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NUTRITIONAL STATUS AND ITS ASSOCIATION WITH BODY COMPOSITION COMPARTMENTS IN PHYSICALLY INDEPENDENT, ELDERLY MEXICAN SUBJECTS

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Abstract: *Objective:* The aim of this study was to assess nutritional status by combining the mini nutritional assessment (MNA) and body mass index (BMI) and to explore the association between nutritional status categories and body composition compartments. *Design:* This is a cross-sectional study based on a non-randomized sample. *Settings:* Free-living, elderly people residing in community and in shelter homes. *Participants:* 245 physically independent adults over 60 years of age were evaluated. *Measurements:* Nutritional status was assessed by combining the MNA survey and BMI. Body composition was determined by a validated predictive equation. The relation between the categories of nutritional status and body composition, specifically fat mass, was tested by an ANOVA. *Results:* The prevalence of undernutrition on the MNA was 4.9%, and 31% of subjects had risk of undernutrition; while 40% and 32% by BMI were overweight and obese, respectively. The elderly with risk of undernutrition had significantly lower values for body weight, BMI, waist circumference, total body fat, FFM and arm circumference. Fat mass increased or decreased according to the associated nutritional status categories. Subjects with undernutrition according to the MNA had the lowest mean values for fat mass, which were significantly different from those found in elderly subjects classified as well-nourished, and in obese participants. *Conclusions:* This combination of methods allows a better understanding of alterations of nutritional status. The risks of undernutrition, overweight, and obesity were the most frequent problems. Due to its association, the fat mass compartment proved to be an effective means of identifying subjects at risk of undernutrition. Finally, intervention studies designed to improve the nutritional status of the elderly Mexican population are warranted.

Key words: Nutrition status, MNA, BMI, body composition and the elderly.

Introduction

Older people constitute one of the groups most vulnerable to undernutrition due to physiological decline, a high prevalence of chronic diseases, socioeconomic and psychological determinants, and other causes, such as anorexia, cachexia, malabsorption and hypermetabolism (1-3). The prevalence of undernutrition and the risk of this condition as determined by the mini nutritional assessment (MNA) in older adult populations in hospitals, rehabilitation clinics, nursing homes and community is relatively high, at 22.8% and 46.2%, respectively. Also, an effect of these different settings on prevalence has been reported (4). There are many approaches to assessing undernutrition (5-7). The MNA is a highly sensitive, specific and accurate tool for identifying elderly subjects who are at risk of undernutrition, or who already suffer from it (8). Moreover, in a study of an older Danish population (9) this survey was shown to predict morbidity and mortality. However, in sectors with a high prevalence of overweight (20.2%) and obesity (35.5), such as elderly Mexican people (10), the MNA might have limitations for assessing nutritional status.

The body mass index (BMI) is another simple tool used to assess nutritional status; though it has serious limitations for detecting undernutrition (11). Recent research on a diseased population with a broad age range recognized that body composition parameters are more sensitive for detecting undernutrition than BMI and albumin values (12). However, BMI is still used universally to describe obesity in the elderly, despite controversies over its association with mortality in this age group (11). With respect to morbidity, recent findings indicate that the current BMI cut-off points of 25-29.9 and

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≥30 kg/m² for overweight and obesity, respectively, seem appropriate for elderly men due to their association with morbidity (13).

Malnutrition, defined as a state in which a deficiency, excess or imbalance of energy, proteins or other nutrients causes adverse effects on body form, function and clinical outcomes (14), is a frequent, serious health problem among the elderly in developing countries (15, 16). Recently, the coexistence of undernutrition, obesity and vitamin E deficiency was reported in older people in northwest Mexico, together with several metabolic risk factors for cardiovascular disease (15). The suggestion is that relatively high rates of undernutrition may be present in people though their BMI measurements classify them as overweight or obese (16).

