ANALYSIS OF WEIGHED DIETARY INTAKES OF NURSING HOME RESIDENTS

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CHAPTER I

INTRODUCTION

Although the term "geriatrics" was first used by an American physician, Ignaz L. Nascher, in 1909, to describe a medical specialty dealing with the study of diseases of the aged, the concept is much older. Hippocrates (460-377 B.C.) is credited with some of the first writings that describe diseases characteristic of old age (3). However, the psychological and the sociological problems of the elderly were given little consideration until the twentieth century when more attention developed concerning the major problems of old age, other than disease.

One of the fundamental problems of the aging population that has received increasing emphasis is that of nutrition. Nutritional problems may be related to disease, but more often they are psychological or sociological in origin. It is a fact that the percentage of persons over 65 years of age in the United States has increased annually over the last several decades. Many of these persons reside in nursing homes, which has expanded the need for study in the areas where problems have been recognized.

The increase in the number of persons over 65 may be attributed to the growth in population and to a longer life expectancy. In 1900 there

were two million persons over 65; in 1950 there were twelve million; and it is estimated there will be 21 million living Americans past age 65 by 1975 (60). Today's life expectancy is 68.4 years, a gain of 21 years since 1900 (60). In the United States there are more than 13,000 licensed nursing homes with 600,000 beds (20). More than half of these have been built in the last five years.

Another factor to be considered is the passing of Social Security legislation in 1965, popularly called "Medicare", which was a result of the nation's growing awareness and concern for the problems of the aged. The interest in nursing homes thus created has brought about the opening of a new field for employment of para-medical personnel occasioned by the demand for an ever-increasing quality of health care. Today, nursing home care includes physical therapy, occupational therapy, speech and hearing therapy, recreation, social and religious activities, dietary and nutritional planning, as well as medical and nursing services.

As a result, many consulting dietitians are being employed in nursing homes to satisfy the demands of this new field. They are, of course, concerned with the food service to the nursing home residents and the nutritional well-being of these aging people. Since the dietitians are trained to plan adequate menus and to develop good food-service techniques in the dietary personnel, one might assume nutritionally acceptable meals are offered the residents. One wonders, however, about the response to the food that is served, to what extent it is consumed, and what the nutritional value of the food actually eaten is as compared to that

offered. If there is a difference in the food consumed by nursing home residents from the food planned and served, what are the reasons for the diet not being eaten, and what might be done to help bring about consumption of nutritionally adequate diets?

It is generally recognized that older people tend to have poor appetites and a decreased ability to digest certain foods. Mastication may be difficult due to loss of teeth, ill-fitting dentures, or no dentures at all. Other factors may influence their food selections and consumption such as: income; illness; living conditions, especially living alone; ability to perform routine household tasks; and life-long food habits. Food intake in the older person is significantly influenced by the factors listed above. For those persons living in nursing homes, the sociological and psychological adjustment they must make upon entering a nursing home has added impact. Special diets and an immobile condition (bedfast) may be directly related to dietary intake and nutritional status of these people.

This study was planned in recognition of the increasing number of persons over age 65 and the growing percentage of them residing in nursing homes. Also, there is an expanding interest on the part of consultant dietitians in relation to the nutritional well-being of persons for whose food service they are responsible. The purposes of this research were:

1. To conduct a weighed dietary intake study on a sample of residents in a nursing home;

2. To compare the nutritive content of the food consumed with the nutritive content of the food served;

3. To compare the dietary intakes of these elderly subjects with the Recommended Dietary Allowances of the National Research Council, 1968.

4. To use the computer to make the nutrient analysis of the dietary intakes as well as of the menus as served.

The Stillwater Nursing Center was chosen as a representative nursing home in which to conduct this research.

CHAPTER II

REVIEW OF THE LITERATURE

The Process of Aging

Although the total population is growing younger, the older population, 65+ years, is growing older--half are more than 72.6 years old (49). Each day, there is a net increase of about 800 people aged 65+, but the ratio of persons 65+ to those 18-64 remains about 17 per 100 and shows no sign of increasing (49).

The physical criteria of old age has been described as follows:

(a) Gradual tissue dessication.
(b) Gradual retardation of cell division, capacity of cell growth and tissue repair.
(c) Gradual retardation of tissue oxidation, i.e., a lowering of the basal metabolic rate.
(d) General cellular atrophy, increased cell pigmentation, and fatty infiltration.
(e) Gradual decrease in tissue elasticity and degenerative changes in the elastic connective tissue.
(f) Decreased speed, strength and endurance of skeletal neuromuscular reaction.
(g) Decreased strength of cellular muscle.
(h) Progressive degeneration and atrophy of the nervous system, impaired vision, hearing, attention, memory and mental disturbance (34, p. 443).

Three cell aging processes are presently being studied. They are: (1) the decline in the functional efficiency of nondividing, highly specialized cells, such as nerve and muscle cells; (2) the progressive stiffening

with age of the structural protein collagen; and (3) the limitation on cell division, whether human fibroblasts in a cell culture can divide indefinitely or if they have only a finite capacity for doing so (31).

Cell cultures of normal human fibroblasts taken from four-month-old human embryos were studied and the conclusion drawn that these cells have a lifetime of approximately 50 population doublings. After reaching this limit of capacity for division the cell population would die. These findings were confirmed by varying the techniques of the experiments and by culturing cells from adult donors. Fibroblasts from human embryos will divide in cell culture 50 ± 10 times, those from persons between birth and age 20 will divide 30 ± 10 times, and those from donors over 20 will divide 20 ± 10 times. Doubling lifetimes of cells from animals other than man have also been studied and those shorter-lived ones had cell doublings comparable to the animal's life expectancy. The author concludes that the life-span of fibroblast populations in cell cultures is determined by intrinsic aging of the cells rather than by external factors (31).

Several organs in man lose weight after middle age and this has been attributed to cell loss (31). The human brain weighs considerably less in old age than it does in the middle years. The kidney shows a large reduction in nephrons accompanying cell loss and the number of taste buds per papilla of the tongue drops from an average of 245 in young adults to 88 in the aged (31).

Therefore, Hayflick suggests, there is an overall programmed limit on an organism's length of life due to the ultimate failure of the normal

cells to divide or function and that no matter if all the incidental causes of aging were checked, human beings would still die (31). Another factor inherent in this theory is that there may be deterioration of the messages coded by deoxyribonucleic acid for protein synthesis. Certain enzymes involved in the transcription of information from deoxyribonucleic acid may degenerate with age causing copying errors (31).

Tappel attributes the aging process to an intracellular "tug of war" between two factors acting on a third. The intensity and duration of radiation-like effects acting upon polyunsaturated lipids seem to oppose the vitamin E available to protect the lipids from excessive destruction (72). Recently an increased need for vitamin E has been suggested if there is an increase in the unsaturated fatty acid content of the tissues (43). This is thought to be due to the need for inhibition of oxidation of these unsaturated compounds which the antioxidant, alpha-tocopherol, does.

Polyunsaturated fats are a necessary dietary component, but there is new evidence that they may have a harmful effect in being the primary source of radicals within the cell that cause it to age (72). Radiant energy can penetrate into every cell in the body. When it does it strikes a polyunsaturated lipid and if enough vitamin E is present the radiation will have little effect. If vitamin E is deficient in the cell, the rays will loosen a hydrogen molecule when it strikes the lipid, causing peroxidation. Free radical intermediates are formed with peroxidation and the free radical then flies about within the cell, forcefully and randomly, until it strikes another molecule, causing all sorts of damage (72).

Because the mitochondria and the endoplasmic reticulum contain a great deal of polyunsaturated lipid, they are very vulnerable to the peroxidizing effect. When the mitochondria are hit by the free radicals they swell abnormally, disintegrate and dissolve; thus, knocking out the energy-generating apparatus of electron transport and phosphorylation (72).

Lysosomes are another cell organelle that has the function of digestion of nutrients and dissolving cellular waste materials. This is accomplished by acidic hydrolytic enzymes. When the lysosomes are punctured by the free radicals bouncing about in the cell, the hydrolytic enzymes are released into the cell and consequently they destroy other cellular components. Another effect concerned with the lysosomes is the accumulation of an excessive amount of debris when the free radicals are causing damage to the other cell organelles. As the lysosome becomes overloaded with waste materials it founders and the cell drowns in its own waste (72).

Tappel reports, "The decisive clue to cell age is the ash or 'clinker' that remains when the cell has been burned out by peroxidation. These clinkers are colored pigments that remain after the attack by free radicals" (72, p. 5).

There are three major protective mechanisms to this chemical reaction--lipid antioxidants, water-soluble antioxidants and free radical scavengers (72). The best known antioxidant of all is vitamin E. Selenium is another useful antioxidant.

Vitamin C serves as an aqueous free radical trap as well as playing a role in enzymic functions such as in the hydroxylation of proline in

collagen biosynthesis (72). Glutathione, cysteine and sulfhydryl proteins together constitute a pool of compounds that function as important aqueous antioxidants and free radical scavengers.

Another theory that has been advanced is that reduced physiological and anatomical performance efficiency is due to a loss of protoplasm (70). Individual cells die, thereby decreasing the number of functioning units in the organ.

One investigator suggests that the functional failure or disappearance of individual cells accompanies the aging of functioning tissue (43). The kidney of an old man has about 50 percent the amount of blood flow and excretory capacity as that of a young man, and only about half the number of nephrons. Reduction in specific functions of cells decreases 10 to 15 percent, while total organ performance may be reduced by 40 to 60 percent. Therefore a gradual loss of some of the functioning cells rather than partial loss of activity in all the cells could explain age impairments.

Cause of age impairments may be also in the failure of endocrine and neural mechanisms evidenced by a decreased response of the aged to stresses of all kinds. There is a slowed return to normal after any stress.

From the nutritionist's viewpoint, aging is a continuous process of change covering the entire life span. The kind of nourishment may determine when cellular changes appear (70). The life processes of the cells depend on the maintenance of a specific internal environment. When food does not provide adequate amounts of the essential nutrients over a period of time, alterations in the cell structure and in the composition of

body fluids occurs. These changes may be reflected in the outward appearance of the individual, his behavior, his demeanor, his activity, his mental state, and his social and emotional reactions (70). The omission of even one nutrient may make it impossible for the body to maintain its vital life activities.

The question arises as to whether or not the cells' internal environment can be improved by nutritionally guided adjustments in the diets of older people so that better health is manifested. It has been shown that older persons have not lost their capacity to build new body tissue or to mineralize their skeleton when their diets contain adequate protein, vitamin D and calcium (71). Consequently, the consumption of adequate diets should result in lessened health problems in the aging. Subjects have displayed greater work ability, increased clearness of skin and luster of hair, loss of weight and a more youthful appearance with dietary improvement (71).

Human nutrition and metabolism change very little during the life span. However, the process of aging produces change which presents special problems in nutrition during senescence or involution. Though processes of aging are continuous throughout life, the effects of aging are most obvious at the beginning and the end of the normal life span.

Research on the nutritional requirements of the aging has been hampered by the high individual variability of this age group. These large biological variances have been explained by the unique individual differences in body insults absorbed over a lifetime. No two persons

have the same injuries, intoxications, infections, nutritional insults, fatigues or emotional traumas (69). Causes of bodily harm may have been due to accidents, viral or bacterial disease, surgery, toxins from air pollution or cigarette smoking, and so on. The high incidence of chronic disease also increases individual viability.

Besides the cumulative effect of these many varied insults, there are physiological changes due to the mode of living of the individual. Some detriment or scarring is left behind from every toxic or psychic injury even though it may not be apparent. Pathologists actually find it impossible to determine what changes in old age are due to aging and what are due to accumulated insults (69).

Physiological age and chronological age may be quite different. Changes due to aging may vary widely between different persons. Some persons are prematurely aged at 50 or 60 while others are mentally and physically alert at 70 and 80 (69). These variations make individualization a necessity when one is dealing with older men and women.

Since nutrition is more than diet it includes not only the consumption of adequate and balanced quantities of all the necessary nutrients, but also the digestion of foods in the alimentary canal, their absorption, and their transport to the cells where they are utilized. Nutrition may be impaired at any one or more points in this sequence. Absorption and transportation of foodstuffs are affected by changes in the alimentary canal that occur with aging.

The volume of all digestive juices is diminished, including trypsin

and pepsin, which interferes with digestion (69). There is evidence that salivary amylase is reduced in persons past 60 but pancreatic amylase and lipase activities show only a slight decrease (43). On the other hand, proteolytic activity is greatly decreased (43). The amount of stomach acid secretion varies not only with age but with sex. Achlorhydria increases steadily with age in both men and women, but it is more marked in men than women (43).

Pernicious anemia is accompanied or preceded by loss of gastric acid production, and both these conditions are more prevalent after age 35 (43). Failure of absorption of vitamin B_{12} occurs in pernicious anemia and the blood levels of this vitamin are decreased in old age (43).

The utilization of fats and fat-soluble vitamins may be hampered by impaired function of the gallbladder while atrophy of the mucosa of the bowel may impede absorption in that area. Because of interference with absorption, increased quantities of specific food substances may be desirable to replace deficiencies that would be theoretically necessary. With inefficient absorption an allowance for wastage is indicated (69).

Transportation of absorbed food elements from the intestinal canal to the tissues is often inhibited by the changes in the circulatory system that accompany advancing age. Cardiac inefficiency may reduce the supply of oxygen to the cells which interferes with the removal of metabolic debris. Arteriosclerotic changes apparently parallel increasing age in man (69). Hypertensive arterial disease hinders the nutrition of the tissue cells by constricting the circulation and transportation of foodstuffs

and oxygen.

Renal efficiency is gradually diminished probably due to capillary stasis and reduced permeability (69). Thus, there tends to be more accumulation of detrimental metabolic debris in the tissue interstices. This makes a liberal fluid intake more imperative because it is more work for the kidneys to secrete a small volume of highly concentrated urine than a larger volume of dilute urine. A liberal intake of water in one form or another does not place a strain on the aging myocardium as once was assumed (69).

With normal aging, there is a slow decrease in the ability to maintain the constancy or efficiency of the physiological processes, such as temperature, pulse rate, blood concentrations of glucose, protein and calcium (69). Older persons do not adjust as well as younger adults to conditions of stress such as extremes of temperature or excess in carbohydrate intake and so on. A low blood sugar content may induce episodes of angina pectoris since glucose is a major source of cardiac energy (69).

Another example of lowered efficiency is the fact that the older person does not tolerate well either dehydration or the rapid introduction of fluids. The acid-base balance is less well maintained. Also, hypoproteinemia has dire effects in that it causes edema, poor wound healing, and decreased resistance to generalized infection; therefore, the maintenance of plasma protein becomes an absolute necessity (69).

Another diminished function is the basal metabolic rate which declines with age. This is significant in determining the level of calories

for the older person who, even though active, will require fewer calories due to a lower basal metabolism rate. Changes in the basal metabolic rate indicate changes in thyroid activity which is known to affect cholesterol metabolism, the role of which is not completely defined in the development of arteriosclerosis (69).

Disturbances in digestion may result in loss of calcium and phosphorus and the bone atrophy seen in senile persons. One author reports that one of the most common causes of inadequate utilization of calcium consumed is lowered gastric acidity and hepatic and pancreatic insufficiency, often seen in the aged. As a result of these deficiencies fat absorption is reduced, accompanied by the inability to absorb the fat-soluble vitamin D essential for the absorption and utilization of ingested calcium (69).

