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# Association between Nutritional Status Determined By Mini Nutritional Assessment and Serum Marker Levels in Older Adults at Eldercare Facilities

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## Abstract

Malnutrition in the older adult is an ongoing situation in Mexico and is most apparent in individuals that reside in hospitals, nursing homes, and retirement homes. For that reason, it is necessary to evaluate the nutritional status of these adults by means of the Mini Nutritional Assessment (MNA) and levels of three serum indicators that are commonly ordered when making malnutrition diagnosis. An analytical cross-sectional study was carried out on 100 older adults residing in eldercare facilities. Nutritional status was evaluated by means of the MNA and three serum indicators (albumin, ferritin, and hemoglobin). Descriptive statistics were used to analyze sociodemographic characteristics, and a Student's *t* test, based on sex and reference values, was used to compare mean values of the three serum indicators. A Chi-square test was used to compare proportions in individuals, based on sex, who had normal nutritional status or were malnourished, and who were at risk of malnutrition. A One-way ANOVA with Scheffé post hoc test was used to identify the association between serum indicators and the nutritional status of older adults. Of the 100 older adults studied, 53% were men and 47% were women. The mean age was 85 ± 0.7 years. According to the MNA, 20% had normal nutritional status, 55% were at risk of malnutrition, and 25% were malnourished. The mean indicator values were: albumin 4.7 ± 0.04 g/dL, ferritin 74.2 ± 8.7 ng/mL, and hemoglobin 13.0 ± 0.1 g/dL. No significant association was found between serum indicators and each MNA classification. However, when the same indicators were compared between the sexes, hemoglobin showed a significant difference ($P$=0.037). Women had lower values but those values did not extend beyond the established physiological range for this population. There was a 55% prevalence of risk of malnutrition in the nutritional status of older adults living in Mexican eldercare facilities in a Mexican province and it was even more frequent in women.

**Keywords:** Nutritional state; Older adult; Mini nutritional assessment; Serum indicators; México

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**Abbreviations:** MNA: Mini Nutritional Assessment; ECLAC: Economic Commission for Latin America and the Caribbean; OAEF: Older Adults in Eldercare Facilities; NOM-167-SSA1-1997: Official Regulation

167 of the Mexican Department of Health; BMI: Body Mass Index

## Introduction

The increase in the worldwide adult population is perhaps the most significant demographic event that has had an impact on developing countries, especially in Europe. It has been observed for a long time [1]. Projections made by the Economic Commission for Latin America and the Caribbean (ECLAC) indicate that the population 60 years of age and older will increase from the 8% reported in 2000, to 14.1% in 2025, and to 22.6% in 2050 [1]. In Mexico, the population over 60 years of age will have gone from 6.87 million in 2020, to 36.2 million by 2050 [2].

The aging process is a deterioration of organic functions and adult quality of life. Many studies have been carried out on this subject and they emphasize the effect of nutritional deficiency on efficacy and functionality of organic systems such as the digestive system [3,4], the cognitive system [5], and the musculoskeletal system [4,6], among others. Velazquez et al. [7] concluded that in Mexico, knowledge pertaining to nutrition in the elderly is limited, and that protein-energy malnutrition in individuals over 60 years of age is the principal cause of functional deterioration.

Different studies show that malnutrition prevalence in the older adult living independently in the community is lower than that of older adults living in hospitals, nursing homes, or retirement homes [8-10].

The variables evaluated in the study of malnutrition among older adults in Mexico have been studied separately. Serum markers are clinically quantified and anthropometric measurements are obtained by means of the Mini Nutritional Assessment (MNA) evaluation instrument, but the two are not evaluated integrally. Albumin is probably the most commonly used serum marker in research studies, but this should not rule out the importance of utilizing other markers [8,11-13].

A complete evaluation of the nutritional status of the adult population should include medical history, physical examination, anthropometric indicators, corporal composition, and the determination of albumin and other serum proteins such as hemoglobin, prealbumin, and ferritin [8,14,15].

The MNA brings all the above-mentioned parameters together. It is widely recommended by health professionals, and by national and international clinical and scientific organizations. It has high sensitivity (96%), specificity (98%), and reliability (97%) for malnutrition studies in the older adult [16,17].

