

Nutritional status of institutionalized elderly in South Florida

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SUMMARY. To assess the nutritional status of an elderly nursing home population of South Florida, forty - seven persons with ages ranging from 65 to 96 years were studied. Complete clinical examination and anthropometric measures were performed, along with blood cell count, biochemical blood parameters and assessment of water-soluble vitamins levels. The most common clinical findings were edentulous (67 %), general pallor (44 %), hyperpigmentation (33 %), dry skin (26 %) and arcus corneitis (26 %). Thirty-five percent of the studied population had cholesterol levels greater than 220 mg/dl. Triglyceride levels were also significantly elevated in a considerable subset of our subjects, with 30% having levels above threshold value of 150 mg/dl. Small proportions of subjects showed low levels of albumin (6%), total protein (28%), ascorbic acid (2 %), and thiamin (9 %). Forty-five percent of males were pyridoxine deficient, while 63 % of the females presented such deficiency. This study underscores the need to define, with greater precision, the nutritional status of aged populations as well as improve our inadequate standards associated with the "normal" aging process. Nutritional intervention -only possible when appropriate standards are defined- can potentially serve not only to prevent the occurrence of significant morbidity and mortality, but can also be employed to enhance quality of life in the elderly individuals.

RESUMEN. Estado nutricional de personas de edad avanzada residentes en hogares de cuidado en el Sur del Estado de Florida. A los fines de conocer el estado nutricional de personas de edad avanzada, se estudiaron 47 personas residentes en un ancianato en el Sur del Estado de Florida, de edades comprendidas entre 65 y 96 años. Se realizó un examen clínico completo y se tomaron medidas antropométricas al igual que parámetros bioquímicos de la sangre y se estudiaron los niveles de vitaminas hidrosolubles. Los hallazgos clínicos más comunes fueron edentulous (67 %), palidez general (44 %), hiperpigmentación (33 %), piel seca (26 %) y arcus corneitis (26 %). Un 35 % de la población estudiada tenía niveles de colesterol mayores de 220 mg/dl. Las concentraciones de triglicéridos fueron también significativamente elevadas en un considerable segmento de los sujetos, con 30 % de ellos que presentaban valores sobre 150 mg/dl. Una pequeña proporción mostró niveles bajos de albúmina (6 %), proteína total (28 %), ácido ascórbico (2 %) y tiamina (9 %). Se encontró deficiencia de piridoxina en un 45 % de los hombres y un 63 % de las mujeres. Este estudio puntualiza la necesidad de definir con mayor precisión, el estado nutricional de la población de edad avanzada, al igual que mejorar nuestros inadecuados estándares asociados con el proceso "normal" de envejecimiento. La intervención nutricional -posible solo cuando se dispone de estándares definidos- puede servir potencialmente, no solo para prevenir la ocurrencia de una morbilidad y mortalidad significativa, sino también ser utilizada para mejorar la calidad de la vida de los ancianos.

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INTRODUCTION

Health care professionals have become more aware that with an elevation in population size and improved health care, there is a rise in the number and proportion of elderly persons. The U.S. has estimated a steady growth in the number of elderly from 25.5 million in 1980 to 64.3 million in 2030 (1). That is to say, from 11.3 percent

of the total population to 21.1 percent. In Florida, in 1980, 17.3 percent of the total population was elderly, which was the highest proportion for any state (1). Consequently, health care expenditures for the elderly are expected to increase in proportion with the size and longevity of the population.

Nutrition has been underestimated as a modulating factor of the normal aging process. Nutritional factors have been shown to significantly impact upon indicators of life's quality e.g., response to infectious challenge and intellectual function. The elderly population is particularly vulnerable and at high risk for development of malnutrition since aging is accompanied by a broad range of physiological and psychological changes such as impaired physical activity, altered food selection, limited social support and depression.

