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An Evaluation of the Nutritional Status of Elderly Women Living in a State Psychiatric Hospital

Nita Elizabeth Whitfield
University of Tennessee, Knoxville

To the Graduate Council:

I am submitting herewith a thesis written by Nita Elizabeth Whitfield entitled "An Evaluation of the Nutritional Status of Elderly Women Living in a State Psychiatric Hospital." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Nutrition.

Roy E. Beauchene, Major Professor

We have read this thesis and recommend its acceptance:

Mary Jo Hitchcock, Mary Nelle Traylor, Rossie L. Mason

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

January 8, 1971

To the Graduate Council:

I am submitting herewith a thesis written by Nita Elizabeth Whitfield entitled "An Evaluation of the Nutritional Status of Elderly Women Living in a State Psychiatric Hospital." I recommend that it be accepted for nine quarter hours of credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Nutrition.

Major Professor

We have read this thesis and recommend its acceptance:

Accepted for the Council:

Vice Chancellor for
Graduate Studies and Research

AN EVALUATION OF THE NUTRITIONAL STATUS OF ELDERLY WOMEN LIVING IN A STATE PSYCHIATRIC HOSPITAL

A Thesis

Presented to

the Graduate Council of

The University of Tennessee

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

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by

Nita Elizabeth Whitfield

March 1971

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ABSTRACT

The purposes of this study were to evaluate the nutritional status of elderly institutionalized women as indicated by nutrient intakes, blood levels of selected constituents, and bone density measurements; and to study the correlations that exist between these parameters.

Participants resided at Eastern State Psychiatric Hospital. Permission for participation was obtained by signed consent of the subject and her legal guardian. Complete dietary information (7-day records of weighed food consumption) was obtained for 67 participants. Physical measurements (height, weight, and bone density) and blood samples were obtained for 54 and 52 of the subjects, respectively.

Daily nutrient intakes from meals and snacks were calculated by computer, using the food values of USDA Handbook No. 8, and were compared to the RDA. Bone density values of the phalanx 5-2 were determined, using the direct scan technique. Blood values of hemoglobin, plasma ascorbic acid, serum total protein, and serum albumin were obtained by standard laboratory procedures.

The mean daily nutrients served at meals exceeded 100% of the RDA. However, less than two-thirds of the nutrients served at meals, except for calcium, were consumed. Mean daily nutrient intakes from all sources (meals, snacks, and supplements) exceeded the RDA, except for energy, protein, and calcium, which supplied 87%, 98%, and 87% of the RDA, respectively. However, from food

consumed at meals and snacks, only the mean intakes of phosphorus and niacin equivalents met the RDA and mean intakes of vitamin A and ascorbic acid from food were less than two-thirds of the RDA. Intakes of all nutrients, except calcium and ascorbic acid, significantly decreased with age. Twenty-two percent of the subjects received some type of prescribed multi-vitamin supplement and 6% received an iron supplement.

Mean values of hemoglobin, serum total protein and albumin, and plasma ascorbic acid were acceptable or high according to the ICNND criteria. Significant correlations were found between ascorbic acid intakes and plasma ascorbic acid, and between protein intakes and serum albumin and hemoglobin concentration. No significant correlation was found between protein intake and serum total protein or between iron intake and hemoglobin.

The mean bone density value was 0.81 ± 0.03 gram equivalents of alloy per cubic centimeter of bone, with a range of values from 0.40 to 1.41. A significant correlation was obtained between bone density and daily intakes of energy, protein, phosphorus, vitamin A, and ascorbic acid from food, but not with intakes of calcium nor with vitamin A and ascorbic acid if supplements of the latter two nutrients were included. Bone density was significantly correlated with serum albumin, but not with blood levels of hemoglobin, ascorbic acid, and total protein. Values of bone density significantly decreased with age, and significantly increased with height and with weight. The weight distribution of the subjects appeared to be quite normal for women of this age group.

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CHAPTER I

INTRODUCTION

With the numbers of elderly persons increasing, it is anticipated that these persons will represent even a larger segment of our population. In the United States in 1969, twenty million individuals were over 65 years of age (1). Every tenth American was in this population. The trend toward social responsibility for this age group has led to an increasing interest in their health. Although many factors contribute to the health and well-being of the elderly person, one of utmost importance is the quality of his diet. The degree of health enjoyed by our aging citizens today, undoubtedly has been promoted by advances in nutritional knowledge as well as developments in other fields.

The problem of relating nutrition to aging is complex because of the difficulty in controlling the host of genetic and environmental factors, which contribute to the variability among the aged population. Also, the high incidence of chronic disease in the elderly increases individual variability. Few studies have related bone density values, blood constituent levels, and nutrient intakes in an evaluation of the nutritional status of aging persons.

The purposes of this study were to evaluate the nutritional status of elderly institutionalized women as indicated by nutrient intakes, blood levels of selected constituents, and bone density measurements, and to study the correlations that exist between these parameters.

CHAPTER II

REVIEW OF LITERATURE

Evaluation of the nutritional status of aged persons has been reported on groups of individuals living in their own homes and in institutions using such criteria as dietary intake, physical measurements including bone density, and levels of nutrients in selected physiological fluids, e.g., blood and urine. However, in general, not all of these criteria have been used in a single investigation. The studies reviewed here summarize the literature available regarding the nutritional status of the aged. It should be remembered that not all findings based on the Recommended Daily Dietary Allowances (RDA) are directly comparable since the allowances have been revised at 5-year intervals.

