *at least* the 35 days he spent in the medical intensive care unit! At this time he appeared cachectic; muscle wasting was obvious. There was minimal glossitis, along with extensive purpuric lesions on the skin, particularly at injection sites. Scalp hair was easily pluckable and came out abundantly by the handful. Our diagnosis was adult marasmus, or protein-caloric malnutrition. With full awareness that his malnutrition might be irreversible, he was placed on a program of comprehensive parenteral nutrition for approximately ten days. However, the patient developed fever, multiple pulmonary infarcts, shock, respiratory failure, and died on the 83rd postoperative day.

COMMENT

This man probably represents a classic case of iatrogenic, or perhaps more accurately called hospital-staff-induced, protein-caloric malnutrition which resulted in terminal starvation. It is well established, but not adequately appreciated, that such patients withstand infection and injury poorly. For example, Nevin S. Scrimshaw at M.I.T. and others have shown clearly that minor infections, even measles, can readily kill a malnourished child, although the true cause of death, malnutrition, seldom appears on the record or in the statistics in such cases. The result, as in this case, is that undue reliance is placed on antibiotics and little or no attention is paid to the factors that nourish the immune mechanisms and support the repair process.

This patient should have been given comprehensive nutritional support in the early postoperative period, possibly even before the surgical procedure. I venture to suggest that he would have survived if this had been done. It is particularly distressing to observe that, in the case just described, an elegant and technically complex open-heart surgical procedure was successfully performed, at great expense to the American taxpayer, yet, in my opinion, the patient died primarily from a failure to provide his fundamental nutritional requirements.

Case Number Three

A 46-year-old male with a past history of alcoholism and lead poisoning developed chronic diarrhea and lost approximately 22.8 kg. [50 lbs.) during the six months prior to hospital admission. Physical examination revealed bilaterally symmetrical scaly dermatitis of wrists, hands, ankles, and feet. An x-ray of the abdomen revealed calcification of the pancreas. Laboratory studies demonstrated anemia [PCV 25] hypoalbuminemia and hypocalcemia. A malabsorption work-up was initiated. No vitamin supplements were administered. On the seventh hospital day a physician's note on the chart read "doubt pellagra." On the eighth day a diagnosis of pellagra was made on clinical grounds by a consultant. Blood samples were taken and treatment was started at once. There was dramatic improvement following the daily administration of a multiple vitamin preparation plus 100 mg niacinamide daily. Although blood levels of niacin, riboflavin, folate and vitamin B_{12} were reported as normal, the laboratory reported subnormal levels of thiamin and ascorbate. In addition to vitamin therapy, he was given supplemental pancreatic extract orally.

COMMENT

The normal blood niacin level is not unexpected. Chronic pancreatic insufficiency no doubt contributed to the syndrome of malnutrition in this individual. However, it took eight days to make a diagnosis that might have been made in eight minutes. Appropriate therapy was delayed and hospitalization was unnecessarily prolonged.

Case Number Four

A 24-year-old male who had been an insulin-dependent diabetic since age nine developed nephrotic syndrome, peripheral neuropathy and muscular atrophy. He was discharged from the hospital and remained bedridden at home for approximately two months consuming a poor diet without vitamin supplementation. Daily caloric intake was estimated to be 400 to 500 calories. When next admitted, he had widespread skin leisions, more pronounced on exposed surfaces, and other clinical features compatible with pellagra.

COMMENT

Although the long-range course may not have been affected, a vitamin supplement and better diet could have improved the patient's sense of well-being and obviated the need for this hospitalization.

Case Number Five

A 25-year-old female underwent an ileal by-pass procedure seven months earlier. Subsequently, she developed a chronic illness characterized by nausea, vomiting, diarrhea, intermittent fever, jaundice anorexia, and muscular weakness. Body weight had declined from 160 kg (355 lbs.) to 103.6 kg (230 lbs.). She had received regular injections of vitamin B_{12}, and an oral multi-vitamin preparation that did not contain folate. The thought of food became repugnant to her. Food intake became limited to a few servings of vegetables and essentially no meat. Her tongue became sore and she lost her taste for food.

Laboratory studies revealed anemia, hypoproteinemia, hypocalcemia, and hypomagnesemia. Plasma folate (*L. casei*) was 1.04 ng/ml (normal 2 to 10.1), serum carotene was 24 μg percent (normal>50) and the serum B_{12} was 2,084 pg/ml (normal 160 to 900 pg/ml). Serum zinc was 54 μg percent (normal 60 to 148).

She was given total parenteral nutrition for a period of two weeks via a central venous line inserted through the subclavian vein. This provided 100 grams daily of protein (casein hydrolysate) and 2,000 calories as glucose. In addition to the vitamins and minerals given by the I. V. route, she received a solution containing 20 mg of zinc sulfate orally three times daily for one week.

There was a dramatic improvement in her sense of well-being, mood, and strength. There was improvement in most laboratory indices. although liver function and serum bilirubin remained abnormal. She was discharged with a good appetite, weighing 135.1 kg (220 lbs.).

COMMENT

The management of obesity is difficult at best. A great deal more needs to be learned about the physiology of digestion and nutrient absorption in obese subjects such as the one described. It seems certain, however, that more careful attention to the principles of nutritional equilibrium would have greatly lessened some of the discomfort and complications experienced by this patient.