Surveys of institutionalized, or free-living elderly (2) have indicated the necessity for better characterization of the needs of the elderly and emphasize the importance of nutrition in the prognosis of disease. Conversely, nutritional intervention may provide a useful device for improving the quality of life in elderly individuals.

The present study was undertaken to assess the nutritional status of a nursing home population in Miami, Florida, by examining selected anthropometric, clinical, hematological and biochemical parameters.

MATERIALS AND METHODS

Subjects: All forty-seven elderly residents of a nursing home, 36 females (76.6 %) and 11 males (23.4%), whose ages ranged between 65-96 years participated in the study. Participants were ambulatory, totally independent, middle class, and largely caucasian (1 black female). No particular ethnic selection practices were followed. Meal planning was provided by a dietician and all meals were available within the institution.

Subjects were informed of the risks and benefits of the study, in accordance with the requirements of the Human Subjects Committee of the University of Miami and were asked to sign a consent form prior to clinic visit.

Anthropometric Measurements: The following anthropometric measures were performed: Standing

height was measured once, to the nearest 0.1 cm., without shoes, using a standard vertical weight rule and height was recorded in centimeters (cm); weight/height (W/H), body mass index (BMI) (weight/height²), and ponderal index (PI) (weight/height³) were also computed. Weight was measured in light clothing, without shoes, using a calibrated balance arm scale (Healthometer). One reading was made to the nearest 100 grams. Calibration of the scale with a standard weight was performed prior to measurements. Subcutaneous triceps skinfold was measured using calibrated Lange-type skinfold calipers having a pressure of 10 g/mm². The calipers were calibrated prior to testing. Two measurements of the triceps skinfolds were made, and measured to the nearest 0.5 mm on the back of the unclothed pendant right arm at a level midway between the tip of the acromion and the tip of the olecranon. The distance from the acromion to the olecranon of the right arm was recorded to the nearest 0.5 cm by means of a tape measure. Midarm circumference was measured on the standing patient and when the arm was in 90° angle flexion. Midpoint between acromion and olecranon was established, and the midarm circumference was subsequently measured with the subject's arm relaxed and hanging loosely at his or her side; it was recorded in centimeters.

Hematological Analyses: Venipuncture was performed on fasting subjects. Blood samples were drawn from the antecubital vein of seated subjects, using sterile plastic syringe and 19-gauge needles. Routine blood chemistry (SMAC-26) (Technicon AU5000) and complete blood cell count were analyzed by a commercial laboratory.

Vitamin Level Analyses: Vitamin C determinations were determined utilizing the method of Kutnink et al. (3). Values below 0.2 mg/dl were considered deficient. Thiamin status was measured as reported by Stevens et al. (4) utilizing a functional test of nutritional adequacy of vitamin B₁. An activity coefficient (AC) greater than 1.2 was considered a deficient thiamin status. Nutritional assays that employ enzymatic methodologies produce an activity coefficient that reflects, in an inverse fashion nutritional status with regard to that specific nutrient. Thus, elevated AC is indicative of a nutrient deficiency. Pyridoxine status was also measured by a functional test as described by Chaney et al. (5). An activity coefficient (AC), greater than 1.8 was considered a deficient pyri-

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doxine status. All of the analyses were performed at the Clinical Nutritional Laboratory at the University of Miami, Department of Epidemiology and Public Health.

Statistical Analysis: Descriptive statistics, including distributional parameters (e.g., means and standard deviations) of individual measures, and Pearson correlation coefficients were computed. In addition, comparisons of sample parameters with available normal values were evaluated employing an independent t-test procedure. Nominal alpha level (0.05, two-tailed) was considered for the analyses using the Bonferroni corrections (6).