Nutritional Status Studies

Perhaps one of the earliest and most complete nutritional status studies of an aging population was conducted by Morgan et al. (2) and Gillum et al. (3) in 1948-49 in San Mateo County, California. Seven-day diet records, diet histories, physical examinations and blood and urine analyses were obtained from 577 apparently healthy volunteer men and women of middle socioeconomic status. Participants lived in their own homes, except for 47 men housed in a county home. Hemoglobin levels of men living in their own homes were significantly higher than those of women until age 75. A positive correlation was found between dietary protein and hemoglobin, and between iron and hemoglobin, both significant at the 1% level. Dietary ascorbic acid intake and serum levels of this nutrient were directly correlated in all subjects. Mean daily ascorbic acid intakes of women were 86 mg and mean serum levels were 1.07 mg per 100 ml. The mean serum protein level was 6.44 gm per 100 ml in women. No correlation between serum protein levels and protein intake was found.

Abbott et al. (4) reported hematologic values and dietary practices of 306 healthy men and women living in a high socio-economic retirement community in Florida. Daily mean intakes of eight nutrients, obtained from 7-day dietary records, met or exceeded the RDA except for calories. Hemoglobin values were within the normal range. No correlation was found between hemoglobin levels and dietary iron intakes.

As one phase of a regional study of nutritional status in six North Central states, Leverton and coworkers (5) measured blood levels of selected constituents in several hundred healthy women, 30 to 90 years of age. Mean hemoglobin values were 13.3 gm per 100 ml and mean serum protein values were 6.71 gm per 100 ml. No significant correlations were found between dietary intakes of protein and hemoglobin or serum protein levels. Nutrient intakes exceeded two thirds of the recommended allowances.

Davidson et al. (6) obtained 7-day dietary records and anthropometric measurements of 104 apparently healthy "middle class" aging men and women. Daily nutrient intakes were near the RDA. A positive correlation was found between brachial fat and percentage above desirable weight for females. Roentgenographic density of bone did not correlate with calcium and protein intakes. Females had less dense bones than males.

Brin and coworkers (7) reported blood levels of selected constituents for free-living and institutionalized subjects as part of a nutritional status study with 234 volunteer men and women over 65 years of age. The mean plasma ascorbic acid level was 0.68 mg per 100 ml with significantly higher levels in women than in men. Eight percent of the subjects had deficient plasma ascorbic acid levels, according to criteria of the Interdepartmental Committee on Nutrition for National Defense (ICNND) (8).

In 1957, Tucker et al. (9) studied nutrient intakes and selected blood constituents of 48 men and women in a public institution for the aged. Intakes of calories and eight nutrients were calculated from weighed food intakes. Approximately one-third of the women consumed less than three-fourths of the served amounts of iron, vitamin A, thiamine, and niacin. More than half of the subjects were rated as only "fair" or "poor" for blood levels of hemoglobin, vitamin A, carotene, and ascorbic acid.

Dietary Studies

Some of the early research regarding the dietary patterns of aging women was conducted from 1947 to 1959, as cooperative regional studies of the State Agricultural Experiment Station of the United States Department of Agriculture.

As a part of these regional studies, Swanson and coworkers (10) obtained 24-hour dietary records of 2,189 women in five North Central states. Intakes of calcium, vitamin A, ascorbic acid, and riboflavin were below two-thirds of the RDA in the diets of 75%, 50%, 40%, and 35% of the subjects, respectively. Nutrient intakes tended to decrease with age. In the Western region, Wilcox et al. (11) reported that approximately 40% of the women past 50 years of age consumed less than two-thirds of the RDA of calcium. Ascorbic acid was below two-thirds of the RDA in approximately 30% of the participants.

Beegle et al. (12) recorded the weights of selected foods eaten by 242 women between 30 and 90 years of age in six states in another phase of the regional research studies. The serving size of nearly all foods and food intake decreased with advancing age.

In Rochester, New York, LeBovit (13) conducted a household food consumption survey with beneficiaries of Old-Age, Survivors, and Disability Insurance (OASDI). Nearly three-fourths of the households had diets that met two-thirds of the RDA for eight nutrients. Daily intakes of ascorbic acid were less than two-thirds of the RDA in 10% of the households. Vitamin supplements were taken by about one-third of the participants. Intakes from diets met nutrient recommendations in half of the households using supplements.

Fry et al. (14) studied the nutrient intakes of 32 healthy, socially active women, 65 to 85 years of age, who lived in their own homes. Mean daily intakes of calcium, iron, and vitamin A obtained from 7-day dietary records, were below two-thirds of the RDA in 16%, 12%, and 9% of the participants, respectively.

Except for calcium and riboflavin, average daily nutrient intakes decreased slightly with age.

In 1962, Steinkamp et al. (15) reported dietary findings for 229 men and women in a third follow-up study of an aging population in San Mateo County, California, 14 years after the original nutritional status study (2, 3) had been conducted. One-day dietary records of 141 men and women participating in each of the four studies showed a decreased food intake with increased age. More than one-fourth of the diets in each study were below two-thirds of the RDA for calcium and niacin. In the 1962 study, one-fourth of the men and one-half of the women had less than two-thirds of the RDA for calcium. Ascorbic acid and vitamin A were below two-thirds of the RDA in approximately 25% of both men and women. Vitamin and mineral supplements were taken by 35% of the subjects, although their nutrient intakes were generally adequate.

Kane (16) studied nutrient intakes and factors related to dietary practices of 22 aged women living in their own homes. Fifty percent of the subjects had dietary intakes that provided less than two-thirds of the RDA for either iron, calcium, or protein. Only seven of the subjects had caloric intakes which met the RDA. Fifteen subjects took vitamin supplements. Subjects who shared meals with companions had a better diet than those who ate alone.

Graf (17) reported nutrient intakes of 60 aged men and women, served cafeteria style in a state mental institution in

Pennsylvania. Mean daily nutrient intakes, obtained from 7-day dietary records, met two-thirds of the RDA. Protein was the only nutrient for which men had higher intakes than women. Caloric intakes of women decreased with age, whereas no change was observed in the caloric intake of men.