Some of the other conditions seen in the elderly which are intimately related to nutrition should be mentioned. The hemoglobin level tends to drop below that of young adults and this is correlated with both the protein and the iron content of the diet. Since women of all ages show lower hemoglobin levels than those of men, there may be a sex hormonal control in the hematopoietic mechanism (43). Gout is noticeable in many of the elderly which is brought about by impaired uric acid metabolism (69). The length of time required for return of blood sugar to the fasting level has been seen to be significant when glucose tolerance tests were taken (43). Missing teeth or poorly fitting dentures may cause poor mastication which in turn causes intolerance or avoidance of certain foods. Eating

only soft foods may bring about constipation, or foods not chewed well may lead to an irritable bowel. The sense of smell is often diminished which affects appetite. The psychic stimulus, which starts the flow of saliva and gastric secretion, is consequently lost (24).

The gradual loss of output from the adrenal gland and the sex glands may also have a nutritional effect. It has already been reported that hemoglobin levels may be sex hormone controlled. Sex hormones may control ascorbic acid levels as well (43). Although serum ascorbic acid tends to rise or drop rather readily in response to changes in intake, women had higher levels than men at every age, in a study of men and women from 50 to past 80 years of age (43). This study also revealed that there was a significant correlation of mortality rates with low ascorbic acid intakes. The investigator suggests hormones may control cholesterol blood levels too, since the women in the study maintained higher levels than the men; yet, much more coronary disease is seen in men than in women (43).

One approach to the scientific measurement of the digestive system's ability to transfer the nutrients from the human diet to the blood supply is the metabolic balance technique. Everything entering and leaving the body is analyzed by detailed chemical studies to measure how well the system absorbs the food nutrients. Various functions of the digestive system can also be studied. Both of these types of investigation have been carried out in regard to aging, but more research is needed in this area. Individual functions, such as the decreasing volume of gastric

juices, show changes with age. However, metabolic studies indicate little difference in nutrient utilization between young and old.

The food habits of people in our country do little to combat the changes induced by the aging process. Some of these are: excess caloric intake especially from sugar, alcohol, white flour, and fats; too little meat, fish, poultry and eggs; too little milk and cheese; too little of the vitamin-rich fruits and vegetables. In the cooperative nutritional status researches, these characteristics of the national diet were also characteristic of the diets of the elderly people studied (44).

Nutritive Intake of Older Persons

Evidence indicates nutritional problems in the aged are not due to some peculiarity of age, but to lifelong eating habits, disease, accidents and psychological factors (62). A real problem exists in maintaining the nutritional health of the older members of our population. In January, 1967, President Johnson sent to Congress a "Message on Older Americans" in which he made recommendations pertaining to the extension of the Older Americans Act of 1965. Title IV of the Act states, "Recent research into the nutritional needs of older people indicates that a large number of them suffer from lack of proper nutrition" (21, p. 96).

Dietary surveys have shown that perhaps one-third or more persons over 65 consume diets containing less than recommended amounts of nutrients, especially calcium, ascorbic acid, and riboflavin. The same nutrient deficits occur again and again in all parts of the country in

vitamin C, calcium, iron and vitamin A. Nutritional Status, U.S.A. (44) is the report of an extensive investigation that took place between 1947 and 1958 in all fifty states. Deficiencies were determined on the basis of two-thirds of the recommended allowances. Older women in the North Central region showed 20 percent of the group to have intakes low in thiamine and niacin, more than 30 percent low in riboflavin and vitamin C, 40 percent low in vitamin A, and 50 percent low in calcium. About 10 percent of the day's meals of the California and Colorado older women were low in niacin, 10 to 20 percent in thiamine, iron and riboflavin, 20 to 30 percent in vitamins A and C, and 30 to 45 percent in calcium. The diets of older men did not show significant deficiencies except in vitamin A, calcium and vitamin C (44).

Recently, results of a study in Indiana of 22 women between 60 and 99 years of age reported that only three of the subjects had diets that met the recommendations for calories and for seven of the nutrients according to the Recommended Dietary Allowances (36). The most frequent deficits found in the individual diets were those of calories, iron, calcium and protein.

In Colorado, another study was conducted to determine the nutrient content of daily meals served to patients of eight selected nursing homes (39). Four consecutive days were used during which time at each meal a tray with an average serving of all foods and beverages for regular diets was weighed. The daily dietaries were calculated for calories and nine nutrients, using Composition of Foods--Raw, Processed, Prepared (80),

and compared with the range of Recommended Dietary Allowances, 1964, for all patients. Except for ascorbic acid, the mean nutrient content of the regular menu served to patients in all homes exceeded the lower level of the range of Recommended Dietary Allowances, 1964, for the various age groups of both sexes. The energy value ranged from 1386 to 1887 calories. Protein content exceeded 60 grams per day in six homes.

In two groups of active healthy women 65 years of age or older, two methods of dietary analysis were used to assess their nutritive intakes (24). Weighed intakes and the 7-day dietary record were compared on the basis of calories, protein, calcium, ascorbic acid, and vitamin A. Iron, phosphorus, and the B vitamins were not studied because they are commonly associated with protein in food. In general, the diets provided two-thirds or more of the Recommended Dietary Allowances, 1958. Iron, calcium, and vitamin A were consumed at less satisfactory levels in the diets of 12, 16, and 9 percent of the women, respectively. Moderate anemias are almost the rule in elderly persons (43). Average nutrient intakes except for calcium and riboflavin, decrease slightly with increasing age.

Another investigation was made of the individual food intake of 24 men and 24 women in an institution for older persons (78). The food consumption was recorded for 14 days and the nutritive intake of each individual was compared with the average content of nutrients in standard portions of the food served as well as with the Recommended Dietary Allowances, 1953. For every nutrient, more than half of the subjects had values less than that of the standard portion. Iron, vitamin A, thiamine,

niacin, and ascorbic acid, were the nutrients deficient in 75 percent of the intakes.

When the intakes were compared with the Recommended Dietary Allowances, 1953, it was found that half of the subjects ate less than 90 percent of the iron, niacin and ascorbic acid recommended. The women as a group had lower nutritive intakes than the men. Generally, the diets of aging men remain better than those of women (71).

In this study, although the standard portions served met the Recommended Dietary Allowances, 1953, many individual intakes fell far below them. It was significant that the range of actual consumption showed a large variation. Some individuals had intakes three times as great as others, especially that of vitamin A and ascorbic acid (78).

A survey was made in Iowa of the food intakes of a group of women representing an area probability sample of all women 30 years of age and over in the state at the time of the survey (42, 51, 71). The food energy value of the diets decreased with increasing years until mean daily calories of those over 80 years were 400 calories less than for those in their forties. Protein and calcium intakes also declined, as did the ascorbic acid and vitamin A values of the diets. The trend toward the consumption of diets low in calories, protein and calcium appeared to be generally characteristic of both men and women after 70 years of age (71).

The calorie level of the diet may be indicative of the adequacy of the diet. Most foods rich in food energy, except sugars, starches, certain fats and oils, are also rich in other nutrients. It is very difficult

without careful planning to secure an adequate diet when the caloric value is less than 1800 calories (70).

In a Michigan State College study on women from 40 through 90 years of age, it was obvious that the total calories ingested was the determining factor in the ingestion of other nutrients (50). There were many complaints of chronic fatigue, nonspecific ill health, and lack of energy. In this particular study, the conclusion was drawn that 1600 to 1800 calories per day tended to result in a diet providing a satisfactory amount and distribution of specific nutrients (50).

A continuous supply of energy is necessary for the biochemical reactions in the cells. The feelings of fatigue, lassitude, and lack of interest in life seen in many of the elderly may be directly due to a diet consumption too low in calories. On the other hand, diets of excess energy value may be eaten by many which induces overweight and the health risks associated with overweight (41). In an Iowa study, 35 percent of the women 50 to 59 years old, and 28 percent of those between 60 and 69 years were 20 percent over their desirable body weights (70). Another extensive investigation of body composition during maturity and the nutritional implications conclude that average caloric intake during maturity tends to be larger than actual calories needed (7).

Data from studies in an outpatient nutrition clinic at Ohio State University support the concept that obesity is a major problem among aged persons (64). Of 800 individuals seen during the year 1958-59, 200 were over 65 years of age. Sixty-eight percent of these persons were more

than ten percent overweight while only eight percent were more than ten percent underweight. Another author reports, however, that aged women continue to eat the same kinds of food as younger women but fewer calories are consumed and there is a difference in the food groups making up the calories (71). Since obesity is a recognized problem in many elderly individuals there is a need for assistance in selecting an adequate diet reduced in total calories.

Results of one study showed a downward trend with age was apparent in mean intakes of food energy, protein and calcium. For every ten years increase in age, the values decreased on the average by about 85 calories for food energy, 4 grams for protein, and 0.3 grams for calcium (70).

The role of protein in the renewal of protoplasm and special body proteins and in the maintenance of the various enzyme systems is well known; consequently, a protein-deficient diet may make a person seem older than he is. When caloric intake is too low, protein may be burned as a source of energy instead of being used for the nourishment and maintenance of body cells. The consequences of protein deficiency are obvious; edema, decubiti, delayed wound healing, impaired antibody formation and osteoporosis are only a few (64).

The possibility still exists that the aged have different requirements for protein or specific amino acids than younger persons; although, protein allowances for persons over 55 are the same as for younger adults. Some limited studies have shown a need for total essential amino acid nitrogen greater in men 50 to 70 years and the requirement for lysine and methionine

higher for older subjects. However, others have not had the same results. One author suggested up to age 69 at least 66 grams of protein per day is required for nitrogen balance (43). She reported after age 70 a somewhat lower intake, 59 grams, sufficed in the subjects studied. Another suggestion has been made. Since many elderly patients are in a state of negative nitrogen balance, ingestion of 2 grams of protein per kilogram of body weight may be necessary to produce a positive balance (69).

The lower activity and the lower basal metabolic rate of the healty old man may be evidence that he needs fewer calories (34). However, if his protein needs are the same as that of the younger individual and if his calorie requirements are less, then the diet should be more concentrated in its protein content. Thus, any sacrifice in the caloric intake should be made at the expense of carbohydrates and fats rather than the proteins (34). The value of eggs in the diet of the aged person is questionable because of the controversy concerning the hazards of cholesterol ingestion (69).

Adequacy of protein intake may also serve as an index of adequacy in respect to thiamine, riboflavin, niacin and iron. Therefore, an important factor in the nutrition of aged people is the inclusion of protein in amounts equivalent to the recommended allowance. Some reasons for the reduced use of meat, fish and poultry may be difficulties in mastication and the fact that this group has a high satiety value causing some to object to the "full" feeling (71). Some persons think, too, that meats are too fatty and not easily digested.

Even though most of the minerals required by the body are available in ample quantities, calcium and iron are frequently deficient. It has been shown that the older person has more difficulty in absorption and utilization of calcium and increased difficulty in maintaining calcium balance (69). Some evidence suggests that the mineral requirements for older persons are greater than those of younger persons. For example, a higher daily intake of calcium was found to be necessary in older individuals to establish calcium equilibrium than in young adults (64).

There is a noticeably low consumption of milk among the oldsters. In the Iowa study of women 30 to 90 years of age, fluid milk provided an average of 0.14 grams of calcium daily (71). Cheese and ice cream added only 0.1 grams because of little use. Some studies suggest long-term dietary calcium deficiency due to restricted milk intake, either voluntary or because of milk intolerance, may cause osteoporosis to develop.

More effort should be made to see that the milk group is included in the diets of older persons not only as the major source of calcium, but for the high-quality protein and the riboflavin as well. Many, especially women, express a dislike for milk or say that as a beverage it causes flatulence or that it contains too many calories.

If one wants to avoid increasing fat or caloric intake, skim milk may be served. Many dried skim milk preparations are fortified with additional iron and vitamins so that their use contributes considerable value to the diet of the senile person.

In the Michigan State College study, the one food which gave the greatest factor of safety to a diet of 1600 calories or less was milk or its equivalent in buttermilk or cheese (50). No diet without milk provided over 0.5 grams calcium daily. A pint of milk per day increased the intake of protein, calcium, phosphorus, and several vitamins to the point that a diet of no less than 1600 calories was adequate.

Adults do not outgrow their need for calcium and the incidence of osteoporosis is prevalent in approximately 25 percent of the middle-aged and older population group (70). The mean daily intake of calcium for the 1,072 women referred to in the Iowa study was 0.5 grams compared to the recommended 0.8 grams (70).

Osteoporosis, a disease in which there is a decrease in total bone mass with no change in chemical composition, is a common problem in the elderly. It causes pain and deformity and may contribute to the high rate of fractures. The possible importance of calcium intake, activity, and exposure to sunlight in regard to bone loss has been considered. A number of studies have indicated the importance of dietary calcium in the prevention and treatment of osteoporosis. In certain patients, osteoporosis has been associated with an inadequate calcium intake over a long period of time.

Evidence is not conclusive as to the role food calcium levels play in the maintenance of bone integrity in aging men and women, according to one author (43). Some sources report limited benefit has been noted from increases in calcium intake in the prevention and alleviation of

osteoporosis (43, 41). The intake requirement and calcium storage are being studied for their association with bone loss and age.

Another food group that should provide many important nutrients in meals planned for the elderly is the enriched and unrefined cereals group. However, calories in this group may need to be curtailed in order to increase calories from the milk and meat groups, because it often provides a disporportionately large share of total calories in diets of the aged (71).

Selection in the fruit and vegetable food group appears to be the problem rather than insufficient quantity. In the diets of Iowa older women, choices from this group provided adequate calories but the foods chosen did not furnish the required vitamin A or ascorbic acid (71).

Fats, sweets and desserts add calories that will bring the total of the diet to a level equivalent to the energy requirement, but all other food groups should be included first. These foods are important also because they add flavor to a meal and they add to the satisfaction of eating. However, there was a tendency among aging Iowa women to maintain too high a consumption of sweets and desserts, furnishing 20 percent of the day's calories from these foods (71).

Also, fat has been considered a potential cause of arteriosclerotic change, but this has not, as yet, been established in man by controlled observations (69). Besides fat, sugar consumption has been suggested as a predisposing factor in heart disease. Dr. John Yudkin, Professor of Nutrition, London, proposed the theory that coronary heart disease is more closely associated with the level of sugar consumption than with the

level of any other dietary component, including saturated fats (85).

Dr. Yudkin said there is strong evidence that sucrose is an important factor in the cause of heart disease. Consumption of sugar, not starches, by a population is more directly proportional to the affluence of the society than is intake of animal fat. Heart disease is much more prevalent in the wealthier countries than in the poorer countries. Also, studies reveal that people who develop heart or circulatory disease have been eating more sugar than those without the disease. Others reported there was no difference in fat consumption between those who developed coronaries and those who did not. The average intake of sucrose in the United States per person is about two pounds each week (85). The implications in these facts may be significant in planning diets for the elderly with their known potential for cardio-vascular diseases.

"As wealth increases deficiencies disappear, but the diseases of affluence appear," said Dr. Jean Mayer (40, p. 4). The proportion of fat and sugar both have increased considerably in the American diet.

Studies conclude that there is not enough evidence that the basic nutritional requirements of the healthy aged person is any different from those of younger individuals (34, 71). However, it is generally accepted that more signs of nutritional inadequacy are found in older persons than in younger ones, but there is no reliable evidence to indicate that such deficiencies are due to an increased requirement of nutrients (66).