It is important to stress the need to maintain good nutritional status in the growing elderly population, as it is an important determinant of health and functional status (17, 18). Few studies have explored the relation between body composition, and undernutrition (12, 19, 20) and overnutrition (12). A study of 41 male volunteers aged 62-to-91 reported that fat-free mass and fat mass were significantly lower in undernourished subjects diagnosed by the MNA than in the eutrophic group (19). A second study found an association between undernutrition and the risk of undernutrition, also assessed by the MNA, with lower body fat mass and lean body mass in patients with chronic obstructive pulmonary disease (20). To our knowledge, no studies of the association between nutritional status categories and body composition compartments in the elderly have been published, so the main objective of this study was to assess the prevalence of alterations in nutritional status by combining the MNA and BMI, and then explore the association between nutritional status and body composition compartments in independent, elderly Mexican men and women subjects.

Methodology

Study design

This is a cross-sectional study that used a convenience sample of free-living and institutionalized elderly men and women. All subjects resided in the Delegación Alvaro Obregón in Mexico City, Mexico. Volunteers underwent a nutritional assessment that included anthropometry, were interviewed, and answered the MNA survey. All the health educators involved were trained to measure standardized anthropometric parameters according to Habitch's procedures (21), and to apply the MNA. All volunteers were informed of the study protocol and signed the appropriate consent forms.

Inclusion and exclusion criteria

The elderly people included in this study spend part of their time in retirement clubs that offer a variety of activities, but normally live in their own homes. Senior citizens living in shelter homes and those who went to appointments in certain public medical centers were also invited to participate. Subjects had to be over 60 years of age for inclusion. Admission was largely independent of health, nutrition and cognitive status, though potential subjects with cognitive impairment or disabilities, and those who reported edema, or kidney, liver or heart failure were excluded. The capacity to respond adequately during the interview was also considered among the eligibility criteria.

Measurements

Anthropometry

Body weight was measured using an electronic floor scale model FG80616 (GmbH & Co, ADE, Hamburg, Germany) with subjects barefoot and lightly-dressed. Standing height was recorded without shoes using an ultrasonic height measuring unit MZ10020 (GmbH & Co, ADE, Hamburg, Germany). Body mass index was calculated by dividing body weight in kilograms by height in meters squared. Mid-upper arm circumference (MUAC) and waist and calf circumferences were measured in cm using a Gulick anthropometric tape measure (Creative Engineering, Plymouth, Mich., USA). Skinfold thickness was measured using a Lange skinfold caliper (Lange, Beta Technology Inc, Cambridge, Maryland). All anthropometric measurements were assessed following the protocol of the International Society for the Advancement of Kinanthropometry (ISAK) (22).

Nutritional status by combination of the mini nutritional assessment and body mass index

The risk of undernutrition, undernutrition and normal nutritional status, was assessed using the MNA questionnaire (8), a tool that classifies elderly subjects in only three groups: undernutrition (score <17), risk of undernutrition (score 17-23.5), and normal nutritional status (score ≥24), while overweight and obesity were assessed by the BMI, using the cut-off points recommended by the WHO (23), and recently associated with morbidity in elderly populations (13).

Body composition

In addition, body composition estimates were obtained by the following equation: Fat mass (kg) = 0.165 * calf skinfold, mm) + (0.355 * biceps skinfold, mm) + (0.521 * body weight, kg) - (6.054 * gender (men = 1, women = 0) - 13,171. This equation was validated against the four-compartment model to estimate fat mass (kg) in Mexican elderly people (24). Fat-free mass (FFM) was obtained by the differences between body weight (kg) and fat mass (kg). Estimates were then used to establish a possible relation between the spectrum of nutritional status categories (undernutrition, risk of undernutrition and normal nutritional status, according to the MNA; and overweight and obesity, according to BMI) with the mean values of fat mass and fat-free mass obtained by the mentioned equation. It is widely recognized that body composition compartments accurately identify patients with low fat-free mass and low, or high, reserves of body fat (12).

Data analysis

The data were analyzed using NCSS software (Number Cruncher Statistical System for Windows 2002, Kaysville, UT, USA). Descriptive statistical analysis was applied, and a two-sample t-test was employed to test for significant differences among the mean values of the anthropometric and body composition compartments between groups. Proportions were assessed using a chi-square test. Associations between the nutritional status categories (undernutrition, risk of undernutrition, and normal nutritional status, according to the MNA; and overweight and obesity by BMI) and the mean values of body composition compartments were tested by a General Linear Model (GLM) ANOVA, using age and sex as covariates; while a Fisher's LSD multiple comparison test was used to make pair-wise comparisons among the means. P-values of < 0.05 were considered statistically significant.