Bone Density Studies

In assessing the nutritional status of aging people, several investigators have measured bone density. In general, these studies have shown a reduction in bone density with age (18, 19, 20). Davidson et al., (6) however, reported no reduction in bone density with age in a group of apparently healthy people, 51 to 97 years of age. The females in the study had slightly lower mean bone density values than the males. No relationship could be shown between the intakes of calcium or protein and bone density. A study by Mason et al. (18) on the other hand, suggested a relationship existed between calcium intake and bone density since both declined in the elderly. Dallas and Nordin (21) found that osteoporotics (individuals with severe skeletal demineralization) consumed significantly lower amounts of calcium and protein than control subjects. Morgan and coworkers (19) reported no significant correlations between bone density of the phalanx 5-2 and either the intakes of protein, ascorbic acid, and calcium or the blood levels of hemoglobin and ascorbic acid.

Dietary practices as related to the degree of bone mineralization in apparently healthy aged women has also been investigated by Reeves (22). Some subjects with adequate intakes of calcium exhibited the same degree of skeletal demineralization as those with inadequate intakes. Serum levels of calcium and total protein were normal in all subjects. Furthermore, no relationship was found between adequacy of current protein intake and degree of mineralization of bone.

An investigation of the incidence and degree of osteoporosis in 565 institutionalized men and women 65 years and older was reported by Gitman and coworkers (23). The over-all incidence of osteoporosis in females was 65.8% and in males, 21.5%. Females showed a significant increase of incidence with age. No significant correlations existed between degrees of osteoporosis and blood levels of either hemoglobin, total protein or albumin.

In a study of age-associated bone densities of ambulatory women without known osteoporosis, Smith et al. (24) found that the amount of axial and appendicular bone was unrelated to the amount of ingested calcium in women matched for height, weight, and age. Also, Garn and coworkers (25) found no significant relationship between daily intakes of calories, calcium, or protein and bone loss in subjects over 45 years of age. They concluded that the best natural protection against bone loss in the aged is a large skeletal mass in young adulthood.

CHAPTER III

EXPERIMENTAL PROCEDURE

Subjects

This study is an initial phase of an over-all study designed to investigate the effects of dietary supplements on bone density.

The participants were elderly women living at Eastern State Psychiatric Hospital. They were chosen from apparently healthy ambulatory women whose mental state did not interfere with their normal activities within the framework of the institution. The subjects were 55 years of age or older and they ate the regular diet served in the cafeteria. The study was explained to potential subjects by members of the research team in group sessions on the wards. Letters of explanation and participation consent forms were given to each person. Following the group session, the study was individually discussed, any questions answered, and those women who desired to participate signed the consent forms. The name of the nearest relative or guardian was secured from hospital records. Letters of explanation and permission forms were also sent to the nearest relative or guardian, along with a copy of the consent form signed by the patient. Samples of these letters and forms may be found in Appendix A. Self-addressed stamped envelopes were included for the return of the consent forms. Follow-up letters were sent or telephone calls were made to guardians who failed to reply to the first letter.

Only those individuals who signed the consent form and whose legal guardian gave signed permission were allowed to participate. Such consent was obtained for 67 individuals, who were the subjects of this study. They ranged in age from 55 to 86 years, with a mean age of 69 years.

Dietary Information

Seven-day records of food intake were used to obtain dietary information. With the limited resources of the research team, it required three recording weeks to obtain the food intake of the subjects. Each serving of food, as provided by the cafeteria, was weighed and likewise the amount of each food unconsumed was weighed. The actual weight of each food eaten was obtained by difference. The system used for determining the weight of food served and consumed is presented in Appendix B. Determination of food intake was carried out as much as possible without the knowledge of subjects so that the effect on normal eating habits would be minimized. Snacks were recorded for each of the 7-day periods by the research team with the help of ward personnel. Actual weights of most snacks could be ascertained but some estimations were necessary. The intakes of vitamin and mineral supplements were obtained from medical records.

Nutrient intakes from meals and snacks were calculated by computer, using the food values in USDA Handbook No. 8 (26). Nutrients provided by vitamin and mineral supplements and by any food not listed in Handbook No. 8 were calculated and added manually. Niacin equivalents from tryptophan were calculated on the basis of 1% of the available protein being tryptophan (27). Nutrient intakes of the subjects were compared to the 1968 Recommended Daily Dietary Allowances (27). Complete dietary information was obtained for 67 participants.

Bone Density

Measurements of bone density were made on a instrument developed by the Department of Nutrition at the University of Tennessee.

The midpoint of the left phalanx 5-2 was visibly marked and the hand was positioned in the finger stand of the instrument. The marked pathway was scanned as the finger passed through the X-ray beam and the absorption curve was traced simultaneously. Planimeter measurements of the antero-posterior were made and referred to a standard absorption curve obtained by tracing an aluminum alloy wedge. Linear measurements of the flesh and bone from the finger and wedge tracings were used in computer calculations. Bone density values are expressed as X-ray equivalent grams of alloy per cubic centimeter of bone. The method used to determine bone density has been described in detail by Mason and Ruthven (28). Bone density measurements were obtained for 54 of the subjects in the study within three weeks after obtaining the dietary intakes.

Height and Weight

Height and weight measurements were obtained at the time the bone density measurements were made. Subjects were weighed wearing light indoor clothing including shoes. Weight was recorded to the nearest one-fourth pound and height was measured to the nearest one-fourth inch.

Constituents in Blood

Fasting blood samples were collected from 52 subjects before breakfast by medical personnel of the hospital. Hemoglobin was determined by the cyanmethemoglobin method of Hainline (29). Plasma ascorbic acid determinations were made spectrophotometrically, using 2,6-dichloroindophenol, as described by Mindlin and Butler (30). Serum total protein and albumin were determined using the salt fractionation procedure of Saifer and Zymoris (31) and the biuret reagent of Gornall et al. (32). Values obtained for hemoglobin, plasma ascorbic acid, and serum proteins were rated using the Interdepartmental Committee on Nutrition for National Defense (ICNND) guide as a standard (8).