Vitamin deficiency syndromes are not common in the aged patient but subclinical vitamin deficiencies may exist and actually seem to be

the rule rather than the exception. An Ohio State University study did not find elderly hospitalized individuals to have low intakes of vitamin A, thiamine or riboflavin, but evidence for deficiency of ascorbic acid intake was found (64). The conclusion was that clinical manifestations of vitamin deficiencies are rare in elderly individuals whether or not they are hospitalized (64). On the other hand, one investigator found evidences of malnutrition in 142 of 431 patients admitted to a county nursing home (64).

In a rather extensive investigation of 577 subjects in San Mateo, California, it was found that death rates in individuals with a low blood concentration of vitamin A, niacin and ascorbic acid, either one or all three, was higher than in those subjects with normal or high concentrations (21, 43). Vitamin A level in the blood is relatively stable whereas the blood carotene fluctuates with the immediate carotene intake. The cumulative effect of vitamins A and D makes uncertain the use of large daily supplements by elderly people in view of the toxicity of excesses (43).

Scientists have discovered that thiamine requirements of older women are greater than those of younger women; that older women are more quickly affected by low thiamine diets; and, that they are slower in responding to increased amounts of thiamine. It has been shown that liberal additions of the vitamin-B group and ascorbic acid to the dietary of older persons can make for great improvement in general vitality and vigor (69).

One worker has demonstrated a relationship between blood levels of ascorbic acid and number of teeth in older persons (14). Therefore, the

maintenance of good ascorbic acid intake and blood levels may be important to the preservation of the teeth and the prevention of serious gingivitis.

The tocopherols in foods are destroyed by heat processing, oxidation and by preservatives, particularly by chlorine dioxide, the flour bleaching agent now in general use. This fact would appear to create the need for an assured supply of vitamin E in the diet. The diet may be supplemented with vitamin E by using wheat germ or wheat germ oil or capsules of alpha-tocopherol (43). Blood levels of vitamin E in over 1200 men and women living in London showed no differences due to sex; however, there was some increase with age (43).

It has been suggested that, because of difficulties in absorption and utilization, the usual normal intake of vitamins for an adult should be doubled for those in later maturity or in actual senility (69). However, the balance between the various vitamins should be preserved at approximately the usually recommended levels.

Condiments and spices may need to be avoided because they irritate the intestinal tract and they tend to contribute to vascular and renal irritation. However, seasoning in the food is very important since persons are used to having it and taste buds in the older person may be less sensitive, requiring food to be something other than bland for it to be palatable. Salt, or sodium, has been investigated for its relationship to congestive heart failure and to high blood pressure, both common in oldsters. Preventive as well as ameliorative use of a low sodium diet may

be advocated (43).

One author finds no contraindication to the use of coffee and tea in the diets of the elderly unless insomnia is a problem and then caffeine in any form should be restricted late in the day (69). A specific illness might require caffeine to be eliminated. He also suggested that the morning diuresis and stimulation of caffeine might be desirable to the older persons. This same author advicated the use of alcohol in moderation to supply quick fuel, relax tensions and increase the appetite (69).

Water should be considered one of the essential nutrients because of the role it plays in the human body. Seventy percent of body weight is water. Intracellular water is about 50 percent of the total body weight and extracellular fluid about 20 percent (69). Consequently, even minor dehydration can have serious effects. Drinking too much water is almost impossible because of the ability of the organism to get rid of excess fluids.

The total intake of fluids should be approximately two liters so that urinary volume is a minimum of 1500 milliliters in 24 hours (69). In the older person, small amounts taken at frequent intervals may be more desirable than large quantities at any one time. This will produce less strain on the ability to absorb in the intestinal canal and on the circulatory system for distribution of the fluid. Fluid intake may need to be restricted in the evening in order to avoid nocturia. Edema, due either to nephrosis or to cardiac condition, does not justify the radical restriction of water (69).

Since many older persons complain that they do not like water, it may be better to offer them flavored beverages such as ginger ale, tea, coffee, soups, fruit juices, broths, and so on.

An adequate fluid intake will help prevent constipation also. Soft bulk in the diet is needed also to avoid the development of hard, dry stools. The older bowel as well as that of the younger person requires an adequate amount of soft bulk (69). Major vegetable sources of soft bulk are the roots, such as beets, turnips, parsnips, carrots and the leaves, such as spinach, lettuce, cauliflower, brussel sprouts, and broccoli.

The senile intestinal mucosa does not tolerate roughage. The roughage from bran and the scratchy fibers of items such as celery and hulls of corn must be distinguished from soft bulk. Control of the bulk in the diet, as well as all other items, must be highly individualized in geriatric nutrition.

Dr. Frederick J. Stare emphasized the importance of consuming a variety of foods for young and old alike. He said, "By eating a variety of such foods as fruits, vegetables, meats, fish, dairy products, and cereals one is most likely to get all of the fifty known nutrients, and doubtless others yet unknown"(66, p. 737). Dr. Stare also stated that better nutrition and better health can be brought about by the selection of enriched foods--flour, iodized salt, vitamin D milk, vitamin A enriched margarine, and fluoridated water. Also, it has been pointed out that because of their search for longevity and good health, older adults may

be particularly susceptible to nutritional quackery offered through popular communications media (41, 66). They probably lack knowledge of what constitutes an adequate diet, too.

Nutrition can play a role in prevention of chronic illness which is very common in the elderly. Besides death, chronic illness accounts for considerable disability. It has been estimated that 25 million persons, or one in six has a chronic disease (4).

The five leading causes of death have shifted from the infectious diseases to the chronic diseases (14). They are: heart disease, cancer, intercranial vascular disorders such as hemorrhage or thrombosis, accidents, and diabetes (4). They are all related to the development of degenerative tissue changes prevalent in the later years of life.

Eighty-five percent of persons over age 50 die from heart and circulatory dieseases, nervous system disease, and malignant neoplasms. Heart and circulatory diseases are responsible for 54 percent of all deaths. Although cholesterol intake has been related to hypertension and arteriosclerosis, data in many studies fail to support a relationship between high serum cholesterol and cardiovascular-renal deaths (4).

An example of the role of nutrition in chronic disease is in the alleviation of symptoms and serious effects of most chronic diseases which may be delayed or avoided by adequate weight control or reduction. Obesity is more of a problem in the middle-aged or elderly group than is undernutrition. The relationship between overweight and cardio-vascular deaths has been clearly established (14). However, undernutrition may

predispose pulmonary tuberculosis and other chronic lung diseases (4).

Good nutrition can also prevent vitamin and mineral deficiencies that might contribute to the complications of chronic illnesses. There are factors that prevent good nutrition other than improper diet. A large percentage of the aging have some condition for which medications and a special diet are prescribed. The National Nutrition Survey in Texas revealed one out of every five persons over 60 to be on some type of special diet (46). The special diet may not be well accepted by the patient. Physical handicaps can interfere seriously with efforts of the elderly to eat. Arthritis, Parkinsonian tremor and other infirmities may be serious deterrents to taking meals without help (62).

Aside from the fact of physical disability, the desire or will to seek or prepare a good diet has deteriorated and it is difficult to induce the older individual to choose and to like that which is good for him. Alcoholism may be another barrier to adequate food intake (62).

Meeting the nutritional needs of the person as well as the therapeutic requirements becomes imperative for his successful maintenance and improvement. People with nutritional deficiencies require a longer time for convalescence than those whose good nutrition has been maintained. Providing adequate nutrition has significantly shortened the duration of disability which follows surgery, injury, or disease (4). The role of nutrition in geriatrics is to conserve health and to equip the elderly to withstand the onset of degenerative diseases (55).

Nutritional Supplements in Diets of the Aged

A study of 56 volunteers from institutions and others from their own homes in Washington, D.C., and surrounding Maryland suburbs revealed the only nutrient intake in insufficient amounts in their diets was calcium (74). The average intakes of other nutrients showed no deficiencies. This was a result of the fact that the majority of the subjects were considered healthy as well as their taking multiple vitamin supplements. No significiant difference in nutrient intake was found to exist between home and institutional environments.

In the National Nutrition Survey, 1969, Texas reported 38 percent of the elderly individuals were taking vitamin and/or mineral supplements (46).

In the San Mateo County, California, study of aging individuals, 80 participants (35 percent) took one or more food supplements in the form of either multiple or single vitamins or both, mineral supplements, or other food supplements (67). Twenty-six percent used multi-vitamin capsules; six percent had mineral supplements; and ten percent took other food supplements. Of the 72 individuals taking some form of vitamins, 27 (37 percent) had diets adequate in the nutrients found in the vitamin preparations. However, in the other 45 persons taking vitamin supplements, only a few of them received an adequate amount of the specific vitamin in which their diets were low. Thus, the value of unprescribed supplementation is questioned.

Supplementation of minerals was shown to be even less effective (67). Only three of the 89 diets low in calcium were so supplemented and none of the 23 diets low in iron.

Healthy adults who received adequate diets had no need for vitamin supplements except during pregnancy and lactation when 400 U.S.P. units of vitamin D daily were required if the intake of vitamin D-fortified milk was low, according to a statement by the Council on Foods and Nutrition of the American Medical Association (18). There are indications for the use of supplementary vitamins, however. They are useful during periods of emotional illness, when there may be bizarre food habits or food intake may be greatly reduced. They may be used when restricted or nutritionally inadequate diets are prescribed for pathological conditions. Vitamin supplementation also is indicated when it is necessary to employ parenteral feeding. Dietary supplements may be prescribed in any prolonged illness associated with decreased food intake or in any situation in which a person is unable or unwilling to eat an adequate diet. The statement pointed out that dietary inadequacies should be corrected by a proper diet, but supplementation with vitamins might be necessary until dietary adjustments are made and the body stores are repleted.

Excessive or unnecessary supplementation should be avoided; and, therapeutic vitamin mixtures should be used only in treatment of deficiency states, not as dietary supplements. There is real danger of toxicity from too large amounts of fat-soluble vitamins, especially A and D, because the excess accumulates in the body (18). Although it has been recognized

that many older people are in a poor nutritive state, this does not mean that they should be dosed with excess vitamins and proteins. Such nutrients when fed in excess must be metabolized, conjugated, and excreted, which provides work but no apparent benefit to the aging tissues (34).

Minerals are often combined with vitamins in mixtures for dietary supplementation. A statement from the American Medical Association said that although some vitamin mixtures with calcium and/or iron included have proved beneficial, there was no good evidence to support the addition of the 12 or more mineral elements essential for man (18). Few of these minerals are likely to be lacking, and iron should be given as such if the need for it is expressed. Sodium, chlorine, and iodine are usually supplied by iodized table salt. Copper is usually adequate in the diet and there is no evidence that addition of the trace elements, such as manganese, zinc, and cobalt, to the human diet is needed.

One author, Dr. Francis Stern, advocated the use of a nutritional supplement to diets of nursing home residents (68). He stated that many problems and conditions, such as mental disturbances, depression, senility, as well as low-cost meals and a lack of trained supervisory personnel, contributed to the difficulty in maintaining the nutritional status of the aged residents. Due to these factors there was often inadequate intake of food, especially of protein, vitamins and minerals. Therefore, Dr. Stern concluded that nutritional deficiencies in elderly patients can be improved by using dietary supplements to increase the intake of suitable proteins, vitamins and minerals.

Dr. Stern conducted an investigation with 62 geriatric patients having malnutrition in association with various diseases (68). They were given a liquid nutritional supplement (Nutrament) daily. Ten control patients were given their usual diets without supplement. The average percentage weight gain was 90 percent in the Nutrament group compared with 14.5 percent in the control group. By the end of the study the average percentage weight gain for the supplemented group was six times that for the control group. An improvement in behavior and attitude was also observed. There were correctable side effects such as nausea, flatulence, constipation, and foul mushy stools.

In another study, a nutritional supplement (Meritene) plus nonfat dry milk and water, was provided in an eight-week period to a group of 23 elderly psychotic females (25). There was a substantial weight gain, the experimental group gaining three times that of a control group. The effect of this supplemental nourishment on appetite and food intake at regular mealtimes was also tested. Measurements of plate wastage revealed that the nutritional additive did not decrease the ordinary food intake at mealtime. The authors of this study also recommended using an easily administered dietary supplement to partially correct the nutritional problems of elderly institutionalized patients.

The sale of vitamins to supplement diets is a nationwide business and is often related to food faddism. Many times advertising is aimed at older people and the purchase of vitamin and mineral mixtures may be unnecessary and a waste of money for the elderly.

Food Service in Nursing Homes

Recognition of the role of nutrition in the lives of the aged population makes it imperative that food service be a central consideration in the administration and operation of nursing homes and extended care facilities. As small nursing homes have gradually disappeared, larger facilities for long-term care have emerged with an average bed size of 60 to 70 capacity (65). Although nursing homes have grown in size, their dietary services often have not developed consistently with the size and scope of the other services in the home. Accreditation and licensure standards set by national and state agencies generally have not required the services of dietitians. The dietitian's association with food service in nursing homes has been quite limited until recently.

A study in Nassau County, New York, tested the assumption that an overall effort at standard-setting would yield significant results in upgrading the quality of the diets of patients and their satisfactions with the food services (38). Food and nutrition practices in the licensed nursing homes in that county were observed, recorded, and then compared to theoretic standards that appear in the literature. Menu planning, food purchase, storage, preparation, service, housekeeping, and food handling were investigated. The team members also determined the extent to which the patients in the homes ate the food and used the facilities for group eating.

At the time this report was made, 1955, only a few governmental agencies required licensure of nursing homes. Since Nassau County had

been under this regulation since 1941, it was of interest to determine if setting of standards initiated improvement of care and services in the homes. The findings were compared with records kept since 1941 and it was found that the setting of standards were reflected in improved food practices as well as in safe environment and constructive nursing care (38).

Now, with the passage of legislation affecting national standards for health care of the aged, standards have been set for hospitals, extended care facilities, and home health agencies. Regardless of the size of the nursing home or extended care facility, dietetic or nutritional service is required for certification under Medicare. This service can be provided on a full-time, part-time, or consulting basis, but the service must be available (11).

The requirement for extended care facilities set by the Medicare program states:

> A person designated by the administrator is responsible for the total food service of the facility. If this person is not a professional dietitian, regularly scheduled consultation from a professional dietitian or other person with suitable training is obtained (65, p.21).

The provisions of Medicare assure a continuity of care from an acute stage in the hospital to the convalescent stage in an extended care facility. Very often there are transfer agreements between hospitals and nursing homes. When a patient moves from one facility to another his records accompany him. Thus, a dietary regimen is uninterrupted and therapy is continuous. Food can be one of the most important elements in therapy during return to normality after an illness has passed.

Dietitians and nutritionists have recognized this situation as a new opportunity to extend the benefits of sound nutritional planning; and, nursing homes are experiencing an impetus for employing dietitians. "The need for excellent dietary services and imaginative nutritional counseling in extended care facilities cannot be emphasized enough" (11, p. 7).

Guidelines for part-time and consultant dietitians employed in nursing homes or extended care facilities have been published by the American Dietetic Association (56). In them the hospital dietitian is cautioned that food service in nursing homes differs from hospital food service. Although the principles of organization and management are the same, the application is different. The dietitian must be able to recognize the individual strengths and needs of the facility and make careful evaluation before advice is given. She must also be cognizant of the fact that patients in nursing homes are different from those in hospitals because they are usually there for long periods of time. Diet is closely tied in with their sense of well-being and satisfaction (56). It is necessary for the consultant dietitian to have an interest in and understanding of people, their idiosyncrasies, problems, and needs.