The MNA has been used in multiple studies evaluating nutritional status in the older adult in different living situations; those who live independently in the community, those who are hospitalized, those who live in nursing homes, and those who live in retirement homes (eldercare facilities). These studies have corroborated the MNA's operative validity [16-18].

The objective of the present study was to evaluate the nutritional status in older adults in eldercare facilities (OAEF) in Mexico through the Mini Nutritional Assessment (MNA), and to identify the association of nutritional status with levels of three serum markers ordered as part of the malnutrition diagnosis.

## Methods

An analytical cross-sectional study was carried out on a population of 130 OAEF. Thirty of these individuals were eliminated from the study because they did not fit the selection criteria, and so the final sample was made up of 100 OAEF. The participants were older adult residents of the following eldercare facilities in the state of Colima in Mexico: *Casa Hogar del Adulto Mayor "La Armonía*" (n=41), *Casa Hogar para adultos mayores "San Vicente de Paúl"* (n=18), *Casa hogar para adultos mayores "La purísima Concepción"* (n=25), and *"Asilo de Manzanillo" (n=16).* From January to December 2010, nutritional status was evaluated using the MNA and levels of 3 serum markers were determined.

### Participants

Both men and women 60 years and older were included in the study. Official Regulation 167 of the Mexican Department of Health, 1997 (NOM-167-SSA1-1997) guidelines were followed. This official regulation is still in force and establishes the principles,

criteria, policies, and strategies of health care and the development of social welfare activities for older adults [19].

Participants had resided at the above-mentioned facilities for a minimum of three months. Both their decision to participate in the study and the signing of the statements of informed consent were carried out by them or by relatives. Subjects whose chronic degenerative pathologies were metabolically controlled when blood samples were taken were included in the study. Individuals whose mental capacities were severely impaired, making communication impossible, or those presenting with some type of uncontrolled pathology (diabetes mellitus, high blood pressure, kidney or liver diseases) were excluded from the study. Blood samples that were hemolyzed when registered or transported, or that did not meet requirements established by the official regulations (NOM-003-SSA2-1993) regarding the disposition of human blood and its components for therapeutic purposes, were eliminated from the study [20].

Questionnaires that were not properly filled out were also eliminated from the study, as were those individuals who after participating in the entire process would not accept having blood taken during the final study phase.

### Ethical considerations

The present project was approved by the Research and Ethics Committee of the Faculty of Nursing at the *Universidad de Colima*. The authorities of the participating eldercare facilities, as well as the care providers and older adults, all received letters of informed consent containing the guidelines of the Declaration of Helsinki for Medical Research Involving Human Subjects [21].

### Mini Nutritional Assessment (MNA)

Three categories defined by this instrument were used: normal nutritional status (score ≥ 24), at risk of malnutrition (score 17-23.5), and malnourished (score under 17 points) [16,17,22].

To obtain a Body Mass Index (BMI), the anthropometric parameter in the MNA, the height of each older adult was measured in meters using a non-elastic measuring tape. A 120-kilogram capacity German *Tor* scale was used to weigh each individual. A canvas "*lounge chair*" accessory was attached to the scale, making the weighing more reliable and more comfortable for both the researcher and the older adult. A standard cut-off point for Body Mass Index in the older adult has not yet been established, and generally, a BMI of 24-29 Kg/m$^2$ is considered normal [14,23,24].

In addition, general data such as name, age, sex, illnesses, and current medication intake were obtained for each older adult.

## Serum markers

In order to quantify the serum markers, a sample of venous blood was taken from the study subjects who had fasted for 8 hours. Full blood count, in particular hemoglobin, was determined by spectrophotometry (*Advia 60, BAYER HealthCare Diagnostics Division, Co.*) using a 500 nm wavelength. Albumin was also quantified by spectrophotometry at a wavelength of 550 nm (*Express Plus 550, BAYER HealthCare Diagnostics Division, Co.).* Serum ferritin levels were quantified by chemiluminescence with ACS 180 SE equipment *(Automated Chemiluminescence System, BAYER Co.*) [25].

The different serum markers were quantified with equipment that was previously calibrated to carry out readings by means of specific chemical reagents (*Sera-Pak Plus* and *ACS: 180 Ferritina*, both from *BAYER, Co.*). Clinical analysis laboratory experts at the *Universidad de Colima* carried out blood sample processing and analysis.