Statistical Analysis

The "t" test was used to evaluate the statistical significance of the difference between means and the Pearson correlation coefficient to determine relationships between bone density, nutrient intakes and selected constituents of blood. These statistical procedures are described by Steel and Torrie (33).

CHAPTER IV

RESULTS AND DISCUSSION

Mean daily intakes of selected nutrients from meals, meals plus snacks, and from all sources (meals, snacks, and supplements) of all of the subjects (n=67) participating in the study are presented in Table 1. The 1968 Recommended Dietary Allowances (RDA) for women 55-75 years of age are included for comparison (27).

Mean daily nutrient intakes from all sources exceeded the RDA except for energy, protein, and calcium, which supplied 87%, 98%, and 87% of the RDA, respectively. Without vitamin and/or mineral supplements, only the mean intakes of phosphorus and niacin equivalents exceeded the RDA, and vitamin A and ascorbic acid mean intakes were less than two-thirds of the RDA. Supplements significantly increased the mean intakes of vitamin A ($P < .05$), ascorbic acid ($P < .05$), niacin ($P < .05$), thiamin ($P < .005$), and riboflavin ($P < .01$). Also, mean intakes of energy, calcium, and riboflavin from meals and snacks were significantly higher ($P < .05$) than intakes of these nutrients only from meals.

The daily mean intake of energy in this study (1480 kcal) is less than that reported by Fry et al. (14) and Steinkamp et al. (15), who found aging women to have mean energy intakes of 1696 kcal and 1605 kcal, respectively. These investigators

TABLE 1

MEAN DAILY NUTRIENT INTAKES FROM MEALS, MEALS PLUS SNACKS, OR MEALS PLUS SNACKS AND SUPPLEMENTS COMPARED TO THE RDA

		Meals		Meals and Snacks		Total[a]	
Nutrient	RDA	Mean ± SE	Percent of RDA	Mean ± SE	Percent of RDA	Mean ± SE	Percent of RDA
Energy (kcal)	1700	1383±32	81	1480±33	87	1480±33	87
Protein (g)	55	52±2	94	54±2	98	54±2	98
Calcium (mg)	800	644±15	80	696±19	87	696±19	87
Phosphorus (mg)	800	854±22	106	902±25	113	902±25	113
Iron (mg)	10	8.0±0.2	80	8.3±0.2	83	14.2±3.3	142
Vitamin A (IU)	5000	3077±123	62	3167±126	63	6152±1262	123
Thiamin (mg)	1.0	0.73±0.02	73	0.75±0.02	75	2.30±0.53	230
Riboflavin (mg)	1.5	1.27±0.03	85	1.35±0.03	90	2.80±0.52	187
Niacin Equiv (mg)	13.0	16.87±0.55	130	17.32±0.55	133	30.38±5.09	234
Ascorbic Acid (mg)	55	35±1	64	36±1	65	66±13	120

[a]Includes nutrients from meals, snacks, and supplements.

also reported higher mean intakes of ascorbic acid and vitamin A than those found in the present study.

Although 86% of the subjects consumed snacks sometime during the recording period, intakes varied considerably. Some subjects consumed snacks only once during the recording week, e.g., at a party on the ward, while others consumed snacks daily at the commissary.

The percentages of subjects having 10% or more of their mean daily dietary intakes of the selected nutrients from snacks are presented in Table 2. Snacks contributed 10% or more of the daily intake of energy, calcium, and riboflavin in 21%, 18%, and 16% of the subjects, respectively. However, snacks made a 10% or more contribution to ascorbic acid intakes in only 3% of the subjects and to iron intakes in 4%. The extent to which calories, calcium, and riboflavin were supplied to the intakes of some of the subjects by snacks can be explained by their daily selection of milk products. Soft drinks further contributed to the energy intakes from snacks. Foods containing ascorbic acid were, in general, not chosen as snacks.

Twenty-two percent of the subjects were receiving some type of prescribed multi-vitamin supplement. In general, these supplements provided more than 100% of the RDA for thiamin, riboflavin, ascorbic acid, and vitamin A. Six percent of the subjects took iron supplements, which provided 65 mg of iron for three subjects and 130 mg for one.

TABLE 2

PERCENTAGE OF SUBJECTS WITH TEN PERCENT OR MORE
OF THEIR MEAN DAILY DIETARY INTAKES OF
INDIVIDUAL NUTRIENTS FROM SNACKS

Nutrient	Percent of Subjects
Energy (kcal)	21
Protein (g)	6
Calcium (mg)	18
Phosphorus (mg)	13
Iron (mg)	4
Vitamin A (IU)	7
Thiamin (mg)	6
Riboflavin (mg)	16
Niacin Equivalents (mg)	7
Ascorbic Acid (mg)	3

Of the diets being supplemented for vitamin A, 67% contained less than two-thirds of the RDA for that nutrient. Corresponding values for ascorbic acid were 59%; for iron and thiamin, 50%; and for riboflavin and niacin, 7%.

Other studies (6, 13, 15, 16) reporting supplementation to the mean nutrient intake of aging persons have been with free-living subjects, who took supplements possibly by choice. In such studies, Steinkamp et al. (15) found that 37% of those taking some form of vitamin supplement had diets already adequate in these nutrients.

As it was indicated in the procedure, three recording weeks were necessary to obtain the nutrient intakes of all the subjects. In view of the fact that the mean nutrients provided during the recording weeks were not significantly different, the data for the three weeks were combined. The mean daily nutrients provided are compared to the RDA and to the mean daily amounts consumed in Table 3. The amounts of the provided nutrients all exceeded 100% of the RDA. Niacin equivalents were provided at more than twice the RDA and protein at more than one and one-half times the RDA. Thus, the dietitian planned and served nutritionally adequate meals. However, this did not mean that subjects consumed an adequate diet. Only 74% of the mean daily calcium provided was consumed, and all other nutrient intakes were less than two-thirds of that provided at meals. Thus, the fact that mean intakes of nutrients at meals were lower than the RDA was actually due to the failure of the subjects to eat the food provided.