Information about present dietary practices in nursing homes can be useful in planning dietary consultative services for these facilities. A study in Colorado pointed up the need for additional reviews of food service in nursing homes and supported a recommendation or requirement that administrators of nursing homes employ consultant dietitians (39).

Dietitians who are employed in nursing homes or extended care

facilities are constantly trying to plan and serve nutritionally adequate meals. Studies reported in the literature show that the average meals served in selected institutions for older persons are relatively adequate nutritionally when compared to the Recommended Dietary Allowances, 1968 (78). However, this does not insure that each resident in the home received sufficient nutrients to meet his dietary needs. Many factors may prevent an institutionalized person from obtaining the full value of the meals as planned. Factors such as the dislike of certain foods, inability to eat some foods due to poor dental condition, or loss of food nutrients in cooking and handling of food affect the actual dietary intakes (78). The ultimate nutritional value of a diet depends on the amount of food actually eaten. Besides many individual and personal factors, management and standards of nursing homes also affect food intake of patients. One worker believed that the quality of care in a nursing home is linked with nutrition (39).

Hankin and Antonmattei reported a need for improved menu planning and meal service in all of a group of selected Michigan nursing homes (28). In another investigation reported in the literature, it was found that suppers were particularly poor, and that they frequently lacked a protein food as well as a serving of a fruit or vegetable (37). Very often the food was served in unappealing combinations; overcooked vegetables were common. The trays were not served attractively. A need for improved food sanitation practices was also noted. The surveys further showed that therapeutic diets were often not served as prescribed by the doctor.

After making these findings, the Indiana State Board of Health provided regularly scheduled dietary consultation to the homes surveyed and later conducted another investigation into their food service practices. The conclusion reached was that the regularly scheduled dietary consultation provided these 11 homes showed improvements in food service could be achieved if the administrator and staff worked effectively with the consultant (37).

The consultant dietitian who plans menus for a nursing home should be attuned as nearly as possible to the needs of the group to be fed. Menu planning is based on these needs as well as the cultural patterns of the persons. If administrative policies and budget will allow the use of a selective menu, this will permit the individual some choice in the selection of his food. Where use of a selective menu is not practical, simple choices, such as choice of bread, beverage, or an alternate entree, will help to satisfy the individual's desire to select his own food. Members of the group for whom the menus are planned should have a voice in the planning where possible and suggestions for foods to be included or left out of the menus should be accepted by the dietitian (57).

For the person between 55 and 75 years of age, the Recommended Dietary Allowances have been used as a guide in menu planning for extended care facilities. The Recommended Dietary Allowances of the Food and Nutrition Board, National Academy of Sciences, National Research Council, 1968 (22) form the basis for the requirements for the older individuals as well as other age groups. Consideration should be given to the

total daily intake of the patient instead of that for each meal because his intake will vary from one meal to the next.

The physical capacity of the individuals often determines the type of food service to be used. If persons are bedfast or confined to their room, some companionship during the meal should be arranged where possible. One author suggested that patients who are unable to eat in the dining room have their food served on a tray in a room other than their sleeping room (55).

Dining room table service is the most desirable approach to food service. Individual plate service or family style in a well ventilated, lighted and decorated dining room favors the development of a homelike environment. Several workers believed that a group of four at each table is the most preferred seating arrangement (57, 58). If residents are physically able to carry trays, cafeteria-type service may be used. A wider variety of foods can be offered with fewer service problems.

The meal time needs to be relaxed and enjoyable. For this reason, persons should be seated for dining on the basis of congeniality (57). Often language, or social barriers, determine the grouping since people are much happier sitting with others who speak the same language or enjoy the same intellectual or social level. It is thought by some that it is better to separate those on modified diets from those on regular diets because the diets are easier handled and jealousy among the residents who do not receive special foods is diminished (57).

An atmosphere of tranquility should prevail during the meal period.

Disturbances during meals interfere both with appetite and with digestion (57). Dietary personnel need to be patient with the fact that eating is a slow process for most of the aged. Trays to slow eaters may be served first and picked up last.

One suggestion that has been made in regard to method of food service is to plan small kitchenettes on the floors or wings so that a resident can make himself a cup of tea or coffee (58). These would be in addition to the large kitchen for meal preparation. The author also commented that dining rooms should be carefully planned and attractively decorated. Small rooms with tables for two or four might be used rather than large dining rooms seating 50 to 100, in order to make mealtime more intimate, conversational, and pleasant (58).

This latter idea has been put into practice in Sweden in their homes for the aged (53). At first, large central dining rooms were designed for the homes, but it was found that small dining rooms were not only more pleasant and homelike, but were less costly to operate because they required less staff. Usually, the dining room adjoins the living room so that residents who come early for meals have a place to wait in comfort. The small dining rooms seat about 12 persons. An attractive service wagon is used to transport the food from the central kitchen. It is made of wood instead of metal so that it looks like furniture rather than institutional equipment. The wagon has a warming plate, drawers for china and cutlery; and, at the bottom, space for trays and a food box (53).

Besides the physical surroundings and the type of food service

employed, other considerations should be made. Smaller meals seem to be more desirable because many old people respond to large servings with distaste, even nausea. This is not true for breakfast, however, since most older persons enjoy a hearty morning meal (8).

Recently, the nutritional intakes of a group of geriatric patients on a three-meal plan were compared with their intakes on a five-feeding program to determine to what extent the Recommended Dietary Allowances were met and to see if consumption was increased when the number of feedings per day were increased (27). The study was conducted at the Veterans Administration Hospital, Wilmington, Delaware, and results showed that there were slight increases in intakes of calories, ascorbic acid, riboflavin, and iron during the five-meal a day plan, but the increase was not significant. There were no significant changes in weight of subjects or in cholesterol determinations. All diets were generally low in calories and iron.

Anorexia is not uncommon when long illness or disablement has weakened a person's desire to live. Small frequent feedings are often much better tolerated than larger meals where there is loss of appetite (69). Foods should be easy to eat because patients may not be interested enough in eating to put out any more than a minimum amount of effort in order to consume their food. Considerable nourishing food can be introduced in the beverage form if the appetite is extremely poor.

Between-meal feedings are often recommended, but these should be carefully planned since extra feedings may prevent adequate eating

at mealtime. Between-meal liquid feedings may prove quite satisfactory though to increase the fluid intake. The feedings should be low in calories and easily digestible in order not to interfere with regular meals (8).

For those persons requiring very soft or pureed foods, regular foods adapted by an electric blender may be better received by the patient than liquid foods or typical soft foods. Blended food can often be made much more palatable and appetizing than commercially prepared pureed foods (8). People with poor dentition or no dentures may need meats chopped up slightly or pureed with broth added to prevent dryness.

Self-feeding should be promoted and adequate provisions should be made to facilitate it. Persons with failing eyesight and neuromuscular changes may need special devices for self-feeding such as weighted dishes and knife and fork combinations. Soup is easier to drink out of a cup than to spoon out of a bowl. Low, flat dishes are better than those with stems which turn over easily. Hot liquids should be served with caution.

Slow motion and untidiness may have to be overlooked and the patient encouraged to feed himself no matter how long it takes or how much he spills his food. A large plastic bib can be used. It is usually desirable to keep the untidy patient away from the group while they are eating (8).

One author observes that the aged person often will eat his dessert first because he prefers it to the other food and it is easier to eat. This may be discouraged by serving the dessert separately, after the main

course (8).

Dietitians and food service supervisors are always concerned with the problem of meeting individual dietary requests; how far should one go in catering to individual whims and fancies. Many times these demands are not so much whims but rather an expression of needs, growing out of attempts to deal with anxiety (57). Most workers with the elderly feel that the policy of individual dietary consideration should be carried out if at all possible; however, limits do exist to the service that can be offered. The dietitian should not let her professional pride be hurt by complaints if she is confident that the meal is properly planned, prepared, and served; but, rather realize that the food situation is an emotional outlet for most persons.

The dietitian should direct the preparation and presentation of food in an attractive and appetizing manner. In order to do this, training programs for food service personnel in nursing homes should be carried out continuously. These programs are usually based on three assumptions to be most effective:

1. That the meals should be nutritionally adequate;
2. That the food should be highly acceptable according to good food standards; and
3. That management practices determine nutritive content and food acceptability (48, p. 223).

The dietitian must deal with the patient's mental attitude as well as his physical condition. The elderly patient should be considered an individual from a particular social structure and economic background

who has changing physical conditions (8). His cultural and religious influences, living arrangements, and economic factors all have a bearing on his food preferences and his eating habits. Life-long patterns are not easily broken. However, the aged person is able to accept change when the "principle of minimal interference" (8, p. 1592) is applied. The older person's mental attitude affects his dietary patterns and nutritional status.

It has been pointed out that the dietitian needs a thorough knowledge and understanding of the individual's reaction to the feeding situation as well as the psychologic factors involved in eating. A four-year experience between the psychiatric and dietary departments at the Home for Aged and Infirm Hebrews of New York has been reported (57). An educational program for nutritionists was undertaken in which psychologic principles involved in feeding behavior were discussed and their application to specific cases outlined. The experience proved of value both to the psychiatric department and the nutrition staff.

The nutritionists learned that much of the irrational behavior seen in their relationships with patients is based on the nutritionist being treated as if she were a parent substitute. This understanding can lead to a greater tolerance for the disordered behavior in patients. The psychiatrists also pointed out that talking is akin to feeding and the nutritionist should take time to carry on a conversation with the residents and to encourage them to feel free to discuss their reactions to food. The dietitian or nutritionist may be giving as much as if she were offering an

attractive meal (57).

Some of the other psychologic aspects of eating problems were studied in the cooperative effort between the psychiatrists and nutritionists. Emotions, anxiety and depression are of great importance as determinants of appetite often causing anorexia, or loss of appetite. In the elderly, rage and disappointment at the situation in which they find themselves, are often reflected in food refusal. Isolation and withdrawal of the aged person may be expressed in a considerable reduction of food intake. Any emotional or behavioral maladjustment may be revealed in the context of the feeding situation (57).

Another area of considerable psychologic interest is the study of food prejudices, aversions, and allergies. These often result from unpleasant associations to early illness, discipline, or religious and cultural taboos. Experience with the elderly indicates that some restrictions of specific foods are unwarranted (57). Food prejudices or ritualistic systems of eating often serve as protective devices against anxiety. Favorable alteration in food tolerance may be achieved by an understanding atmosphere of permissiveness and freedom of choice.

Herbert Shores, Executive Director, the Dallas Home and Hospital for Jewish Aged, told dietary consultants at a workshop in Texas recently, "The older person in a nursing home gives up a way of life he has known and controlled in return for care and survival" (63, p. 287). Most people resist coming to a nursing home and do so because of ill health, serious economic reversals, and disruption of their normal living patterns such as

the loss of spouse. Living in a nursing home, therefore, creates fears, uncertainties and loss of control of one's own environment. What may appear to be hostile, aggressive, ungrateful behavior may be a plea for help and understanding.

Methods of Dietary Survey

Charlotte Young and co-workers have made a comparison of dietary study methods and the results have been published (83, 84). Three population groups were studied and it was found that for an individual, in any of the three groups, the 24-hour recall did not give the same estimate of intake as the dietary history or as the seven-day record. She concluded that to describe the intake of individuals, the two methods could not be used interchangeably.

For the mean of a group, the dietary history gave distinctively higher values for two groups than did the estimates obtained by the 24-hour recall. However, the history and 24-hour recall gave results which were in better agreement for the third group (84). For the mean of a group, the seven-day record and the 24-hour recall tended to give approximately the same estimates for the dietary intake for most nutrients. This was true for all three population groups studied (84). Other investigators suggest that the 24-hour recall and the seven-day record may be substituted for each other under certain conditions (75).

The National Nutrition Survey of 1969 has employed the 24-hour recall method of dietary survey since the investigators were interested

in the nutritional status of groups rather than individuals. In this instance the 24-hour recall was of everything consumed by the total household from the home preparation source and was not allocated by individuals. In one-half of the households a 24-hour recall was taken of everything consumed the previous day by any male or female 60 years of age or older (45, 59). It should be noted that in dietary surveys of population groups, the intake of the individual is masked (75). The same types of surveys may be used to study an individual intake, but some of the techniques may be different.

The 24-hour recall which is used extensively to study groups, was tested with a group of older people for its accuracy since it depends on memory (9). The study was to determine if there were any measurable differences between the data obtained from younger and older groups when the 24-hour recall method was used. A reference menu was used to form the basis for probing, which constituted the measure of degree of forgetting. The conclusion reached was that there is a difference in response to the 24-hour recall between younger and older subjects. The older subjects remembered less about their food intake.

It was found almost unanimously for all population groups studied for the ten nutrients that the dietary history did not give the same estimate of intake for an individual as the seven-day record. Thus, a seven-day record cannot be accurately predicted from a dietary history.

In another assessment of dietary study methods, 37 patients submitted data collected by three methods: seven-day record, dietary interview,

and 24-hour recalls (77). The means were compared and correlation coefficients determined for several nutrients. The seven-day record and the interview gave more similar information, but it was concluded that predictions of intake based on knowledge gained by one method are not accurate. The differences in mean values were not consistent. The author suggested that only one method should be used in the collection of data for any particular study (77).

A study was conducted at the Walter G. Zoller Memorial Dental Clinic to analyze the significance of diet histories and diet records (35). A detailed diet history was taken from each subject at the beginning of the investigation. This was accomplished by the interview technique. Next the subjects were asked to weigh on gram scales and to record their food intakes for a period of 14 days. This was done over a three- to four-month period with repeated diet records kept during that time.

Nutrient values from the diet histories were calculated as well as from several of each of the subjects' diet records. When calculations based on diet histories were compared with those based on diet records, it was apparent that diet histories frequently did not agree with actual diet records. The variations in the different periods of diet records showed significant differences. Diet histories involving a small number of subjects are not dependable data in research programs and may lead to false conclusions. Quantitative records of actual food intake must be taken for such purposes. Weighing seems to be more accurate than measuring (35).

It is agreed by most workers that weighing is an accurate means of

learning what people eat, but it is an almost impossible method to use in field studies of any magnitude. Investigators also conclude that the weighing of food by the subject himself appears to alter intake (76).

In Michigan the diets of elderly women were studied from several aspects (51). One was to determine the validity of two methods of data collection, the 24-hour recall and weighed diets. The computed diets from both methods accurately reflected the results of laboratory analyses for nitrogen, calcium, and phosphorus. However, the apparent mean intake of all nutrients was greater when measured by the recall diets. The authors surmise that this may have been due to the accepted fact that self-weighed diets have intakes influenced by the act of weighing. For example, there are fewer between-meal snacks eaten probably due to the inconvenience of weighing.

Beal suggested that the perfect method of dietary intake collection would be to weigh or measure all foods consumed in an extended period of time and to analyze aliquot samples of all foods for their nutrient content (2). Another author comments that a study of weighed portions of food actually eaten by patients in nursing homes would have considerable value in determining the nutritional value of actual dietary intakes (39). However, the expense of time, money and personnel limits this method to a few subjects for short periods of time.

Balance studies, with weighed and analyzed intake and output, are another means of accurate but limited investigation. Beal stated that this leaves for practical use, the 24-hour intakes and dietary histories. She

cautions against applying information acquired from even a 30-day intake to long-term intake predictions; but the chances of approaching a usual intake improve as the number of 24-hour intakes increase (2).