RESULTS

Anthropometric Measurements:

Significant statistical differences were observed among females and male groups in height ($p < 0.02$), triceps skinfold thickness ($p < 0.006$) and in the calculated weight/height ratio ($p < 0.05$). Moreover, highly significant correlations were noted between body weight and skinfold thickness in all individuals studied, but particularly among women ($p < 0.006$). The proportions of individuals which would be considered to be obese varied depending upon the criteria applied. When employing triceps skinfold thickness, as the most appropriate index, 9.0 % of the males (TST > 18.6 mm) and 8.5 % of the females (TST > 25.1 mm) were found to be obese. In contrast, when utilizing the Body Mass Index as an index (BMI > 27), 19 % of the subjects were found to be obese (15 % female). While the proportion of obese individuals varied

with the criteria utilized, there were good correlations between the various indices in predicting obese individuals. TST was highly correlated with both BMI and PI in males as well as females ($r=0.712$, $p<0.003$) ($r=0.666$, $p<0.007$).

Clinical Findings:

The most common findings among study subjects were edentulous (67 %), general pallor (44 %), hyper-pigmentation (33 %), cracked/dry skin (26 %) and arcus corneitis (26 %). Clinical findings frequently observed in males were edentulousness (82 %) general pallor (73 %), conjunctival pallor (73 %), and xerosis (36 %). Hyper-pigmentation and arcus corneitis were the two findings which showed a particular pattern of female predominance (Table 2).

Hematological Findings:

Results of the hematological indices monitored are shown in Table 3. There was an apparent difference in the proportion of subjects with low mean hemoglobin levels between males (36 % of subjects) and females (24 % of subjects), but when corrected for age, the differences were no longer significant. Twenty-eight percent of females and 50 % of males had low hematocrit levels. Similar proportions of the population were deficient in total red cell count (28 % of females and 57 % of males). Fourteen percent of subjects exhibited a low white blood cell count (WBC). While the mean corpuscular volume (MCV) for all subjects was 88.4 ± 6.7 , no individuals had MCV values above the normal range and 4 % had MCV values below the normal limit. In contrast to the signi-

TABLE 1
ANTHROPOMETRIC MEASUREMENTS

	MALES (n=11)	FEMALES (n=36)	TOTAL (n=47)
Age (years)	76.0 \pm 14.2	81.6 \pm 7.9	80.0 \pm 10.3
Height (cm)	174.3 \pm 7.0**	159.5 \pm 9.1	162.9 \pm 10.6
Weight (Kg)	69.9 \pm 17.4	57.3 \pm 16.3	61.5 \pm 17.4
Weight/Height	42.5 \pm 8.3*	35.8 \pm 11.0	37.3 \pm 10.3
BMI (Kg/m ²)	24.1 \pm 4.9	22.5 \pm 6.8	22.9 \pm 6.1
PI (Kg/m ³)	13.7 \pm 3.0	14.1 \pm 4.2	14.1 \pm 3.8
TST (mm)	10.4 \pm 5.6***	16.9 \pm 6.7	14.9 \pm 1.0
MAC (cm)	26.0 \pm 4.0	26.2 \pm 5.4	26.3 \pm 5.0

Mean \pm SD*

- * Significant difference at $p < 0.05$
 ** Significant difference at $p < 0.02$
 *** Significant difference at $p < 0.006$
 BMI: Body Mass Index
 TST: Triceps Skinfold Thickness

PI: Ponderal Index
 MAC: Mid Arm Circumference

TABLE 2
CLINICAL FINDINGS OF NUTRITIONAL SIGNIFICANCE

SYMPTOM	MALES (n=11)	FEMALES (n=36)	TOTAL (n=47)
General Pallor	73*	32	44
Edema	27	21	23
Easily Pluckable Hair	9	11	10
Cracked/Dry Skin	27	25	2
Hyperkeratosis	9	4	5
Pellagrous Dermatitis	18	39	33
Atrophic Nails	0	4	2
Conjunctival Pallor	73	18	33
Conjunctivitis	0	11	8
Arcus Corneitis	27	36	26
Cataracts	0	0	7
Dacrocystis	18	0	5
Xerosis	36	18	23
Edentulous	82	61	67
Partial Dental Plates	0	7	5
Pyorrhoea	0	7	5
Smooth Tongue	0	7	5
Atrophic Papillae	18	11	13
Glossitis	18	4	8