Admittedly, these are only five examples, chosen for the purpose of calling attention to a serious problem. There are many others. I would like to be able to tell you about renal dialysis patients, patients with burns, cancer, diabetes, and the many alcoholics. I assure you that, if space permitted, I could cite a long list of hospitalized patients who have endured similar experiences, simply because basic principles of nutrition were not observed by the attending staff.

These experiences have led us to start an informal review of in-hospital practices, in an effort to gather statistical information and to get a better understanding of the frequency and causes of nutritional problems. Although the results must be considered preliminary, some interesting results are beginning to appear. Dr. Elizabeth Prevost, a postdoctoral fellow in Nutrition in our institution, has recently completed a review of eighty medical and surgical charts, selected only on the basis that the patient had been hospitalized for two weeks or more at the time of chart review. It is our intention to review 100 such charts, but preliminary analysis indicates the following:

1. Body height was not recorded in 56 percent of the cases. Thus, it was impossible to calculate the patients' ideal weight.

2. Body weight was not recorded in *23 percent* of the cases.
3. Body weight was not recorded during the first seven days in *26 percent;* and was not recorded regularly in 43 percent.
4. Of 36 subjects whose data were suitable for analysis, weight loss occurred in 22 (61 percent) and it averaged 6 kg.
5. Patients were not allowed any food by mouth for an average of 3.1 days. It has not been possible to tally the number of meals they missed altogether.
6. Hypoalbuminemia (<3.0 gram-percent) was present in 28 percent at admission and developed later in an additional nine, making a total of 37 percent. Orders reflected no apparent therapy (in terms of diet or intravenous feeding) in fifteen of these thirty cases.
7. Excluding patients on the hematology service, anemia was present at admission in 37 percent; another 16 percent of the patients developed anemia while in the hospital. The staff's penchant for taking blood samples from patients is probably a contributing factor.
8. Fourteen patients were hospitalized for more than three weeks, without oral or parenteral vitamin supplementation, although circumstances of their illnesses and prior histories suggested the possibility of nutritional inadequacy.
9. The hospital pharmacy issued 128,000 units of intravenous glucose during the year, mostly liter-size bottles of 5 percent or 10 percent glucose. Assuming that each unit represented a displaced meal, and 18 percent of all projected meals consisted of a bottle of glucose, this figures out to be a nutritional deficit of 2,600 calories for each patient, each week.
10. Virtually all patients received expensive and elaborate diagnostic studies, complex drug programs, or highly specialized surgical management.

We believe this preliminary analysis indicates an urgent need for a nutrition survey on a statistically adequate national sample of hospitalized patients.

It seems abundantly clear that we are not making appropriate use of information that is in our possession for the care of the sick and disabled. This, in my opinion, is inexcusable. In an effort to seek out causes, so that suitable corrective action may be taken, I have drawn up a list of undesirable nutrition practices now taking place in our hospitals. I believe they exist to a greater or lesser extent in most large U.S. hospitals today. The majority of these deficiencies could be corrected by the application of a little commonsense and effort. In terms of benefit to health, and in contrast to the vast sums of money being poured into certain areas of health care and research, relatively small investments in nutrition can pay rich dividends.

Undesirable Practices Affecting the Nutritional Health of Hospital Patients

1. Failure to record height and weight.
2. Rotation of staff at frequent intervals.
3. Diffusion of responsibility for patient care.
4. Prolonged use of glucose and saline intravenous feedings.
5. Failure to observe patients' food intake.
6. Withholding meals because of diagnostic tests.

7. Use of tube-feedings in inadequate amounts, of uncertain composition, and under unsanitary conditions.

8. Ignorance of the composition of vitamin mixtures and other nutritional products.

9. Failure to recognize increased nutritional needs due to injury or illness.

10. Performance of surgical procedures without first making certain that the patient is optimally nourished, and failure to give the body nutritional support after surgery.

11. Failure to appreciate the role of nutrition in the prevention of and recovery from infection; the unwarranted reliance on antibiotics.

12. Lack of communication and interaction between physician and dietitian. As staff professionals, dietitians should be concerned with the nutritional health of *every* hospital patient.

13. Delay of nutrition support until the patient is in an advanced state of depletion, which is sometimes irreversible.

14. Limited availability of laboratory tests to assess nutritional status; failure to use those that are available.

I have presented here evidence which suggests that malnutrition is a common accompaniment to the stress of illness among hospitalized patients. It undoubtedly contributes to increased mortality and morbidity. Although when recognized, malnutrition is usually reversible and preventable, it often goes unrecognized. Preliminary experience suggests the need for a nutrition survey on a statistically adequate national sample of hospitalized patients.

Many undesirable practices concerning the nutritional care of hospitalized patients have their roots in long-standing neglect of nutrition in medical education and in health care delivery systems.

Relatively modest revisions of attitude, administrative effort, and financial support could reverse this neglect and pay rich dividends. There is every justification, and an urgent need, for these revisions to be made without delay. Readers of *Nutrition Today* who are affiliated with a hospital are encouraged to look at the nutritional practices in their institutions. They shouldn't be surprised to find a skeleton behind the first door they open.

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