Although seven-day studies are commonly taken as sufficient, a number of investigators conclude that one week cannot be considered a long enough period to give an accurate assessment of the average intake of nutrients by an individual (13). One survey lasted for six months when the food intake of older women was studied. The most recent study of any such duration has been reported by Chappell (13).

This British worker studied two subjects, one for 70 weeks and the other for 13 weeks. The diets were weighed by each subject and the calories and nutrients in them calculated from food tables. The weekly intake of calories and nutrients showed considerable variation. Standard errors of eight to 15 percent for most of the dietary components and much larger percentage errors for some vitamins were found when mean daily intakes were based on one week random samplings within a year. The author concludes from these findings that the results of short-term dietary surveys should be interpreted with caution. A more accurate estimate of average intakes can be obtained from a number of one-week periods during the year rather than from a single sampling of the same total duration (13).

Business and professional men in the Minneapolis-St. Paul area were asked to weigh and record the food they ate for two consecutive weeks in order to compare variations in intakes in different weeks (1). Average amounts of groups of food eaten and average nutritive content of

the food eaten by the 39 men were remarkably similar for both weeks. The most substantial differences were found in vitamin A and ascorbic acid because of their uneven distribution among vegetables, fruit and other foods. This author concluded that although there is week-to-week variation in diets, a one-week record will prove as satisfactory as two consecutive weeks for determining food intakes (1).

On the other hand, Yudkin conducted a survey on six young women for four consecutive weeks (86). Each subject weighed her diet and then the calories and nutrients in them were calculated from food tables. The weekly intake of calories and nutrients showed considerable variation; so Yudkin concluded, that to have an accurate assessment of a person's intake, a prolonged period of study would be necessary because of variations in food consumption.

Many authorities feel that a dietary record covering a period of seven consecutive days or twenty consecutive meals is the shortest length feasible from the standpoint of accuracy in a dietary intake study. However, there are others who believe that a larger number of carefully taken one-day records are as good as a smaller number of seven-day records (12). This theory was tested in a regional study of the nutritional status of various population groups in the northeastern part of the United States.

By the use of variance components, it was found in the 150 analyses representing all nutrients and all population groups studied that a dietary record need consist of only one day when characterizing the dietary intake

of a group (12). Great importance is placed on the number of days as compared to the number of subjects. For greater precision, it was more efficient to take more subjects, not more days, in order to obtain an estimate of the mean intake for a group.

Besides the problem of how many days, the question of which days must be decided. This is particularly important when the record is to be taken for one day only. In the study reported concerning the northeastern states, there were no significant differences beyond chance occurrence between days for any of the nutrients or for any of the population types except the college student group (12).

The number of subjects can also be selected so that the estimate of the mean for the group will have a desired precision. A graph has been developed from which the number of subjects in relation to the number of days necessary for a given precision can be estimated (12).

There are other less used methods of dietary survey. Wiehl has outlined a new method for developing a short schedule for qualitative classification of dietary patterns (82). The short schedule could consist of simple questions for obtaining information needed to classify individuals according to dietary practices. Another method used by one study group was an extensive questionnaire (76). The questionnaire was designed to provide information of the usual food intake for a month. This was a difficult and time-consuming method for the subject. The validity of the questionnaire has not been tested.

The inventory method to determine quantities of food consumed in

dietary studies has been used in some instances (28, 48). This involved a beginning inventory of all foods on hand when the study started, a record of all items purchased and delivered, and an ending inventory at the end of the time period. Then the net amounts of each food utilized in the period were determined. The daily availabilities per capita were computed for each food group and the average daily availabilities of certain nutrients were then calculated using food tables.

Nutrient intake data offer direct means of estimating dietary levels for several nutrients for which routine laboratory or clinical tests have not yet been developed (45). Christakis suggested that the evaluation of findings often presented difficulties inasmuch as dietary history methodologies as well as biochemical indices of nutritional status have not yet been standardized or universally accepted (15). His statement was based on a nutritional study of New York school children in which he found there was no demonstrable correlation between the evaluation of clinical status and the evaluation of diet histories. Therefore, a composite of epidemiologic and biochemical methods appears to be required not only to detect overt signs of malnutrition but to categorize the nutritional status of a population group in relation to desirable nutrient ranges (15).

The Computer in Calculating Dietary Data

Recent reports have suggested that computers are proving to be powerful analytical tools, especially in research work. J.A. Prest states, "The few individuals who have so deftly avoided computers for the past

ten years--perhaps in the benign hope that they would go away--had better accept the fact that computers are here to stay" (29, p. 1488).

The food intake of a subject for a given period may be determined from tables of nutritive values for given amounts of each food. Calculations have generally been done by hand on desk calculators. Consequently, the time and cost involved have usually limited the number of diets that could be evaluated. With the emergence of low-cost, high-speed computing, routine statistical analyses in many areas have been programmed for computers (73).

Information in nutrition studies is usually secured in order to see how well the diet of an individual or a group of individuals' diets conform to the nutritional recommendations based on age, weight, height, sex, occupation, and so on (73). The daily recommendations of the National Research Council, the Recommended Dietary Allowances, 1968, are easily punched into output cards to be used in the evaluation of the dietaries. The usual plan of assessment includes calculation of the daily dietary intake of the following nutrients: calories, protein, fat, carbohydrate, vitamin A, ascorbic acid, thiamine, riboflavin, niacin, calcium, and iron (79).

Another option of the system is for dietary data to be categorized to show the food-group sources of selected nutrients (72). Additional information may be obtained by utilizing factors related to dietary selection, cost data, food patterns, and almost any other available item of interest. The possibilities for the use of computers to evaluate dietaries is almost unlimited and the scope of the "output" is largely determined by the

investigator.

Besides the analysis of dietaries, the computer may be used to evaluate the nutritional quality of menus. A dietitian should know the quantity and quality of nutrients in her menus. Hand calculating the nutrients in a diet or menu is not only laborious, costly, and time-consuming, but also subject to computation errors. The advance of data processing technology and the availability of equipment makes the use of electronic methods for calculation of nutritive values practical.

One author reported a study conducted in 1962 in 28 Veterans' Administration Dietetic Services where the computer was used to analyze regular and modified menus for hospital patients (5). One week's menus were broken down at one time into 14 nutrients based on gram weight. Both daily and weekly averages of each nutrient appeared on the machine "printout" for each type of diet. The computerized method provides the dietitian with calculations important in improving dietetic management and planning as well as information necessary to adjust menu items to provide nutritional adequacy.

Other projects utilizing the digital computer are reported in the literature. The electronic computer method of analysis has been used to study extensively old data on file in the Louisiana State Board of Health, as well as recent data collected there (29). The workers feel that by the use of this more rapid and accurate method, it may become possible to characterize and to differentiate diets and dietary habits. It may also be possible to identify new trends as they develop.

One article reported a two-year study in which a digital computer was used in computing and summarizing all dietary data gathered in various studies of a research nutrition clinic (79). The authors commented that the program has been quite satisfactory and the professional dietitian has been freed from laborious calculations. Consequently, more time for quantitative estimates of food intake during the interview was permitted.

In a research project at Ohio State University, the computer was used to determine the adequacy of the diets of selected young women (32). The study was programmed to calculate the nutritive value of the individual diets and to determine the percentage of the Recommended Dietary Allowances obtained in them. The mean nutritive values of the dietary intake of the total group and the standard deviation of each of the participants from this mean were also given.

The Department of Human Nutrition, London School of Hygiene and Tropical Medicine, used short computer programs for their calculations involved in nutrition and dietetics (52). In one program, the diets were calculated in terms of 20 nutrients using the weights of foods eaten and number of subjects surveyed. The diets were evaluated in terms either of meals or of total 24-hour intakes.

Dietitians of the Clinical Research Unit of the University of Michigan Medical Center have been using the digital computer as a tool in small dietetic operations for three years to calculate research diets (33). They have successfully adapted the system to one for everyday use by the dietitian in a small dietetic service.

In a rather extensive study of atherosclerosis in two orders of monks, the investigators found that the utilization of electronic computers had reduced the calculation of dietary data from 90 minutes per subject per study to approximately 15 minutes (26). They also found the amount of time required by professional nutritional personnel was markedly reduced since clerical persons and machines could do 60 to 70 percent of the work involved. One nutritionist could handle 10,000 individual diet records per year.

The careful preparation of the data prior to the analysis stage determines the excellence of the results obtained. To summarize, the dietary survey data must be:

1. Carefully collected in accord with the fixed design of the study;

2. Transposed qualitatively and quantitatively to worksheets by some tested and proven efficient system of coding; and

3. Transferred to punch cards (32, p. 52).

The initial step in assessing the value of a diet is to record the food consumed. Other pertinent facts may be collected and recorded also, such as age, sex, weight, and so on. Next, the food items must be coded. A standard coding method has been established by the U.S. Department of Agriculture for the food tables in Composition of Foods-Raw, Processed, Prepared (80), and Nutritive Value of Foods (47). This facilitates the use of punch cards in tabulating the dietary information.

The next step is to have a card punched for each item of food included in the investigator's list. The amount of each food is expressed

in terms of common household units or by 100 gram portions. Included also are amounts of individual nutrients contributed by that food in the quantity designated. Sets of cards punched with the food table values may be purchased (19). These are referred to as master cards.

A second card called the "food record card" is punched for the food items included in the survey, but in the amount actually consumed by a given subject on a given day (73). The unit of quantity must be the same as that used for the master card, either by weight or measure. If there are foods or food combinations that do not appear in the master card set, cards must be punched for them and added to the master set.

At this point, a problem may arise that is concerned with nutrient data on mixed or composite foods. Whenever possible, the 100 gram portions of mixed foods should be derived directly from the nutrient values of their ingredients (29). Recipes should be used for calculating the composite value, or ingredient information on a product secured from the supplier if possible.

Now, the program must be written. This is a list of operating instructions which is stored in the computer. It has been prepared in logical sequence by a programmer who is a technician serving as the communication link between the researcher and the machine (30). Before talking with the programmer, the nutritionist and statistician must outline the tables of desirable results of the complete operation.

The programmer then prepares a flow chart which uses basic symbols to show each step the computer must perform. The program must then be

coded into machine language such as FORTRAN before it is placed in the memory of the computer. The program has to be "debugged" by processing some input data and comparing the output with the results which have been calculated by hand. After making necessary corrections, the program is ready for use.

There are many advantages to using the computer in the analysis of dietary data. Several authors agreed that the time saving feature is the outstanding one. This advantage over tedious calculations done by hand on desk calculators makes possible more extensive dietary surveys than were practical before the advent of the digital computer (32). Only seconds are required for the computer to accomplish the following: compute all individual values, add the values, calculate the average if several days are used, compute the percent of calories derived from protein, fat, and carbohydrate, and type out the final results (79).

Computers not only save time but they increase accuracy (26). The system allows the processing of vast amounts of raw data with precision. The results are produced in a form which is readily adaptable to further analyses, correlations, summaries, and statistical evaluations (79). Special features and optional operations of most computers permit flexibility and extended usefulness of the system and data (29).

Another advantage is that a given set of cards may be used several times, or the results of initial computations can provide a basis for subsequent analysis (73). The number of nutrients calculated can be increased allowing a greater depth of menu analyses to be obtained without additional

manpower (5). Another important feature is that content figures for individual food items rather than average figures for a class of foods is used (5).

Some investigators have indicated what they consider to be the advantages of computer use:

1. Improved comparability of data from different studies;
2. Easier application of new approaches to the analysis of dietary data; and
3. More efficient storage of data for future use (30, p. 457).

In one article, the authors cautioned that it is to be remembered that the computer is a tool, not a brain (30). It can only follow instructions and make logical selections according to criteria carefully worked out in advance.

Food Composition Tables

In order to assess the nutritional intakes of individuals or groups of people, not only the quantity of each food consumed must be known, but also its quality in terms of nutrient composition. There are several reliable tables of food composition that are suitable for use in the United States.

Composition of Foods-Raw, Processed, Prepared is an analysis of 2483 food items, published by the U.S. Department of Agriculture (80). Data in the tables was compiled from chemical analyses performed by government laboratories, industry, and university research agencies. Food tables are constructed to report average food values and many

factors are taken into consideration in arriving at the published figures. Some of these factors are: variety of food, season of production, geographic differences, the effect of storage for periods prior to marketing, the effect of manufacturing and preparation practices (42, 81). Every effort is made to have values typical of the product available the year round throughout the country.

Bowes and Church Food Values of Portions Commonly Used is another table that classifies foods by food group (17). Nutrient values are stated in terms of commonly used portions, that is, household measures. The data has been derived from other published figures. Twenty-six nutrients are listed for 1500 food items.

Laboratory analysis is a method, other than calculations from food composition tables, of determining the nutrient content of a dietary intake (81). Samples representing food eaten must be obtained and carefully preserved so that the chemist can perform analysis of either individual foods or of a proportionate aliquot of the foods. The laboratory analysis provides the most reliable energy and nutrient values for describing the actual nutritive content of the food eaten by an individual for a given period. However, it is not a practical method of evaluation of dietaries except in small individual studies, such as in metabolic research problems. Laboratory analysis may be used as a check or comparison for reliability with the food composition tables.

Some dietary surveys are evaluated on the basis of the Basic Four Food Groups (16). A Guide to Good Eating pattern has been set up by the

U.S. Department of Agriculture to insure good daily nutrition (6). Foods with comparable nutrient content are grouped together. There is a recommended number of servings from each of four food groups that will fulfill the requirements of the Daily Recommended Dietary Allowances. The four groups are: (1) milk and milk products, (2) meats, (3) fruits and vegetables, and (4) breads and cereals. Fats and sweets are to be added to these specified number of servings mainly to contribute calories and palatability to the diet.

The Food and Nutrition Board of the National Research Council publishes recommended daily dietary intakes for 16 nutrients (22, 61). These allowances are revised approximately every five years in terms of new knowledge gained from research, and changing activity patterns of the people of the United States. Age groups are listed with divisions according to sex. Pregnancy and lactation have separate allowances.

The Recommended Dietary Allowances are intended to be used as a guide for the general population and they may not be accurate when applied to an individual. They include a margin of safety over average physiological requirements, and there is no way to account for individual differences such as rates of absorption, degree of metabolic breakdown, utilization of energy, effects of drugs, change in activity, or interactions between nutrients (6). In spite of these considerations, the Recommended Dietary Allowances, 1968, remain the most reliable quantitative standards for food intake evaluations.

The Recommended Dietary Allowances should not be confused with

the Minimum Daily Requirements. The Pure Food and Drug Administration specifies minimum daily requirements for major vitamins and minerals (6). The levels defined are such that lower intakes would produce demonstrable deficiency signs. Their use is in connection with legal labelling requirements.

CHAPTER III

METHODS AND PROCEDURE

Research Design

A typical nursing home was selected in which the study could be carried out as conveniently as possible. The administrator was contacted for permission to survey the dietary intakes of the residents in that home. After consent was secured, the director of nurses was informed and her cooperation sought. A meeting was held with dietary department employees in which the study was explained as well as how the investigator would conduct the research.

Necessary data on the nursing home population was obtained from the patients' charts. The following information was recorded for each resident: name, age, sex, whether ambulatory or bedfast, diet order, and vitamin or mineral supplement prescribed. Only those persons under 55 years of age, those listed in a critical stage of illness, and those individuals who were on tube feedings or liquid diets, were eliminated from the possibility of being chosen as a subject.