* Values express percentage of subjects with positive clinical findings.

ficant number of individuals who demonstrated evidence of anemia, no subjects were found to have significantly low levels of serum iron (2.7% of females). There was an apparent difference in iron levels between males (96.3 ± 33.2 mg/dl) and females (85.7 ± 24.5 mg/dl), however, when adjusted for differences in age, no such sex-based significance was apparent.

Biochemical Determinations:

Albumin levels, considered to reflect overall protein status, were less than 3.5 g/dl in 6% of the subjects (in 9% of males and 5.5% of females). Total protein was less than 6.5 g/dl in 28% of the subjects, with no notable differences in either marker of protein status. Mean plasma cholesterol level for the total study group was 214.3 ± 51.8 mg/dl (Mean \pm SD); without significant differences between males and females (Table 3). Thirty-five per-cent of the total population had cholesterol levels greater than 220 mg/dl, considered to represent the threshold for increased risk of atherosclerotic heart disease. Triglyceride levels were also found to be significantly elevated in a considerable subset of our subjects, with a mean plasma

level of 167.3 ± 175.6 mg/dl (Mean \pm SD), with 30% having triglyceride levels above the threshold value of 150 mg/dl (Table 3). A high degree of correlation between cholesterol and triglyceride levels was demonstrated in the study subjects ($r=0.455$, $p<0.001$).

Water-soluble vitamins status are shown in Table 4. Plasma ascorbic acid mean values for the total group were 1.05 ± 0.42 mg/dl. Only 2% of subjects had low plasma ascorbate levels (normal >0.2 mg/dl); and an additional 4% could be considered to be at moderate risk for developing ascorbic acid deficiency (plasma values between 0.2 and 0.39 mg/dl). A greater proportion of individuals at risk for ascorbic acid deficiency was shown in the males, with 18% being at moderate or high risk for developing deficiency compared with 3% of female subjects. Thiamin levels (AC) in red blood cells were low in 9% of males and 8% of females, with a mean value of 1.06 ± 0.11 for all subjects. Pyridoxine (AC) mean values in red blood cells for the total group were 1.92 ± 0.50 ; with no significant sex differences. Whereas only 45% of the males were assessed to be pyridoxine deficient

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TABLE 3
HEMATOLOGICAL INDICES

	MALES (n=11)	FEMALES (n=36)	TOTAL (n=47)
Hemoglobin (g/dl)	12.4 ± 1.9 (36)*	13.3 ± 1.5 (24)	12.9 ± 1.6 (26)
Hematocrit	37.6 ± 5.5 (5.5)	38.9 ± 4.4 (28)	38.6 ± 4.7 (33)
RBC (X10 ⁶)	4.28 ± 0.80 (57)	4.42 ± 0.48 (28)	4.39 ± 0.59 (38)
WBC (X10 ⁶)	6.46 ± 1.78 (7)	6.54 ± 2.16 (17)	6.52 ± 2.03 (14)
MCV (μ ³)	88.6 ± 6.7 (7)	88.3 ± 5.1 (3)	88.4 ± 5.5 (4)
MCH (μg)	29.4 ± 2.9 (14)	29.5 ± 2.0 (9)	29.5 ± 2.3 (10)
MCHC (%)	33.2 ± 2.2 (21)	33.2 ± 1.1 (6)	33.4 ± 1.5 (5)
Serum Iron (μg/dl)	96.3 ± 33.2 (0)	85.7 ± 24.5 (2.7)	88.9 ± 29.0 (2)
Total Protein (g/dl)	6.7 ± 0.34 (0)	6.7 ± 0.34 (11)	6.6 ± 0.46 (28)
Cholesterol (mg/dl)	201.3 ± 58.0 (33)**	219.8 ± 48.8 (44)	214.3 ± 51.8 (35)
Triglyceride (mg/dl)	208.6 ± 299.0 (20)	149.1 ± 84.9 (30)	167.3 ± 175.6 (30)

Mean ± SD

* Percentage of abnormal values

** Percentage above the acceptable level

(AC=1.8), a full 63% of the females surveyed documented that deficiency. Only 18% of study subjects reported using vitamins supplementation on a regular basis.