### Statistical analysis

General population characteristics were analyzed using descriptive statistics. A Student's *t* test was used to compare the mean values of the 3 serum markers, based on sex and on reference values reported in the medical literature. A Chi-square test was used to compare proportions in relation to the statuses of normal nutritional status, at risk of malnutrition, and malnourished in individuals based on sex. One-way ANOVA with the Scheffé post hoc test was used to

identify association between serum markers and the nutritional status of older adults calculated by the MNA. Differences among groups were considered to be statistically significant when $P<0.05$. The SPSS version 14.0 statistical package was used for information analysis and graphing.

## Results

The older adults studied (n=100) had a mean age of 85 ± 0.7 years, a mean weight of 54.3 ± 1.6 Kg, and a mean height of 1.60 ± 0.1 meters. Table 1 shows the demographic variables of the participating older adults residing in eldercare facilities (OAEF).

The MNA classification identified 55% of the participating OAEF as being at risk of malnutrition (Figure 1). Regarding nutritional status evaluation by age, the 80-89 year age group presented with the highest proportions in two of the three MNA classifications (normal nutritional status 50%; at risk of malnutrition 50%) and malnourished adults (42%) were principally found in the age group above 90 years.

In relation to sex, there was no significant difference between the normal nutritional status and malnourished groups ($P$=0.186) or the normal nutritional status and at-risk-of-malnutrition groups ($P$= 0.209). Albumin values in the present study (4.7 ± 0.4 mg/dL) were higher than those of the reference group (Table 2).

Table 2 shows the comparison of nutritional serum marker values reported in the literature and those of the present study. There was a significant difference in hemoglobin ($P$=0.039) and in ferritin ($P$=0.016). When the same serum markers were compared with each MNA classification, there were no significant differences (Table 3). However, when the same indicators were compared in relation to sex, there was a significant difference in hemoglobin ($P$=0.039); women had lower values. These values were within established physiological values for the study population.

## Discussion

In the present study, MNA classification identified 55% of older adults as being at risk of malnutrition. These