TABLE 3

A COMPARISON OF THE MEAN DAILY NUTRIENTS PROVIDED AT MEALS WITH THE RDA AND WITH THE MEAN DAILY AMOUNTS CONSUMED AT MEALS

	Provided			Consumed	
Nutrient	RDA	Mean ± SE	Percent of RDA	Mean ± SE	Percent of Provided
Energy (kcal)	1700	2065±48	121	1383±32	67
Protein (g)	55	88±3	160	52±2	59
Calcium (mg)	800	867±25	108	644±15	74
Phosphorus (mg)	800	1266±37	158	854±22	67
Iron (mg)	10	13.3±0.4	133	8.0±0.2	60
Vitamin A (IU)	5000	5444±556	109	3077±123	56
Thiamin (mg)	1.0	1.17±0.05	117	0.73±0.02	62
Riboflavin (mg)	1.5	1.84±0.04	123	1.27±0.03	69
Niacin Equiv (mg)	13.0	29.82±1.32	230	16.87±0.55	56
Ascorbic Acid (mg)	55	64±5	116	35±1	55

The percentage of women having high (100% or more of the RDA), adequate (between 67% and 100% of the RDA), and inadequate (below 67% of the RDA) intakes of individual nutrients with and without supplementation are summarized in Table 4. Niacin was the most generously supplied nutrient with 85% and 79% of the subjects having high intakes with and without supplements, respectively. All diets were adequate (36%) or high (64%) in phosphorus. At least 90% of the subjects had either adequate or high intakes of energy, protein, riboflavin, and niacin. Vitamin A was the least adequately consumed nutrient in both the unsupplemented and supplemented diets with 52% and 40% of the subjects, respectively, having inadequate levels. Ascorbic acid intakes were inadequate in 48% (unsupplemented) and 37% (supplemented) of the subjects. A higher percentage of subjects had inadequate intakes of vitamin A and ascorbic acid in the present study than in the studies of Fry et al. (14) Davidson et al. (6), and Steinkamp et al. (15). It is interesting to note that an even greater percentage of subjects in the present study would be classed as having inadequate intakes of ascorbic acid if the RDA (70 mg) for the nutrient prior to the 1968 recommendations had been used. However, these two nutrients are frequently low in diets of older people (2, 10, 11). Calcium intakes were also more adequate in the present study than in studies reported by Swanson et al. (10) and Wilcox et al. (11).

Diets, unsupplemented and supplemented, were also classified as high, adequate, and inadequate according to

TABLE 4

PERCENTAGE OF SUBJECTS HAVING HIGH, ADEQUATE, AND INADEQUATE INTAKES OF NUTRIENTS WITH AND WITHOUT SUPPLEMENTATION

Nutrient	High[a] unsupp	High[a] supp	Adequate[b] unsupp	Adequate[b] supp	Inadequate[c] unsupp	Inadequate[c] supp
	%	%	%	%	%	%
Energy[d] (kcal)	19	-	73	-	8	-
Protein[d] (g)	49	-	45	-	6	-
Calcium (mg)	22	22	63	63	15	15
Phosphorus (mg)	64	64	36	36	0	0
Iron (mg)	24	30	60	57	16	13
Vitamin A (IU)	8	24	40	36	52	40
Thiamin (mg)	4	26	66	55	30	19
Riboflavin (mg)	30	45	63	49	7	6
Niacin Equivalents (mg)	79	85	18	13	3	2
Ascorbic Acid (mg)	3	20	49	43	48	37

[a] 100% or more of the RDA.

[b] Between 67% and 100% of the RDA.

[c] Below 67% of the RDA.

[d] Not supplemented.

the following criteria:

High--intake of all nutrients is equal to or above 100% of the RDA.

Adequate--intake of at least one nutrient is below 100% of the RDA but none is below 67%.

Inadequate--intake of at least one nutrient is below 67% of the RDA.

Only 3% of the supplemented diets were classified as high using these criteria, while 34% were adequate, and 63% were inadequate. None of the unsupplemented diets were classified as high, with 70% being inadequate and only 30% adequate.

The correlations of mean nutrient intakes from meals and snacks with age are presented in Table 5. Significant negative correlations were found between nutrient intakes and age, except for intakes of calcium and ascorbic acid. A decrease in nutrient intakes with age was possibly related to decreased activity with age, although records of activity were not kept. Fry et al. (14) found that mean nutrient intakes of elderly women decreased with age, except for calcium and riboflavin. Many other investigators have noted decreased nutrient intakes with advancing age (6, 10, 12, 14, 15).

Mean values of selected blood constituents and percentages of subjects with high, adequate, low, and deficient levels according to the classification of ICNND (8) are presented in Table 6. Mean values of all blood constituents were within the acceptable or high classification. Plasma ascorbic acid was deficient in one subject (2% of the subjects); otherwise the individual values of all the blood constituents were classed above the deficient level. In fact, hemoglobin and

TABLE 5

CORRELATION OF AGE WITH NUTRIENT
INTAKES FROM UNSUPPLEMENTED DIETS

Nutrient	r value	P value
Energy (kcal)	-0.32	<.01
Protein (g)	-0.37	<.005
Calcium (mg)	-0.17	ns[a]
Phosphorus (mg)	-0.38	<.001
Iron (mg)	-0.47	<.001
Vitamin A (IU)	-0.42	<.001
Thiamin (mg)	-0.28	<.05
Riboflavin (mg)	-0.40	<.001
Niacin Equivalents (mg)	-0.42	<.001
Ascorbic Acid (mg)	-0.21	ns

[a] Not significant.