Seven days were chosen at random in such a manner as to include each day of the week in the study. The study was conducted over a period of 18 weeks from July 22, 1969, to November 21, 1969, with a

number from 1 to 18, inclusive, being selected at random to determine the exact week in which the study was to be conducted corresponding to a particular day of the week. The nursing home used cycle menus and the menus for the days studied were served as planned.

Names of the eligible nursing home residents were arranged in alphabetical order and assigned a number. On each study day 14 subjects were drawn at random from the nursing home resident population. The subjects' individual dietary intakes were recorded for each day of study. Any foods eaten by the subjects that were not served on their trays at mealtime were noted.

Two days were chosen as a trial to test and perfect the methods to be used during the study. The set-up in the kitchen and the working relationship with the dietary employees were arranged to interrupt regular kitchen routine as little as possible.

Because of inexperience in this type of dietary survey method, a research assistant, who had conducted a weighed intake project, was employed. Her duties consisted of working on data collection days only to help with weighing the food served and returned. With two persons to handle the subjects' food and trays, meal service was fast enough that there were no delays to disturb either the dietary workers or the patients. Accurate procedures were also more possible because two persons could check on each other.

Forms were made on which the individual subject's food intake could be recorded for each meal. After the subjects for a day were chosen, a food record form for each one was filled out with the subject number, date,

diet, and whether the person would be served in the dining room or in bed (see Appendix A). A form was made for each person for each meal. This was done the day before the study day and all information checked with the nursing home dietary records. Also, on the day previous to an investigation, the dietary personnel were notified.

Weighing of foods was started about an hour before the serving time for each meal. All cold foods were weighed, labeled, recorded and placed on trays in the refrigerator until time to serve. Bread was weighed and stored in waxed bags. A banquet table was placed in the receiving area adjoining the kitchen. Steam table pans were used to make a hot water bath in which the hot foods were held during serving. Hot foods were weighed as the trays were served. Two spring-type dietetic scales were used to weigh all food items to the nearest gram. All foods used were from those prepared by the cooks for that day, and diet orders were followed carefully.

All trays for the subjects were served by the investigator and her assistant from the area they had set up. The trays were served in the usual sequence in order to keep routine as normal as possible. As the dietary workers were ready for a person's tray, the investigator was told, the food weighed, the tray assembled, and delivered to the serving counter ready to go into the tray carrier or to the dining room.

After the meal, trays were collected and returned to the research area where all food not consumed was weighed back and the grams recorded on each food record form. Every effort was made to learn of any foods

eaten that were not a part of the planned menus. Members of the nursing service were cooperative in reporting other foods consumed by the subjects. The same procedure was repeated for each of the meals during the study.

Computer Program

After all data was collected, the grams of each food eaten were determined by subtracting the grams returned from the grams served. Data was transferred from the food record forms used during investigation to work sheets. See Appendix A.

The food items were coded according to the numbers in Table 1 from Composition of Foods-Raw, Processed, Prepared (80), which correspond to the data punch cards carrying the nutritive values per 100 grams of food. The composition of any food or combination of foods not listed in Table 1 of Composition of Foods-Raw, Processed, Prepared (80) was computed using other food composition tables and a card punched with the appropriate information for a 100-gram portion. These were assigned identification numbers and added to the bank of cards. See Appendix A.

A program was prepared for using an IBM Computer Model 360 at the Computer Center, Oklahoma State University. Cards were punched with all collected data and subject identification. See Appendix A. The deck of punched cards carrying the nutrient values of each food were used for the analysis.

This study included the following nine nutrients: calories, protein, calcium, iron, vitamin A, thiamine, riboflavin, niacin, and ascorbic acid.

For each day of the study the amount by weight for each of these nutrients was calculated for each individual included in the study on that day. Each of these weights was then expressed as a percent of the Recommended Dietary Allowance for the appropriate age category and sex of each subject.

A mean percent for each nutrient was obtained for the 85 dietary intakes recorded during the week as well as standard deviations and standard errors. A range for each mean was printed out also. The computer then was used to secure the mean percentages of each nutrient consumed for the following classes: males and females; regular and special diets; ambulatory residents and bed patients.

CHAPTER IV

RESULTS AND DISCUSSION

Description of Sample

A typical nursing home population of 77 residents made up of 19 men and 58 women was chosen for the dietary intake study. Both special and regular diets were represented as well as persons able to eat in the dining room and others confined to their rooms. The composition of the population from which the sample was selected may be seen in Appendix B.

Fourteen subjects were drawn randomly from the population for each of seven days representative of a week. However, on a few occasions trays were lost or discarded before food could be weighed back so several days were short of 14 subjects. Eighty-five were actually obtained. The distribution of subjects by day was: Sunday, 12; Monday, 13; Tuesday, 11; Wednesday, 14; Thursday, 11; Friday, 13; Saturday, 11. The days are listed here in their natural order but were drawn randomly for the study. In the tables, number one refers to Sunday, two to Monday, and so on.

Since there was random selection each day some subjects appeared in the study more than once. Subject number five appeared most often, four times out of seven. See Appendix B. Six persons were drawn three

times; 18 were selected two times; and 27 appeared only once. Twenty-five persons of the total population were not included in the study. Three of these had been eliminated because of age, under 55, and one person was on tube feeding and so did not qualify to be a subject.

The following chart shows the distribution of the 85 dietaries collected.

	No. of Men	No. of Women
Total	26	59
Regular diets	16	26
Special diets	10	33
Ambulatory	10	33
Bed patients	16	26

Menus were not evaluated as planned but as actually served. For example, milk was always available to drink, but often was not served to individual subjects because milk as a beverage was refused. Therefore, the values obtained represent only foods actually served and not necessarily the menus planned with nutritional adequacy in mind. Milk was perhaps the major deviation in food served versus food planned.

Recommended Daily Dietary Allowances, Revised 1968 (22) for age group 55 to 75+ years for males and females, respectively, were used as the standards of nutrient allowances. The value given for each nutrient studied was considered to be 100 percent of the amount required by an individual per day. See Table 1. The values obtained when the dietaries

TABLE 1 Recommended Daily Dietary Allowances, Revised 1968

Sex	Calories	Protein gm.	Calcium gm.	Iron mg.	Vitamin A I.U.	Thiamine mg.	Riboflavin mg.	Niacin mg. equiv.	Ascorbic acid mg.
Males, 55-75+ years	2400	65	0.8	10	5000	1.2	1.7	14	60
Females, 55-75+ years	1700	55	0.8	10	5000	1.0	1.5	13	55

TABLE 2 Percentage ranges of Recommended Dietary Allowances served and consumed for nursing home residents

Nutrient	Percent RDA Served			Percent RDA Consumed		
	Maximum	Minimum	Mean	Maximum	Minimum	Mean
Calories	144.70	59.80	100.15	129.70	33.10	77.03
Protein	231.00	82.70	142.13	190.90	37.30	107.01
Calcium	429.60	30.40	137.75	425.90	28.30	112.94
Iron	223.90	79.90	135.21	176.90	31.90	102.32
Vitamin A	534.80	46.20	166.05	534.50	28.50	120.92
Thiamine	126.90	54.10	88.59	117.90	27.40	68.22
Riboflavin	201.90	47.30	100.56	189.30	19.40	79.87
Niacin	429.90	39.90	126.76	343.80	25.70	92.72
Ascorbic Acid	269.90	29.00	113.40	266.60	14.90	91.67

were analyzed as to food served and food eaten were expressed as percentages of each Recommended Dietary Allowance.

Presented in Table 2 are the range of percentages of Recommended Dietary Allowances served and consumed for the nursing home subjects. A maximum and a minimum percent obtained for the 85 intakes is shown and the means for the entire group.

Food Served

One of the purposes of the study was to evaluate the food served to the nursing home residents. Therefore, it is interesting to note when looking at the means that only one nutrient, thiamine, falls below an average serving of 100 percent with a value of 88.59 percent. This would indicate that on the average the group was being offered a diet adequate in all nutrients except thiamine. It does not, however, follow that individuals were being served nutritionally adequate meals every day. The rather wide range of each nutrient can be seen by studying the maximum and minimum percentage of the Recommended Dietary Allowance offered for the diets of these subjects.

That thiamine was less than 100 percent in the food served the residents was surprising, since observation had not revealed any refusal of bread or cereal by an individual. Cereal was served every morning for breakfast and enriched bread or a hot bread was served at every meal. On consideration of this finding, one explanation seemed to be the fact that a number of persons were bedfast and in such a physical condition to

require only pureed, blended, or liquid foods for consumption. Solid foods could not be eaten; consequently, bread was not served although cereal was usually eaten for breakfast. Also, pork was used only three times during the seven days, and then only the regular diets received it.

Food Consumed

Also from Table 2 may be seen the mean values for each nutrient consumed by the subjects. Four means are above 100 percent: protein, calcium, iron and vitamin A; whereas five are less than 100 percent of the Recommended Dietary Allowances: calories, thiamine, riboflavin, niacin, and ascorbic acid. Thiamine is the lowest at 68.22 percent, perhaps because it was the only nutrient served less than 100 percent. Riboflavin, with a mean percent of 79.87, might be anticipated to be somewhat low knowing that milk was not consumed in adequate amounts by all individuals every day. Other investigators have observed a less than desirable intake of milk in elderly persons (71). Niacin and ascorbic acid with means of 92.72 and 91.67, respectively, were not as low as might be expected, especially ascorbic acid, since the diets of aged individuals have been found to be consistently low in vitamin C (43).

The fact that caloric intake is less than 100 percent of the desirable allowances for males and/or females aged 55 to 75+ years, is of concern only if the subjects are not maintaining their weight. Whether or not there were changes in weight was not determined in the study. A lower than recommended intake of food energy might partially account for low

niacin and thiamine values. Other studies have revealed low caloric levels in dietary intakes of older individuals (70).

Protein is not always found to be adequate in food intakes of the elderly (64) as it was in this study. Neither is calcium often in amounts to meet the Recommended Dietary Allowances (50), but the mean value obtained in this study indicates that on the average the diets consumed were 112.94 percent of the Recommended Dietary Allowances for calcium.

The allowance levels that are recommended are intended to "cover individual variations among most normal persons as they live in the United States under usual environmental stresses" (22). Many workers consider two-thirds of the recommended allowances to be adequate for normal nutrition (15), and only values lower than two-thirds of the Recommended Dietary Allowances are of real concern. It may be noted in Table 2 that no nutrient was consumed at less than 66.66 percent of the recommended levels.

Male and Female Subjects

Illustrated in Table 3 are the percent of Recommended Dietary Allowances of each nutrient consumed by males and females in the study. There were only 26 male subjects compared to 59 female subjects. Because the sample was not drawn to reflect the male and female population of the nursing home, no conclusions can be made from these values. However, it is interesting to note that on the average females consumed a better diet than males. Riboflavin and calcium are the only two nutrients

TABLE 3 Percent of Recommended Dietary Allowances consumed by males and females

Sex	No. of Subjects	Calories	Protein	Calcium	Iron	Vitamin A	Thiamine	Riboflavin	Niacin	Ascorbic Acid
Male	26	62.13	102.81	129.83	97.05	107.12	59.29	85.76	87.53	85.63
Female	59	83.59	108.86	105.49	104.63	126.99	72.16	76.40	94.99	94.34

TABLE 4 Percent of Recommended Dietary Allowances consumed by regular and special diets

Diet	No. of Subjects	Calories	Protein	Calcium	Iron	Vitamin A	Thiamine	Riboflavin	Niacin	Ascorbic Acid
Regular	42	75.43	94.22	119.17	97.56	105.56	64.21	65.44	99.70	79.34
Special	43	78.58	119.50	106.85	106.95	135.91	72.14	92.77	85.90	103.72

TABLE 5 Percent of Recommended Dietary Allowances consumed by ambulatory and bed residents

Condition	No. of Subjects	Calories	Protein	Calcium	Iron	Vitamin A	Thiamine	Riboflavin	Niacin	Ascorbic Acid
Ambulatory	43	78.46	104.02	116.77	101.20	104.37	69.53	71.56	101.89	86.58
Bed	42	75.55	110.08	109.01	103.45	137.85	66.88	87.16	83.32	96.89

which were higher for the males. It had been observed during the investigation that men drank more milk than women.

Regular and Special Diets

Persons on regular and special diets were also compared. See Table 4. It is surprising to note that in all but two instances, calcium and niacin, subjects on special diets ate higher percentages of the Recommended Dietary Allowances than did those on regular diets. Upon reflection, it was recognized that most of the special diets were served to residents who were confined to their beds or rooms and often they needed assistance in eating or had to be fed. Since psychological factors enter into food patterns and dietary intakes (57), it might be that the additional attention during meal time could account for a greater food intake. Special diets were considered to be any modification of the general or regular menu. Special diets occurring in the population may be seen in Appendix B. Subjects were not drawn with any consideration for their diet order so it is noteworthy that 42 regular diets and 43 special diets were selected. Special diet orders accounted for 39 of the population of 77.

Ambulatory and Bed

The dietary intakes of subjects were also evaluated by the computer into classes of ambulatory and bed, ambulatory meaning persons who came to the dining room for their meals, and bed indicating individuals eating

in their rooms or beds. See Table 5. Forty-three subjects ate in the dining room and 42 ate in bed. Four nutrients were higher in the intakes of ambulatory persons while five nutrients were higher in the food consumed by bed patients. This finding parallels the results found in comparing regular and special diets where the special diets, usually eaten in rooms, seemingly were eaten better than the regular diets.

Statistical Analysis

The mean percentages of the Recommended Daily Allowance served and consumed were calculated for each nutrient for each day of the study. The mean daily percentages observed for food served were used for testing the null hypothesis that the mean daily serving of each nutrient was the same percentage of the subjects' respective Recommended Dietary Allowances against the alternative hypothesis that the percentages differ. Friedman's Two-Way Analysis of Variance Test for Ranks was used to test this hypothesis.* This test was chosen because of the inherent lack of independence of the mean responses as observed from nutrient to nutrient.

The application of the test involves displaying the data in a two-way table of N independent rows of k related responses and ranking the responses in any particular row from 1 to k in the order of increasing responses. Table 6 shows the mean percentages for the k = 9 nutrients for each of

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*A description of this test may be found in Siegel, Sidney, 1956. Nonparametric Statistics for the Behavioral Sciences. New York: McGraw-Hill Book Company, Inc., 1956, pp. 166-172.

the N = 7 days. The rankings, indicated in parentheses, illustrate the ordering of the percentages for each of the seven days. If R_j denotes the sum of the ranks assigned to nutrient j, then

$$\chi^2_r = \frac{12}{Nk(k+1)} \sum_{j=1}^{k} (R_j)^2 - 3N(k+1)$$

has approximately a chi-square distribution of probabilities with (k-1) degrees of freedom. Applying this formula to the ranks indicated in Table 6 gives $\chi^2_r = 29.56$. Since $\Pr(\chi^2 \geq 29.56) < 0.0005$, the null hypothesis shall be rejected and it should be concluded that the mean daily serving of each nutrient was not the same percentage of the subjects' respective Recommended Dietary Allowance.