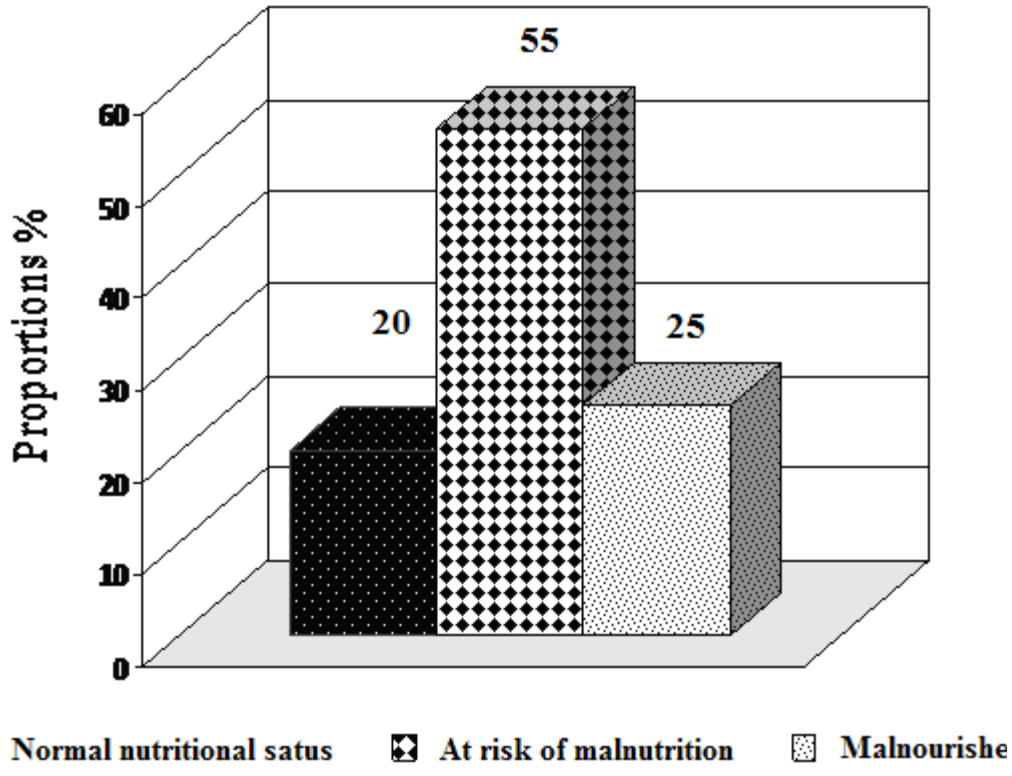


**Figure 1:** Nutritional Status of Older Adults Residing in Eldercare Facilities Determined by MNA

**Table 1:** Demographic Variables of older adults residing in eldercare facilities in Colima, Mexico

| Variables | N (%) |
|---|---|
| Men | 53 (53.0) |
| Woman | 47 (47.0) |
| total | 100 (100) |
| Single | 37 (37.0) |
| Married | 8 (8.0) |
| Widowed | 47 (47.0) |
| Divorced | 8 (8.0) |
| total | 100 (100) |

patients had not begun to lose weight nor had they shown low albumin levels in plasma, but their caloric protein quantity was lower than the recommended quantity. Multidisciplinary geriatric intervention would be necessary for these individuals, and should take into account all possible aspects resulting from proper alimentation and when necessary, promote therapeutic dietary or complementary interventions.

The results of the present study are similar to those reported by Alves de Rezende et al. and Pereida-Machado and Santa Cruz-Coelho [26,27]. Using the same MNA instrument, they classified nutritional status in OAEF in their respective studies as follows: malnourished 8.3% and 15.3%, at risk of malnutrition 45.7% and 55.6%, and normal nutritional status 36% and 29.1%. However, a study carried out by Griep et al (2000) reported different results. Using the MNA on 81 hospital patients, they found that 37% of patients were at risk of malnutrition, 2% were malnourished, and 61% had normal nutritional status [18].

These differences between two American countries and one European country are probably due to various factors, one of which could be a result of the Belgian health system coverage that is described as very good. Another factor could be the difference between populations in regard to lifestyle, alimentation, and environment.

In the present work there was no significant difference between sexes when comparing individuals that had normal nutritional status with subjects that were malnourished, or comparing individuals that had normal nutritional status with persons at risk of malnutrition. These results differed from those reported by Alves de Rezende et al. and Cuervo et al. [26,28]. They reported significant differences between the MNA values obtained in regard to sex in the total population; women had the lowest values in that evaluation. The discrepancy in the results could be explained by the difference between study populations, which underlines the importance of having studies on different populations in order to establish specific recommendations.

In the 80-89 year age group in the present study, the increase in malnutrition was proportional to the increase in age. Malnutrition was proportional to older age when compared with younger groups. This affirmation concurs with that reported by Alves de Rezende et al. and Cuervo et al. [26,28], who also observed that older adult nutritional status was affected in relation to increased age. This is consistent with the observed age-dependent decrease of certain serum variables.

The differences between nutritional serum markers values reported on in the literature, in regard to those found in older adults in the present study, were statistically significant for hemoglobin and ferritin. Once again, this emphasizes the importance of studies on different populations so that specific recommendations can be determined.

In the present study there was no association of serum values of hemoglobin, albumin, and ferritin with each MNA classification (normal nutritional status, at risk of malnutrition, and malnourished). This differed

**Table 2:** Comparison of Reference Serum Indicators vs Study on Older Adults Residing in Eldercare Facilities

| Indicators | Reference * | Study * | P † |
|---|---|---|---|
| Albumin g/dL | 3.4 ± 0.20 | 4.7 ± 0.04 | 0.059 |
| Hemoglobin g/dL | 14.4 ± 0.87 | 13.0 ± 0.15 | 0.039 |
| Ferritin ng/mL | 137.0 ± 25 | 74.2 ± 8.7 | 0.016 |

* Serum markers are shown as mean values ± standard error.
† Calculated with non-paired Student's t test

**Table 3:** Comparison of Reference Serum Indicators Vs Study based on MNA categories in Older Adults Residing in Eldercare Facilities.