DISCUSSION

Our findings corroborate and extend earlier studies regarding the nutritional status of the elderly (7, 8).

An assessment of nutritional risk involves evaluation of a number of parameters simultaneously. The use of multiple measurements and indices is most likely the best way of utilizing anthropometry to monitor nutritional status at the present time as has been demonstrated in the present study. Limitations in the interpretation of anthropometric data are largely due to variations in the different norms and standards developed (7, 8). When using the criteria of

TABLE 4
WATER - SOLUBLE VITAMIN STATUS

	Ascorbic Acid (mg/dl)	Pyridoxine (AC)	Thiamin (AC)
Males (N)	0.96 ± 0.47 (9)** (11)	1.85 ± 0.33 (45) (11)	1.06 ± 0.10 (9) (11)
Females (N)	1.08 ± 0.38* (0) (36)	1.94 ± 0.54 (63) (35)	1.07 ± 0.11 (8) (35)
Total	1.05 ± 0.42 (2) (47)	1.92 ± 0.50 (59) (46)	1.06 ± 0.11 (9) (46)

Mean ± SD

* Significant difference at p < 0.05

** Percentage below acceptable levels

the Ten state survey to assess the prevalence of obesity (9), we found that 8.5% of the women and 9% of the men were obese. According to that survey, 24% of the females and 9% of the men were found to be obese. While the prevalence of obesity was significantly greater than that found in this study, our percentage of obese women was similar to those obtained in another survey among elderly females (10). The extreme variability of those standards used to assess anthropometry is demonstrated by the fact that when viewed in a different manner e.g. using body mass index to assess prevalence of obesity, 19% of our participants were classified as obese. These data describe the current problems with the standardized anthropometric methodology most frequently used in the elderly. Most studies indicate assessing nutritional status via triceps skinfold thickness (TST) and midarm circumference (MAC). Efforts continue to define new means of assessing anthropometric status, e.g., measurement of girth of the hips and waist, with the consequent use of waist to hip circumference ratio (11).

Clinical signs of nutritional status are similarly fraught with many difficulties, particularly when applied to the elderly. While these signs are suggestive of nutritional deficiencies, they may also be related to other non-nutritional disease processes. These clinical parameters are most likely useful if complemented with anthropometric and biochemical measurements; and when determining prevalence of nutritional deficiencies in large scale populations, rather than monitoring nutritional status in a specific individual due to their late occurrence in nutritional deprivation, and their relative insensitivity to marginal degrees of deficiency.

Hematological changes have been used widely in nutritional assessment, since hematopoieses and granulocytopoieses are influenced by nutritional parameters. However, altered hematological profiles may be also related to a variety of non-nutritional causes. Considerable confusion exists regarding the influence of senescence upon the hematopoietic process. Our data have shown an incidence of anemia in 28% females, and 50% males. Nevertheless, the major concern at present is to determine the proportion of subjects who developed anemia due to nutritional causes. While some studies have found nearly 20% incidence or iron deficiency associated with anemia (12), other surveys among the elderly indicate a similar percentage of low serum iron levels to the presently sur-

veyed population (13). The precise incidence of iron deficiency anemia can be expected to vary considerably with such factors as socioeconomic status and institutionalization. In addition, iron uptake from the gut has been noted to be much more variable in the elderly; utilization of that iron which is absorbed and retained for functions such as hematopoieses may also be far less efficient than in younger adults (14). Mean corpuscular volume (MCV) is frequently elevated in subjects with folate and vitamin B₁₂ deficiency, indicating impaired hematopoieses accompanied by megaloblastosis. Recent studies have suggested that megaloblastosis occurs relatively late in the course of such vitamin deficiency, and screening methods with higher sensitivity must be employed (15). It is important to note, that individuals deficient in one nutrient are frequently at risk for deficiency of other essential nutrients.