TABLE 6

MEAN VALUES OF BLOOD CONSTITUENTS AND PERCENTAGES OF SUBJECTS HAVING HIGH, ACCEPTABLE, LOW AND DEFICIENT LEVELS

Blood Constituent	Mean ±SE	ICNND Standards[a]	Percent of Subjects
Hemoglobin, g/100 ml (n=52)	13.9±0.2	H ≥14.5	27
		A 11.0 -14.4	73
		L 10.0 -10.9	0
		D <10.0	0
Serum Total Protein, g/100 ml (n=52)	7.23±0.07	H ≥ 7.0	65
		A 6.5 -6.9	31
		L 6.0 -6.4	4
		D < 6.0	0
Serum Albumin, g/100 ml (n=52)	3.66±0.04	H ≥ 4.24	8
		A 3.52 -4.24	65
		L 2.80 -3.51	27
		D < 2.80	0
Ascorbic Acid, mg/100 ml (n=52)	0.47±0.07	H ≥ 0.40	27
		A 0.20 -0.39	54
		L 0.10 -0.19	17
		D < 0.10	2

[a] Interdepartmental Committee on Nutrition for National Defense suggested levels; H - High; A - Acceptable; L - Low; D - Deficient.

serum total protein values were all classed as high or acceptable except for 4% of the total serum protein values which fell in the low classification. Serum albumin and plasma ascorbic acid values were low in 27% and 17% of the subjects, respectively.

The mean value of plasma ascorbic acid (0.47 mg/100 ml) in the present study was somewhat lower than the mean value (0.84 mg/100 ml) of healthy aged women reported by Brin et al. (7). The present mean hemoglobin value (13.9 g/100 ml) was very similar to that (13.4 g/100 ml) obtained by Gillum et al. (3) from women over 50 years of age. However, the mean serum total protein value (7.2 g/100 ml) obtained in the present study was higher than that (6.4 g/100 ml) reported by Morgan et al. (2).

The correlations of selected total daily nutrient intakes with levels of the blood constituents are shown in Table 7. Ascorbic acid intake was significantly correlated with plasma ascorbic acid, but not with hemoglobin concentration. Protein intake was significantly correlated with blood levels of hemoglobin and serum albumin. However, no significant correlation was found between protein intake and serum total protein or between iron intake and hemoglobin.

Contrary to the present findings, Da Costa et al. (34) found no correlation between protein intake and serum albumin in aged women, and Gillum et al. (3) found a significant correlation between iron intake and hemoglobin in the elderly. However, Gillum et al. (3) reported a significant correlation between protein intake and hemoglobin, and Morgan et al. (2) reported a significant correlation between ascorbic acid intake

TABLE 7

CORRELATION OF SELECTED NUTRIENT INTAKES WITH BLOOD CONSTITUENTS

Relationship Tested	r value	P value
Ascorbic Acid Intake vs		
Plasma Ascorbic Acid	0.62	<.001
Hemoglobin	-0.12	ns[a]
Protein Intake vs		
Serum Total Protein	0.12	ns
Serum Albumin	0.28	<.05
Hemoglobin	0.33	<.05
Iron Intake vs		
Hemoglobin	-0.02	ns

[a]Not significant.

and plasma ascorbic acid in aging women, which corresponds to findings of the present study.

Bone density measurements were made on 52 of the women who participated in the study. Their values ranged from 0.40 to 1.41 gram equivalents of alloy per cubic centimeter of bone, with a mean value ± standard error of 0.81 ± 0.03. Morgan et al. (19) reported a mean bone density coefficient of 1.22 in aging women using a slightly different method. The bone density values reported by Mason et al. (18) for this age group of women were also higher than the values observed in the present study. Mean bone density values of women are usually less than those of men (6, 19, 20).

Correlations of nutrient intakes with bone density values are presented in Table 8. Bone density was significantly correlated with the daily nutrient intakes of energy, protein, and phosphorus. No significant correlations were found between bone density and the total daily intakes of either calcium, vitamin A, or ascorbic acid. However, bone density was significantly correlated to the unsupplemented intakes of vitamin A and ascorbic acid. The lack of correlation between bone density and total intakes of vitamin A and ascorbic acid may be due to the very high intakes of these nutrients in the subjects receiving vitamin supplements. Their mean daily intakes of vitamin A and ascorbic acid were 19,662 IU and 202 mg, respectively. Also, bone density values may be a reflection of nutrient intakes over a much longer period of time

TABLE 8

CORRELATION OF SELECTED FACTORS WITH BONE DENSITY

Factor	r value	P value
Nutrient Intakes		
Energy (kcal)	0.45	<.001
Protein (g)	0.38	<.005
Calcium (mg)	0.25	ns[a]
Phosphorus (mg)	0.46	<.001
Vitamin A (IU)		
supplemented	-0.09	ns
unsupplemented	0.33	<.02
Ascorbic Acid (mg)		
supplemented	-0.07	ns
unsupplemented	0.28	<.05
Blood Constituents		
Hemoglobin (g/100 ml)	0.10	ns
Serum Total Protein (g/100 ml)	0.02	ns
Serum Albumin (g/100 ml)	0.34	<.05
Plasma Ascorbic Acid (mg/100 ml)	0.02	ns
Age	-0.31	<.05
Height	0.52	<.001
Weight	0.31	<.05

[a]Not significant.

than that in which the vitamin supplements were administered. The subjects receiving these supplements had been taking them an average of twelve months. It is possible, but unlikely, that the supplements containing vitamin A and ascorbic acid were not being utilized efficiently. The relationship between bone loss and nutrient intake is a debatable one. For example, Garn et al. (25), Davidson et al. (6), and Morgan et al. (19) found no significant correlations between bone density and intakes of calcium and protein. However, Dallas and Nordin (21) and Lutwak (35) found that bone density significantly correlated with calcium intake.

The relationship of blood constituents with bone density is also presented in Table 8. Bone density was significantly correlated ($P < .05$) to levels of serum albumin. This is in contrast to the findings of Gitman et al. (23), who reported no significant correlation between bone density and serum albumin. In the present study, no significant correlation was found between bone density and blood levels of hemoglobin, ascorbic acid, and total protein, which agree with the findings for hemoglobin and total protein obtained by Gitman et al. (23).