Similarly, the mean daily percentages observed for food consumed were used for testing the null hypothesis that the mean daily consumption of each nutrient was the same percentage of the subjects' respective Recommended Dietary Allowances against the alternative hypothesis the percentages differ. Table 7 shows the mean percentages observed for the k = 9 nutrients for each of the N = 7 days. The corresponding ranks are shown in parentheses. The value $\chi^2_r = 31.54$ results in the computations indicated above. The probability associated with this computation is even less than before, so it must be concluded that the mean daily consumption of each nutrient is not the same percentage of the subjects' respective Recommended Dietary Allowance.

TABLE 6 Mean daily percentages of Recommended Dietary Allowances served and daily ranks of percentages

Day No.	NUTRIENT								
	Calories	Protein	Calcium	Iron	Vitamin A	Thiamine	Riboflavin	Niacin	Ascorbic Acid
1	90.6(4)	135.4(9)	90.2(3)	117.7(8)	93.0(6)	89.8(2)	92.9(5)	65.7(1)	108.5(7)
2	112.3(3)	128.4(5)	168.4(8)	148.4(7)	389.0(9)	100.2(1)	103.7(2)	122.1(4)	138.9(6)
3	85.2(2)	117.2(6)	99.9(5)	118.6(7)	158.9(9)	86.6(4)	85.8(3)	70.4(1)	125.6(8)
4	107.5(2)	155.8(8)	220.9(9)	147.1(7)	125.5(5)	91.0(1)	116.3(3)	130.3(6)	120.4(4)
5	102.4(2)	187.5(8)	121.3(4)	140.7(6)	148.1(7)	89.3(1)	111.2(3)	243.0(9)	137.9(5)
6	96.4(5)	129.5(7)	129.7(8)	126.5(6)	90.0(4)	82.5(2)	84.1(3)	160.3(9)	50.4(1)
7	104.0(3)	142.8(7)	111.3(5)	144.9(8)	148.8(9)	79.0(1)	108.7(4)	94.8(2)	117.4(6)
R_j	21	50	42	49	49	12	23	32	37

TABLE 7 Mean daily percentages of Recommended Dietary Allowances consumed and daily ranks of percentages

Day No.	NUTRIENT								
	Calories	Protein	Calcium	Iron	Vitamin A	Thiamine	Riboflavin	Niacin	Ascorbic Acid
1	74.0(3)	110.8(9)	74.8(4)	94.8(8)	78.5(6)	68.6(2)	76.0(5)	50.5(1)	95.4(7)
2	85.5(3)	97.8(6)	139.4(8)	112.6(7)	245.7(9)	74.6(1)	77.3(2)	97.6(5)	91.5(4)
3	71.3(2)	98.0(7)	81.0(5)	96.4(6)	119.7(9)	73.5(4)	72.6(3)	59.8(1)	104.8(8)
4	85.8(2)	124.6(8)	187.8(9)	119.2(7)	107.1(6)	71.0(1)	97.3(3)	99.2(4)	102.6(5)
5	78.5(2)	131.7(8)	106.0(5)	104.9(4)	112.2(6)	71.0(1)	86.3(3)	176.6(9)	122.8(7)
6	69.9(4)	89.9(6)	98.5(8)	91.3(7)	73.8(5)	62.9(2)	64.9(3)	106.6(9)	37.1(1)
7	71.6(3)	95.9(8)	84.0(5)	93.3(6)	102.9(9)	55.0(1)	78.8(4)	57.2(2)	94.1(7)
R_j	19	52	44	45	50	12	23	31	39

CHAPTER V

SUMMARY AND CONCLUSIONS

The weighing of foods consumed is a reliable but difficult method of assessing dietary intakes. It involved weighing of individual portions of food served and of food not eaten in order to determine the amount of each food consumed. This is a method not often used in nutrition studies because of several restrictions; such as, time involved to conduct the investigation. One worker cannot physically handle very many subjects at a meal nor for an extended number of days. Consequently, acquiring assistants involves financial consideration.

Thus, time and money are two factors limiting the frequency and extent of conducting weighed dietary intake studies. For instance, in this study only 12 to 14 subjects were practical in one day and only one week's duration seemed feasible. An experienced person assisted the investigator.

The chief advantage to this type of study is its accuracy. No estimations are used; therefore, the validity of the information obtained appears to make the weighed intakes worthwhile. For this reason as well as the desire for the experience, a typical nursing home population was selected for a weighed dietary intake study.

Eighty-five individual daily food consumptions were collected from randomly drawn subjects living in the Stillwater Nursing Center, Stillwater, Oklahoma. Approximately 14 subjects were chosen for each of seven days representative of one week during the late summer and early fall of 1969. Only residents under 55 years of age, those on tube feedings, or those critically ill, were eliminated from the population for study.

All food served to each subject and subsequently, the food not eaten, was weighed on spring-type gram scales by the investigator and a research assistant. Later, the grams of food items consumed were calculated in order to study the weighed intakes of the group.

A program was prepared in order to use the IBM Computer Model 360 at the Computer Center, Oklahoma State University to analyze the dietary components. Punched cards corresponding to Table 1 from Composition of Foods-Raw, Processed, Prepared (80) were used for the analysis of the food served and the food consumed.* Nine food nutrients were studied: calories, protein, calcium, iron, vitamin A, thiamine, riboflavin, niacin, and ascorbic acid.

The nutrients served and the nutrients consumed were computed on the basis of the percentage of the Recommended Dietary Allowances, 1968 (22) for the appropriate age and sex category. Mean percentages and

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*Punched cards, Table 1, Composition of Foods-Raw, Processed, Prepared may be purchased from:
Computer Usage Development Corporation
7315 Wisconsin Ave. N.W., Washington, D.C. 20014

standard deviations for all nutrients were obtained for the 85 dietary intakes recorded during the week. See Appendix C for the standard deviations. The percentages of the Recommended Dietary Allowances of the nutrients in the food consumed were also classified according to male and female, regular and special diets, and ambulatory and bed patients.

Because increasing numbers of registered dietitians are being employed in nursing homes as consultants, the nutritional adequacy of the menus, or food served, should be of primary importance. Analysis of the results in this investigation revealed that on the average all nutrients served, except thiamine, were served in amounts above 100 percent of the Recommended Dietary Allowances, 1968 (22). Thiamine had a mean percentage of 88.59.

Since several of the subjects were persons who were able to eat only pureed or liquid foods, the consumption of bread was limited in the total group by the lack of bread eaten by these infirm individuals. This may be one reason that less than 100 percent of the Recommended Dietary Allowance of thiamine was served.

In no instance were the mean percentages for nutrients consumed less than two-thirds of the Recommended Dietary Allowances, 1968 (22). It has been pointed out that the Recommended Dietary Allowances were never proposed as standards for use in nutrition surveys (15). Four nutrients, protein, calcium, iron, and vitamin A, were consumed at more than 100 percent of their recommended allowance levels. The values obtained represent the average for the group as a whole and cannot be used to

predict an individual intake.

Females appeared to eat a better diet than males and persons on special diets were identified as eating better than those on regular diets. There appeared to be a somewhat better dietary intake by bed patients than those eating in the dining room. The last two findings may be the result of more personal attention being given to residents on special diets and those confined to their beds. Since the sample was not drawn to reflect these classes of subjects, no conclusions can be made, but the results indicate these general trends.

Employment of the computer for processing the data was planned both because of the time-saving factor in mechanical methods, and because of the researcher's desire to make this an additional feature of the study. The use of the computer for calculating the nutritive content of dietary intakes has become widespread. Correspondence received by the investigator supports this advance in processing of dietary information. See Appendix D.

Time-saving has been proposed as the chief advantage in computer use. In much less time, large volumes of data can be processed compared to the amount that could be done by the tedious hand-methods previously employed. However, one should not be misled by these statements, but should become aware that more time than might be expected is spent in preparation of the data for the computer.

Accuracy is another reason for mechanical calculation; however, the data put into the computer for analysis must be correct in order to

secure valid information in the analysis. This, too, takes time and effort.

The cost factor should also be considered if one is thinking of using a computer. Actual computer time, although often only minutes, is expensive. Then there is employment of a programmer as well as the cost of card punching. Means of financing the project should be planned for ahead of time.

All features of this investigation are suggestive of possibilities for further study. Because of their accuracy, there is a need for more weighed dietary intake studies. Population groups other than nursing home residents could be used. On the other hand, it would be useful to pursue investigations using a variety of nursing homes since nutrition of the elderly has achieved such importance and interest.

The use of the computer in future dietary studies would seem to be the usual, rather than the occasional, practice. Experience in this method of processing data appears to be a prerequisite for conducting extensive investigations. Different types of programs and analyses should be tried.

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APPENDIX A

DATA COLLECTION FORMS

FOOD RECORD FORM

DATE_____ SUBJECT_____ MEAL_____ DIET_____

BEVERAGE _____ DINING ROOM_____ROOM___

FOOD	AMOUNT SERVED	AMOUNT RETURNED	AMOUNT EATEN

WORK SHEET

Saturday 10-10 Subject _____ Diet_____ DR____Room____

FOOD	CODE No.	SERVED grams	RETURNED grams	EATEN grams
Grapefruit Juice				
Oatmeal				
Fried Egg				
Toast				
Margarine				
Jelly				
Sugar				
Milnot				
Milk				
Bacon				
Brown Beef Tips				
Steamed Cabbage				
Candied Sweet Potatoes				
Tomato Wedge				
Whipped Jello				
White Cake/Chocolate Ic.				
Cornbread				
Margarine				
Sugar				
Milk				
Salisbury Steak				
Boiled Rice				
Green Beans				
Purple Plums				
Bran Muffin				

WORK SHEET Continued

FOOD	CODE No.	SERVED grams	RETURNED grams	EATEN grams
Margarine				
Sugar				
Milk				

RAW DATA PUNCH CARDS

Column Number	Information
1	Day of the week
2, 3	Subject number
4	Sex
5	Diet
6	Bed or ambulatory
7 - 10	Food code number)
11 - 13	Grams served) Food 1
14 - 16	Grams eaten)
17 - 26	Food 2
27 - 36	Food 3
27 - 46	Food 4
47 - 56	Food 5
57 - 66	Food 6
67 - 76	Food 7
77 - 80	DW 70

Numbers used to identify the following:

Day of the week :	1 - 7
Subject number:	1 - 77
Sex:	Female 8, and male 9
Diet:	Regular 1, and special 0
Bed:	3
Ambulatory	4

CARDS ADDED TO NUTRITIVE VALUE CARD DECK

Identification No. Assigned	Food
3000	Milnot
3001	Butterscotch Pudding
3002	Cheese Sauce
3003	French Toast
3004	Hamburger Bun
3005	Tamales with Sauce
3006	Brown Meat Gravy
3007	Carrot Raisin Salad/ Dressing
3008	Lettuce, Tomato, Mayonnaise Salad
3009	Macaroni Salad
3010	Apple-Celery- Nut Salad
3011	Dietetic Jelly
3012	Dietetic Flavored Gelatin
3013	Dietetic Custard
3014	Dietetic Pudding

APPENDIX B

POPULATION DATA

COMPOSITION OF THE NURSING HOME POPULATION

Subject No.	Age	Sex	Ambulatory or Bed	Diet Order	Vitamin Supplement
1	62	F	Ambulatory	Bland	Mi-cebrin T, 1 daily
2	67	F	Ambulatory	General, Low Calorie	
3	91	F	Bed	Regular Pureed	
4	74	F	Ambulatory	Regular	
5	87	M	Ambulatory	Regular	
6	76	F	Bed	Soft Bland	
7	92	M	Ambulatory	Regular	Unicap, 1 daily
8	87	F	Bed	Tube Feeding	
9	89	F	Bed	Soft Pureed	
10	84	F	Bed	Soft Bland	
11	79	F	Ambulatory	Regular	
12	65	F	Bed	Regular	
13	57	M	Bed	Regular Pureed	
14	64	F	Bed	General	
15	98	F	Bed	Soft	
16	77	F	Bed	Bland #4	Theragran M, 1 daily
17	86	M	Ambulatory	Soft	Mycebrin, 1 daily
18	88	F	Ambulatory	Regular	
19	86	F	Bed	Soft	
20	63	F	Ambulatory	Regular	
21	81	F	Bed	Low Carbohydrate	
22	87	M	Ambulatory	Diabetic	Theragran, 1 daily
23	69	F	Ambulatory	1800 Calorie Diabetic	
24	91	M	Bed	Regular	
25	62	M	Bed	1800 Calorie Diabetic, Bland #3	
26	55	F	Ambulatory	Regular	Unicap, 1 daily
27	64	F	Ambulatory	1000 Calorie	
28	87	F	Ambulatory	Regular	
29	87	M	Bed	Regular	
30	86	M	Ambulatory	Regular	
31	88	M	Ambulatory	Regular	
32	87	F	Bed	Soft Low Salt	
33	77	F	Bed	Regular	
34	74	F	Ambulatory	Regular	
35	93	M	Bed	Regular Pureed	
36	95	F	Bed	Soft Bland	
37	86	F	Bed	Soft	
38	59	F	Ambulatory	Regular	
39	83	F	Ambulatory	1200 Calorie Diabetic, Low Sodium	

COMPOSITION OF THE NURSING HOME POPULATION
Continued

Subject No.	Age	Sex	Ambulatory or Bed	Diet Order	Vitamin Supplement
40	78	F	Ambulatory	1800 Calorie Diabetic	
41	65	F	Ambulatory	Regular	
42	66	F	Ambulatory	1000 Calorie Diabetic	Vitamin C, 1 daily
43	83	M	Ambulatory	As tolerated	
44	88	F	Bed	Soft	
45	78	F	Ambulatory	Regular	Unicap Sr. BID Nicotinic Acid, 100 mg TID
46	73	F	Bed	Regular	di-Ca Phosphate, 1 TID
47	86	F	Bed	Bland #3	
48	92	M	Bed	Hi-Protein Pureed	
49	64	F	Ambulatory	Regular	
50	91	F	Ambulatory	General	
51	71	F	Bed	Regular	
52	80	F	Ambulatory	Low Sodium	
53	91	M	Ambulatory	Regular	
54	84	F	Bed	Regular	
55	60	F	Ambulatory	Regular	
56	59	F	Ambulatory	Regular	
57	79	F	Ambulatory	Regular	Nicotinic Acid, 50 mg TID
58	75	F	Bed	1500 Calorie Diabetic Pureed	Unicap, 1 daily
59	80	F	Bed	Regular	One-a-day/Iron TID
60	81	M	Bed	General	
61	74	F	Ambulatory	Regular	
62	80	M	Ambulatory	Regular	One-a-day, 1 daily
63	82	F	Ambulatory	Low Sodium, Low Cholesterol	Nicotinic Acid, 100 mg. BID, Protein Supp. Cap TID
64	71	F	Bed	Bland #4	
65	83	F	Bed	General	
66	80	M	Bed	General-Pureed	
67	37	M	Ambulatory	Regular	
68	51	F	Ambulatory	Regular	
69	50	M	Ambulatory	General	
70	91	F	Ambulatory	1500 Calorie Diabetic	

COMPOSITION OF THE NURSING HOME POPULATION
Continued

Subject No.	Age	Sex	Ambulatory or Bed	Diet Order	Vitamin Supplement
71	78	F	Bed	Low Sodium Pureed	
72	85	F	Ambulatory	Low Sodium	
73	79	F	Ambulatory	Low Salt	
74	75	F	Bed	Soft Low Salt	
75	85	F	Ambulatory	Regular	
76	82	F	Ambulatory	Low Sodium	Thiamine, 100 mg.TID
77	47	F	Ambulatory	Low Calorie, Low Sodium	

DISTRIBUTION OF SUBJECT NUMBERS USING RANDOM SELECTION

Subject No.	No. of Times Drawn	Subject No.	No. of Times Drawn	Subject No.	No. of Times Drawn
1		27	1	53	
2	1	28	2	54	3
3	1	29	1	55	1
4	1	30		56	2
5	4	31	2	57	
6		32	1	58	
7	1	33	1	59	1
8		34		60	2
9	2	35	3	61	1
10	2	36	3	62	3
11	1	37	1	63	2
12	1	38	2	64	2
13	1	39	3	65	
14	1	40		66	1
15	1	41	1	67	
16	2	42		68	
17	1	43	2	69	
18	2	44	1	70	2
19		45	3	71	1
20	1	46		72	
21	2	47	1	73	2
22	2	48		74	
23	1	49		75	
24	2	50	1	76	
25	1	51		77	
26	2	52			

APPENDIX C

STANDARD DEVIATIONS

STANDARD DEVIATIONS

The mean of percentages observed each day for each nutrient is given in Tables 6 and 7 for food served and food consumed, respectively. The corresponding standard deviation of the percentages observed each day for each nutrient is given in Tables A and B for food served and food consumed, respectively. For each of these standard deviations the standard error of the corresponding mean may be calculated by dividing the standard deviation by the square root of the number of subjects observed on that day.