While total serum protein and serum albumin levels may adequately reflect overall nutritional status, there are many difficulties regarding the standardization and significance of such findings. Previous studies have indicated that serum albumin may decline as a result of the normal aging process (16), reflecting probably a decreased ability to synthesize serum albumin or, an increased renal or gastro-intestinal losses secondary to decrease functional ability of these systems. Our findings reveal that 6% of the elderly exhibit significantly low serum albumin values; this is consistent with previous studies and in proportion with the individuals from the studied population that are under-nourished. These results do not appear to be dependent upon renal losses as patients with significant renal disease were precluded from the present investigation.

Elevated serum cholesterol and triglycerides are frequent problems in the elderly patient. Up to one half of elderly men and women surveyed have a significantly elevated level of either cholesterol or triglycerides. It is not clear which component results from changes associated with the normal aging process. Using an upper normal limit of 220 mg/dl, approximately 40% of our subjects had significantly elevated levels of serum cholesterol, and 30% had triglycerides levels greater than 150 mg/dl. In 16 general, women tend to have higher levels of cholesterol and triglycerides (17), which may be indicative of greater incidence of obesity among elderly women. Clinical ma-

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agement is difficult in the elderly patient with elevated lipid parameters, but with normal or low body weight and may carry higher risk of progressive coronary heart disease, if lipid levels remain elevated. Our knowledge regarding lipid metabolism in the elderly is limited at this time, and more information is necessary to improve clinical judgement among this population.

The percentage of individuals with thiamin deficiency in our study, correlates with the findings of other studies of the elderly population (18). Some investigators have reported twice this incidence among specific elderly subpopulations (19). Thiamin deficiency is generally reflective of inadequate dietary intake, and is one of the nutritional deficiencies that is associated with impaired cognitive function in the elderly (20). This may be of particular importance since this deficiency is known to cause behavioral and neurological complications. And a moderate thiamin deficiency may have a significant impact upon various physiological and psychological functions.

A deficiency in pyridoxine levels was observed in approximately 60% of our subjects. Other studies have found a similar but higher incidence, with up to 75% having evidence of pyridoxine deficiency by serum measurements (18,21). Pyridoxine is also involved in various neurological functions, and its deficiency may cause important psychoneurological dysfunction in elderly individuals. In addition, pyridoxine supplementation has been shown to increase responsiveness of lymphocytes in elderly subjects, thereby ameliorating some of the aspects of immune senescence (22).

The possible role of vitamin C as a free radical quencher and an attenuator of the aging process has brought considerable interest. Ascorbic acid deficiencies are related to physiologic abnormalities of the cardiac tissue and various areas of the brain in the elderly (23). In accord with previous studies of vitamin C status in the elderly (18,24), objective evidence of ascorbic acid deficiency, was limited in the studied population. It is likely that ascorbic acid will continue to be one of the most widely consumed dietary supplements despite the absence of supporting evidence of retarding the aging process; therefore, ascorbic acid deficiency will most likely remain relatively uncommon (25).

The present findings indicate the need to define adequate standards associated with the "normal" aging

process and the importance of describing the nutritional status of the elderly population. Only in this way we will be able to identify accurately the individuals at increased risk for nutritional deficiencies and thereby select those for therapeutic supplementation. In this fashion, nutritional intervention can be used as an important clinical tool not only to prevent the occurrence of morbidity and mortality, but also, to enhance the quality of life of the elderly.

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