Bone density values significantly decreased with age ($P < .05$), and significantly increased with height ($P < .001$) and with weight ($P < .05$), also shown in Table 8. These findings are in agreement with those of previous investigations which have related bone density to age (18, 19) and to skeletal mass (25). In a recent study, Jdanov and Nikityuk (36) have reported that senile bone changes are related to body type.

Mean body weight (135 lbs) and mean height (62 ins) of subjects in the present study compared favorably with those given for the reference woman 55-75 years in the RDA (128 lbs, 63 ins) (27) and with the mean value (134 lbs, 63 ins) for women 65 years and older according to Master et al. (37). Twenty-nine percent of the subjects were within the 10% range range of Master's average weight; 35% were above the range; and 36% were below. It would seem that the weight distribution of the subjects in the present study was quite normal. Davidson et al. (6) found the average weight of apparently healthy elderly women to be less than that reported by Master et al. (37).

The findings of this study contribute to an understanding of the problem areas in the nutrition of the elderly. That vitamin A and ascorbic acid intakes were frequently inadequate, despite an adequate amount of these nutrients being provided in the diet by the institution, indicates the complexity of maintaining a desirable level of nutrition in this age group.

More emphasis needs to be placed on the development of realistic methods to secure the ingestion of problem nutrients. Food likes and dislikes of the particular population being served must be taken into consideration. Among other things, the acceptance of particular foods by the elderly depends on the eating habits of the individual in earlier years and the maintenance of a good general health status, e.g., good chewing efficiency, lack of gastro-intestinal tract problems, adequate physical activity, etc. Providing foods for the elderly that will not or can not be eaten by them is self-defeating.

It was also shown that both bone density and nutrient intakes, in general, decreased with age, and furthermore that a positive correlation existed between nutrient intakes and bone density. It is tempting to speculate that the reduction in nutrient intake was responsible for the decrease observed in bone density. However, the relationship may exist because they both are dependent on the general health of the individual which in turn is related to the aging process itself. Perhaps an increase in physical activity and a corresponding increase in nutrient intake would be helpful in maintaining bone density in the elderly. Since the present weight of the subjects was considered to be normal, an increase in caloric consumption without an increase in physical activity would seem to be unwise.

CHAPTER V

SUMMARY

An investigation of the nutritional status of elderly women housed at a state psychiatric institution was conducted in Knoxville, Tennessee.

Nutrient intakes of 67 subjects were calculated from 7-day records of weighed food consumption. Height, weight, and bone density values were obtained for 54 subjects and levels of selected blood constituents were determined on 52 subjects.

It was found that mean daily nutrient intakes from all sources, including vitamin and/or mineral supplements, exceeded the RDA, except for energy, protein, and calcium, which supplied 87%, 98%, and 87% of the RDA, respectively. However, from food consumed at meals and snacks, only the mean intakes of phosphorus and niacin equivalents met the RDA. Mean intakes of vitamin A and ascorbic acid from food were less than two-thirds of the RDA.

The mean daily nutrients served at meals exceeded 100% of the RDA. However, mean daily consumption of all nutrients from meals were less than two-thirds of that served, except for calcium. Mean intakes of energy, calcium, and riboflavin from meals and snacks were significantly higher ($P < .05$) than intakes of these nutrients only from meals. Snacks contributed 10% or more of the daily intakes of energy, calcium, and riboflavin in approximately 20% of the subjects. Only 3% of the

subjects received 10% or more of their daily ascorbic acid intakes from snacks. Twenty-two percent of the subjects received some type of prescribed multi-vitamin supplement and 6% received an iron supplement.

When the diets were classified as high (intake of all nutrients were equal to or above 100% of RDA), adequate (intake of at least one nutrient below 100% of the RDA but none below 67%), and inadequate (intake of at least one nutrient below 67% of the RDA), none of the unsupplemented diets were classified as being high, with 30% being adequate, and 70% inadequate. Including the supplements elevated 3% of the diets into the high classification, but 63% were still classified as inadequate. Ascorbic acid and vitamin A were the individual nutrients most frequently consumed at less than two-thirds of the RDA. Intakes of all nutrients, except calcium and ascorbic acid, significantly decreased with age.

Mean values of hemoglobin, serum total protein and albumin, and plasma ascorbic acid were acceptable or high according to the ICNND criteria. However, levels of serum albumin and plasma ascorbic acid were classified as low or deficient in 27% and 19% of the subjects, respectively.

Significant correlations were found between ascorbic acid intakes and plasma ascorbic acid, and between protein intakes and serum albumin and hemoglobin concentration. No significant correlation was found between protein intake and serum total protein or between iron intake and hemoglobin.

The mean bone density value was 0.81 ± 0.03 gram equivalents of alloy per cubic centimeter of bone, with a range of values from 0.40 to 1.41. A significant correlation was obtained between bone density and daily intakes of energy, protein, phosphorus, vitamin A, and ascorbic acid from food, but not with intakes of calcium nor with vitamin A and ascorbic acid if supplements of the latter two nutrients were included. No significant correlation was found between bone density and blood levels of hemoglobin, ascorbic acid and total protein, although bone density was significantly correlated with serum albumin. Bone density values significantly decreased with age, and significantly increased with height and with weight. The weight distribution of the subjects appeared to be quite normal for women of this age group.

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APPENDIXES

APPENDIX A

LETTERS OF PERMISSION AND CONSENT FORMS

Department of Nutrition
The University of Tennessee
Knoxville, Tennessee 37916
(Date)

(Inside Address)
(Relative or Guardian)
(City, State)

Dear (Relative or Guardian):

The Department of Nutrition at The University of Tennessee is making a study of the nutritional status of elderly women in which (Patient) has indicated a desire to participate. Enclosed is a copy of a letter explaining the study, which we have given to her. The study has also been explained to her personally. A copy of a signed consent form indicating her desire to participate is also enclosed. We need your permission for her to participate. The study will interfere very little with the schedule which she is now following at Eastern State Psychiatric Hospital. To give us your permission, please sign the Permission Form in the space indicated by the red X, write in the date, and return the form to us in the enclosed self-addressed and stamped envelope at your earliest convenience. If you have questions regarding the study, please contact us by writing to:

Dr. Roy E. Beauchene
Department of Nutrition
The University of Tennessee
Knoxville, Tennessee 37916

If you prefer, you may call the Nutrition Department at The University of Tennessee, Knoxville, (974-3491). Dr. Beauchene, Mrs. Mason, Miss Whitfield, or Miss Thompson will be glad to answer your questions.