| MNA | Serum Indicator (g/dL) (ng/dL) | Reference * | Study * | P † |
|---|---|---|---|---|
| Normal Nutritioal Status | Albumin | 3.4 ± 0.20 | 4.7 ± 0.041 | 0.535 |
| | Hemoglobin | 14.5 ± 0.87 | 13.23 ± 0.15 | |
| | Ferretin | 137.0 ± 25 | 64.9 ± 5.9 | |
| At risk of malnutrition | Albumin | 3.4 ± 0.20 | 4.8 ± 0.042 | 0.797 |
| | Hemoglobin | 14.5 ± 0.87 | 13.10 ± 0.14 | |
| | Ferretin | 137.0 ± 25 | 83.75 ± 10.2 | |
| Malnourished | Albumin | 3.4 ± 0.20 | 4.7 ± 0.044 | 0.484 |
| | Hemoglobin | 14.5 ± 0.87 | 12.92 ± 0.19 | |
| | Ferretin | 137.0 ± 25 | 60.78 ± 6.93 | |

* Serum markers values are shown as mean ± standard error
† Calculated with one-way ANOVA with Scheffé post hoc test.

from the study of Alves de Rezende et al. [26] that reported statistically significant differences between MNA categories and the hematological parameters they analyzed. However, it is worth mentioning that the hematological parameters analyzed in that study were different from those of the present study, coinciding only in hemoglobin. The Rezende study did not contemplate albumin and ferritin. Therefore the present study offers new evidence on serum marker behavior during the aging process.

It is important to point out that when comparing serum marker results with MNA classification, albumin values were above the mean by up to 1.4 g/dL for the three groups. Even when variables that could alter the values of this indicator were controlled, this finding could be explained by the fact that the older adults had presented with hemoconcentration due to dehydration. Abbasi and Rudman (1993) reported a hypoalbuminemia prevalence of 6% (<3.0 g/dL) [29]. In the present study, albumin was >4.0 g/dl. The difference is probably due to the fact that the older adults in the Abbasi study presented with an acute process since they were hospitalized patients.

The malnourished group, and principally women, had the lowest values. The difference between hemoglobin reference values and those of the present study could be related to gastrointestinal changes (decrease in gastric acidity, intrinsic factor reduction, etc.), as well as to changes in diet. Other possible causes of low hemoglobin could be chronic diseases, hemorrhages, kidney failure, and inflammatory problems [30]. An orienting laboratory test would be fecal occult blood. Closely related to this finding was the fact that ferritin

concentrations were far below the mean, regardless of the sex-based factor, and the malnourished group had lower values, with women being more malnourished than men. The characteristic conditions of women during the reproductive stage could be related to the low ferritin and hemoglobin levels [30]. Compared with men, women present with different structural and biochemical changes with a fundamentally hormonal influence. In general, anatomical and functional changes of the older adult lead to a deficiency in micronutrient absorption capacity. These changes are related to a reduction in hormonal levels of testosterone, estradiol, and growth hormone. This causes a reduction in energy output and in this manner paves the way for problems of anorexia in the older adult [31-33], further explaining nutritional problems in this stage of life.

In relation to the above, MNA usefulness in determining nutritional status in the OAEF was confirmed and expanded. If nutritional intervention is deemed necessary it should be based on fulfillment of established objectives after a detailed and comprehensive geriatric evaluation.

## Study Limitations

One of the limitations of the present study was its small sample size (n =100). This could be attributed to the fact that the populations are smaller in the eldercare facilities in which the study was carried out due to their location (Colima, Mexico); the elderly tend to live with their respective families for a longer period of time. Another limitation was the high incidence of verbal and auditory communication problems between the study subjects and the researcher that remained constant throughout the development of the project. It should be mentioned that some of the older adults that met the selection criteria did not give their consent to participate.

Despite the small sample size, we believe our study results accurately represent a reality in which the older adults residing in eldercare facilities live and that it is a common condition in the countries with emerging economies, such as Mexico.

## Conclusions

The nutritional status of OAEF in Mexico presented a prevalence of 55% of individuals at risk of malnutrition. This finding was more frequent in women, and they presented with lower hemoglobin values than men. There was no statistically significant association between serum indicators and each MNA classification in this study population.

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## Conflict of Interest

There is no competing financial interest in relation to the research described. All authors have read and approved the manuscript, and take public responsibility for it.

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