Also the mean of all percentages observed for each nutrient is given in Table 2 for both food served and food consumed. The corresponding standard deviation of all percentages observed for each nutrient is given in the last row of Tables A and B for food served and food consumed, respectively. The standard error of the mean may be calculated by dividing the corresponding standard deviation by the square root of the total number of subjects observed which is 85.

TABLE A Standard deviations of the percentages of food served

Day No.	No. of subjects	Calories	Protein	Calcium	Iron	Vitamin A	Thiamine	Riboflavin	Niacin	Ascorbic Acid
1	12	17.98	18.42	53.84	19.23	25.35	15.39	37.84	9.02	44.08
2	13	12.31	20.85	83.89	25.88	54.22	15.59	26.09	24.25	40.34
3	11	14.74	19.70	28.50	16.14	10.90	17.92	20.11	20.05	54.56
4	14	26.64	25.44	124.40	26.40	54.79	20.19	47.03	29.65	43.92
5	11	15.22	30.77	46.49	29.66	13.60	7.57	27.66	118.20	20.15
6	13	15.81	24.24	40.60	31.51	15.68	8.02	33.01	20.88	10.62
7	11	16.94	16.54	40.95	13.78	45.29	13.39	29.80	12.61	27.67
Total	85	18.98	30.40	80.72	26.66	104.85	15.64	34.25	71.09	46.06

TABLE B Standard deviations of the percentages of food consumed

Day No.	No. of subjects	Calories	Protein	Calcium	Iron	Vitamin A	Thiamine	Riboflavin	Niacin	Ascorbic Acid
1	12	18.58	20.08	50.77	23.51	18.07	19.80	34.14	10.34	49.35
2	13	15.02	21.68	78.35	25.47	146.01	17.94	19.17	22.10	41.25
3	11	17.89	31.13	28.79	29.45	41.57	21.22	24.27	24.08	64.93
4	14	25.10	39.07	116.41	22.23	64.30	23.83	46.27	33.51	53.72
5	11	16.23	31.31	42.85	42.60	39.31	14.85	21.97	111.72	31.30
6	13	17.17	27.83	35.33	37.61	24.52	15.94	29.02	54.40	14.27
7	11	21.50	32.36	41.86	35.15	36.29	17.95	33.09	25.19	30.04
Total	85	19.57	32.28	74.49	31.76	86.33	19.47	31.87	61.93	48.94

APPENDIX D

CORRESPONDENCE

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
9000 ROCKVILLE PIKE
BETHESDA, MD. 20014
NBOC #1 Rm. 112 REFER TO:

November 14, 1969

Mrs. Donna Watson, R.D.
1815 N. Boomer Road
Apt. F-13
Stillwater, Oklahoma 74074

Dear Mrs. Watson:

The National Nutrition Survey is developing a data processing technique for handling the information as we are collecting it. In general the method involves the use of food models and a computer program which converts such models to the appropriate quantities of individual food. I doubt very much that the processing that we are using could be easily adapted to the techniques that you are using. Our basic information on the food composition is taken from Handbook #8. Decks of cards for all of the foods in Handbook #8 giving the nutritive values per hundred grams are available from Computer Usage Development Corporation, 7315 Wisconsin Ave., Bethesda, Maryland 20014. These cards are punched directly from the data in Handbook #8. I think it would probably be simpler to develop a small program to convert your food into nutrients using these cards which I think are available for around $30.00. It may even be possible that a deck of these cards has been purchased by someone else at Oklahoma and that you would be able to utilize a set that was already available. In terms of analysis, our experience has been that it is much easier to initiate a simple analysis based on your own needs rather than attempt to use more complex programs for a partial analysis.

I will send you a copy of the procedure by which we collect our data in our general protocol which will give you some idea of the complexity of processing that we have been undertaking. If you have further questions, please feel free to contact us again.

Sincerely yours,

Ogden C. Johnson
Chief, Domestic Program Staff
Nutrition Program
Division Chronic Disease Programs
Regional Medical Programs Service

Enclosure

TULANE UNIVERSITY

School of Public Health and Tropical Medicine

School of Medicine

NEW ORLEANS, LA. 70112

Office of the Dean
1430 Tulane Avenue

27 October 1969

Mrs. Donna Watson, R.D.
1815 North Boemer Road
Apt. F-13
Stillwater, Oklahoma 74074

Dear Mrs. Watson:

The dietary data for the National Nutrition Survey is being analyzed in Washington, D.C. The Nutrition Consultant in charge of the dietary phase of the National Nutrition Survey is Miss Gretchen Collins. Her address is:

Nutrition Program
NBOC #1
11420 Rockville Pike
Rockville, Maryland 20852.

Many Research Nutritionists make a set of computer cards using these references:

(1) "Composition of Foods," Agricultural Handbook #8, Agricultural Research Service, USDA, 1963.

(2) Bowes and Church, "Food Values of Portions Commonly Used", 10th edition, 1966, J.B. Lippincott Company, Philadelphia.

They add additional food analyses as these data become available through Professional Publications.

The Nutrition Section of the Tulane University School of Public Health and Tropical Medicine is now conducting research on pre-school children and on pregnant women and their offspring.

May we wish you much success with your graduate nutrition research project.

Sincerely,

Walter G. Unglaub

Walter G. Unglaub, M.D.
Professor of Nutrition

WU/mp

THE UNIVERSITY OF TEXAS MEDICAL BRANCH
GALVESTON, TEXAS 77550

November 17, 1969

Mrs. Donna Watson, R. D.
1815 N. Boomer Road
Apt. F-13
Stillwater, Oklahoma 74074

Dear Mrs. Watson:

I delayed answering your letter of October 17, 1969 hoping that we would have further computer analysis of our Texas Nutrition Survey dietary data which might make my response more intelligent. However, this is still coming in very slowly and in small bits and pieces so an overall comprehensive evaluation is not possible.

Three approaches were used in calculating the dietary intakes during the Texas Nutrition Survey. These methods have been standarized for all states involved in the National Nutrition Survey. The first part was a dietary frequency or pattern which was obtained on about half of the subjects and families involved in the study. The second approach included twenty-four hour recalls utilizing a series of food models which were constructed to be representative of volumes and units in common use. The third approach involved a structuring of the market basket composed of fifty items which were subsequently narrowed to twenty-six items. Comparative shopping in each of the locations where the subjects for the survey actually lived were carried out in local supermarkets as well as the neighborhood stores. This latter data provided rather good evidence of family food purchases.

I should indicate that several specific groups were concentrated in our sample, these included the nursing mothers and infants through to three years of age, the teenage groups from 10 to 16 and the elderly over 60 years of age.

All our computer cards have been moved to Washington for program development and analysis. From my point of view, I can see no reason that you should not be able to have access to portions of this material that you would like to use in your research work. I know that we have had considerable amount of trouble getting the program fully functioning and it maybe another month or so before they would feel free to release cards for your use.

I would suggest that you write Miss Gretchen Collins who is the nutrition consultant at the national level and her address is:

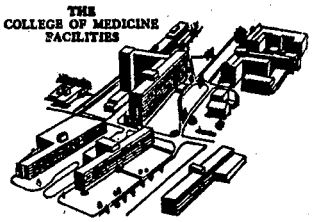
The Nutrition Program
National Center for
Chronic Disease Control
9000 Rockville Pike
Bethesda, Maryland 20014

If we can be of any further assistance, let me know. Thanking you, I remain

Yours sincerely,

William J. McGanity, M.D.
Professor and Chairman
Department of Obstetrics
and Gynecology

WJMcG:nb



Department of Preventive Medicine
Coronary Prevention Program

THE OHIO STATE UNIVERSITY

1357 West Lane Avenue
Columbus, Ohio 43221

October 9, 1969

Mrs. Donna Watson
1815 N. Boomer Road
Apt. F-13
Stillwater, Oklahoma 74074

Dear Mrs. Watson:

In response to your letter of September 29, 1969, I am sending you copies of papers that outline our computer program. I hope this information will be of help to you. You asked if I know of other punch cards that will be available, unfortunately, I do not. The ones that we use belong to our program and it is not possible to have copies sent out at this time. As far as information regarding the USPHS Control Data 160-A diet program you might write to Mrs. Marjorie C. Zukel, whose address is as follows:

Mrs. Marjorie C. Zukel
Nutrition Consultant
Heart Disease and Stroke Control Program
National Center for Chronic Disease Control
Dept. of Health, Education, and Welfare
4040 North Fairfax Drive
Arlington, Virginia 22203

Mrs. Zukel probably would have the information you are looking for concerning this.

Sincerely,

Eleanor Roman

Eleanor Roman (Mrs.)
Nutritionist, Coronary Prevention Program
Asst. Prof., Dept. of Preventive Medicine

ER:veh

SHANDS TEACHING HOSPITAL AND CLINICS • UNIVERSITY OF FLORIDA • GAINESVILLE
area code 904-376-3711
zip 32601

October 30, 1969

Mrs. Donna Watson
1815 N. Boomer Road
Apt. F-13
Stillwater, Oklahoma 74074

Dear Mrs. Watson:

Your recent letter to Mr. Fellers has been referred to me for reply.

I enclose a copy of the Monograph you requested. Unfortunately, the other "papers" you requested are not formal papers, and are not available. In the presentations you referred to, we discussed the current available nutritional knowledge as it relates to future health needs. With automated techniques our basic data from nutritional fields and preventitive health care fields could be improved in quality and quantity. Information could be correlated to provide every individual with his own personal diet "prescription". Although such capability is not presently developed, we do have resources now to begin working towards this goal.

Please feel free to contact me if I can assist you again.

Sincerely,

Robin Brown
Assistant Director
Dietary Services

RB/ts

State of Georgia
Department of Public Health
J.H. Venable, M.D.,
Director
47 Trinity Avenue
Atlanta, Georgia 30334

October 15, 1969

Dear Donna:

Please excuse pencil and pad, but I am attending a training course and have a few minutes before class begins, to answer your letter.

I'm sorry that our values and program are in no condition after five years of no use to update from 1401 to 7090, however, the values being used on the Hunger Analysis are ours after updating and additions in New Orleans.

At this time I suggest that you write USDA for a stock of cards and program instructions for Handbook #8, or Nutritive Value of Foods #72. Send your letter directly to Bernice Watts or better still call her.

Identify your foods consumed in your nursing homes with the same numbers shown in Handbook #8 in a 00000 column field. There are 2483 foods in the book and this will leave additional space if you want to identify specific items, such as foods served that may not be in Handbook #8 which you will compile, identify with index #0800 and assign as they occur. There won't be many. Use the attached sheet for your individual cases; ask if your center has a machine for decoding information from a document and if so prepare your code sheet according to their type paper and marking pencil so you will not have to punch cards.

Identify amount of food eaten in a 4-column field - 00.00. This permits fractions to be converted to decimals for calculation; so 1/2 cup applesauce (29 in #8) will have to be converted to grams. Use the #8 cards just as they are or you may use them in a 10 column field, with the decimal not stored but printed and understood. This will save programming steps and curtail errors and misunderstandings with programs. These may be read off the cards you will receive.

Identify each field on the card and transfer to specific fields of 10; then your programer can write one simple program to read each field and transfer to a hold position.

He may, however, prefer to use the manual of instructions and follow it.

If you run into a food for which there are no values, treat it just like a person's diet. Convert the recipe to grams.

When you finish adding all the ingredients divide by the number of biscuits made and you will have the value of one biscuit, for example. This may then be stored in your data bank as 00410. This step should be done before you run your diet records.

Once calculated, you will not have to do it again. Soon you will have your data file of foods served and can process thousands of individual diet records. Each record took about 1-1/2 minutes to calculate on my program. Yours will be more rapid because your field of storage is constant, plus the speed of the machine.

If possible for the program to be prepared, use a machine that has random access. This will make coding of foods eaten much easier. To find the amount eaten of all foods on weighted diets, calculate all values. Punch, and for temporarily, store; calculate the amount not eaten; punch for store; then subtract for the amount consumed.

I do not believe it will all work at one time. Diet information is a "bloody" program. If you have a choice of programers find a Chemistry or Biology major. They will be more helpful because they understand the variations in amounts of various nutrients and groupings.

I only wish I was in a position to share our (Mary Moore, Louisiana State Medical Center) new program but it has not been checked out plus computer time there is very scarce.

Yours sincerely,

/Signed/

Mrs. Mary Helen Goodloe
Dietary Consultant
Cardiovascular Service

VITA

Donna Rising Watson

Candidate for the Degree of

Master of Science

Thesis: ANALYSIS OF WEIGHED DIETARY INTAKES OF NURSING HOME RESIDENTS

Major Field: Food, Nutrition, and Institution Administration

Biographical:

Personal Data: Born in Hominy, Oklahoma, February 8, 1927, the daughter of Mr. and Mrs. Guy D. Rising.

Education: Graduated from Bryson High School, Bryson, Texas, in 1943; attended Texas Women's University (Denton, Texas), and was graduated from Oklahoma State University (Stillwater, Oklahoma) in 1947 with a Bachelor of Science in Home Economics with a major in Foods and Nutrition; completed requirements for the Dietetic Internship at Veterans Administration Hospital, Hines, Illinois in 1948; studied at Oklahoma State University in 1957 and 1959; completed the requirements for the Master of Science degree in July, 1970.

Professional Experience: Worked as the only dietitian at Ponca City Hospital, Ponca City, Oklahoma, 1948; staff dietitian, Food Service Units, Oklahoma State University, Stillwater, Oklahoma, 1949; Consultant Dietitian, Bristow, Oklahoma, and Okmulgee, Oklahoma area from 1959 to 1970.

Professional Organizations and Honors: Member of the American Dietetic Association, Oklahoma Dietetic Association, American Home Economics Association, Association of Schools of Allied Health Professions, and Advisory Committee of the Nutrition and Diabetes Project of the Oklahoma Regional Medical Program; member of Phi Kappa Phi and Omicron Nu honor

societies; recipient of the Borden Award in Home Economics, 1947; recipient of the General Foods Fellowship for 1969 - 1970; and recipient of the Mary Swartz Rose Scholarship Award of the American Dietetic Association for 1969.