Thank you very much for your interest and cooperation.

Sincerely,

CONSENT FORM

I, ______________________________, would like to participate in The University of Tennessee, Department of Nutrition study. I understand that I will receive either the regular hospital diet or the hospital diet supplemented by vitamins or minerals and that (1) my food intake will be recorded for a week, (2) a blood sample will be taken, (3) urine and feces will be collected for a week, and (4) bone density will be determined by a painless and harmless x-ray procedure. I also understand that these tests will be repeated in December, 1970, and in May, 1971.

Signed ______________________________

Date ______________________________

PERMISSION FORM

I am willing for ______________________________ to participate in The University of Tennessee, Department of Nutrition study. I understand that she will be given either the regular hospital diet or the hospital diet plus a vitamin or mineral supplement and that (1) food intake will be recorded for a week, (2) a blood sample will be taken, (3) urine and feces will be collected for a week, and (4) bone density will be determined by a painless and harmless x-ray procedure. I also understand that these tests will be repeated in December, 1970, and May, 1971.

Signed ______________________________

Date ______________________________

Department of Nutrition
The University of Tennessee
Knoxville, Tennessee 37916
(Date)

Dear (Patient)

The Nutrition Department at The University of Tennessee is inviting you to participate in a nutrition study. The purpose of the study is to evaluate the medical-nutritional status of a group of selected women patients at Eastern State Psychiatric Hospital and then to evaluate the effectiveness of dietary supplements in changing their nutritional status.

Participation in the study consists of allowing us to assign you to a group receiving for ten months either the regular hospital diet or the hospital diet supplemented with vitamins and/or minerals and to:

1. Record food intake for a week
2. Take a blood sample for analysis
3. Collect urine and fecal output for a week
4. Determine bone density by a harmless x-ray procedure similar to dental x-rays

The initial tests (1,2,3,4) will be made this summer and will be repeated in December, 1970, and again in May, 1971.

The dietary supplementation will be in the form of multiple vitamin capsules and mineral capsules. The mineral supplements in which we are particularly interested are calcium phosphate and sodium fluoride. Calcium phosphate has been frequently added to the diets of the elderly to prevent bone loss. Recent studies have indicated that sodium fluoride added to the diet may decrease the amount of mineral lost from bone during aging. Sodium fluoride has long been known to reduce tooth decay when added to drinking water. With age, bones generally become weaker and they may suddenly break. We feel that supplementation of the diet with sodium fluoride may be of value in reducing bone mineral losses and susceptibility to fractures. The level of fluoride used will be well below that which has caused any toxic effects. In rare instances supplementation of the diet with high levels of sodium fluoride has produced side effects such as nausea and joint pain. However, the majority of people who have received sodium fluoride indicate that the mineral is well tolerated and that it tends to reduce joint pain.

We think this study will provide very useful information concerning the nutritional status of older people and we hope that you will desire to help us.

Sincerely,

APPENDIX B

SYSTEM FOR DETERMINING THE WEIGHT OF FOOD SERVED AND CONSUMED

Sheet 1
Food Served

Lunch 9/18/70

Name of Subject	Plate	Plate Plus Fried Fish	Plate Plus Buttered Potatoes	Plate Plus Green Beans	Plate Plus Cole Slaw	Bowl	Bowl Plus Apple Betty	Bread	Milk
	N	g	g	g	g	N	g	g	g
Green	1[a]	493	612	660	723	1[b]	289	25	190[c]

Sheet 2
Food Unconsumed

Lunch 9/18/70

Name of Subject	Plate	Plate Plus Fried Fish	Plate Plus Buttered Potatoes	Plate Plus Green Beans	Plate Plus Cole Slaw	Bowl	Bowl Plus Apple Betty	Bread	Milk
	N	g	g	g	g	N	g	g	g
Green	1[a]	444	400	400	400	1[b]	206	0	5

Sheet 3
Food Eaten

Lunch 9/18/70

Name of Subject	Plate	Fried Fish	Buttered Potatoes	Green Beans	Cole Slaw	Bowl	Apple Betty	Bread	Milk
	N	g	g	g	g	N	g	g	g
Green	1[a]	49	119	48	63	1[b]	83	25	185

[a]Plate #1 weighed 400g

[b]Bowl #1 weighed 200g

[c]Paper Cup (8 oz.) weighed 5g

VITA

Nita Elizabeth Whitfield was born in Camden, Tennessee, May 2, 1939. She attended elementary school in Paris, Tennessee, and was graduated from E. W. Grove High School in 1957. The following September she entered The University of Tennessee at Martin, and in June, 1961, she received a Bachelor of Science degree in Home Economics from The University of Tennessee at Knoxville.

She accepted a home economics teaching position at Clinton High School, Clinton, Tennessee, in the fall of 1961. In the summer of 1963, she accepted an appointment with The University of Tennessee Agricultural Extension Service and was placed as an Agent-in-Training at Dickson, Tennessee. In January, 1964, she was appointed as Assistant Home Demonstration Agent of Metropolitan Nashville-Davidson County, Tennessee, and in January, 1966, she received the position of Home Demonstration Agent, which she held until the summer of 1969.

She accepted a graduate teaching assistantship in the Department of Nutrition at The University of Tennessee in the fall of 1969 and received the Master of Science degree with a major in Nutrition in March, 1971.