Results

A total of 245 older adults were included in the final analysis. Mean age was 74.8 ± 9.1 years; 33% were men and 67% women. The MNA survey revealed that the prevalence of undernutrition in both groups was 4.9%, and that 31% of the total sample had risk of undernutrition. There was no gender effect on prevalence. MNA scores classified most subjects (63.6%) with a normal nutritional status; though 81% of those elderly men and women scored as overweight or obese on the BMI scale. The BMI results for the total sample showed that 40% and 32% of subjects, respectively, were overweight or obese. The prevalence of overweight plus obese subjects was statistically higher in women (72%) than men (28%) ($p<0.01$).

Table 1 shows some of the anthropometric and body composition variables and alterations of nutritional status according to place of residence. The mean values of body weight, fat mass, FFM and the mid-upper arm circumference were significantly higher in men who live in their own homes. There were no significant differences in the prevalence of undernutrition and risk of undernutrition, taken together, or of obesity. Women who live in their own homes had significantly higher values for height, FFM and arm circumference, as well as for some indicators of adiposity; i.e., body weight, BMI, waist circumference, triceps skinfold, and fat mass ($p<0.05$). Also, the prevalence of overweight and obese subjects together was significantly higher among free-living women.

As mentioned above, and shown in Table 1, the prevalence of risk of undernutrition was high for both men and women, regardless of place of residence. Table 2 shows that the elderly subjects with nutritional risk had significantly lower values for body weight, BMI, waist circumference, total body fat, FFM and arm circumference, compared to those who were not at risk of undernutrition. Calf circumference values were lower in both men and women with nutritional risk, but were only significant for the group of elderly men.

With respect to the relation between nutritional status, using the combination of the MNA and BMI categories, and body composition compartments, results show that the mean values for fat mass increase or decrease according to the corresponding nutritional status categories. The main finding was that subjects who scored as undernutrition on the MNA had the lowest mean values of fat mass, and that those values were significantly different from the scores for both elderly subjects who were classified as with a normal nutritional status and with obesity. The same results were observed with respect to body weight. Finally, the mean values of fat mass, FFM and body weight in the obese were the highest, and statistically different from those of elderly subjects classified as overweight, well-nourished, at risk of undernutrition, and undernourished. Table 3 shows the results adjusted for age and gender.

Discussion

To the best of our knowledge, this is the first cross-sectional study to investigate the prevalence of alterations of nutritional status by combining the MNA and BMI scales, and to explore the association between the nutritional status categories as determined by the combination of the MNA and BMI with body composition compartments using free- and assisted-living, independent, elderly people from Mexico City, while also considering the effect of place of residence on nutritional status.

Table 1
Anthropometry, body composition and nutritional status in men and women older than 60 years of age according to place of residence

Variables	Men		Women	
	Shelter homes	Free-living	Shelter homes	Free-living
Weight, kg	63,0±14,3	69,6±12,5*	58,6±16,2	66,1±12,3**
Height, cm	159,0±9,2	161,7±7,6	144,0±8,7	147,7±6,1**
BMI, kg/m^2	24,8±4,7	26,4±3,5	28,1±6,7	30,2±5,6*
Waist, cm	89,3±10,5	91,6±9,4	84,8±9,9	90,8±14,1**
TSF, mm	12,6±7,3	12,6±6,0	16,9±8,9	21,5±7,7**
Fat mass, kg	17,5±8,6	21,6±8,5*	23,7±10,9	28,3±8,6**
FFM, kg	45,5±5,9	47,9±5,0*	34,8±6,9	37,7±5,3**
MUAC, cm	25,8±3,9	28,0±2,7**	26,8±5,7	29,1±3,9**
Calf circumference, cm	32,9±11,1	34,5±3,8	32,0±9,2	33,9±4,4
Undernourished and risk of undernutrition, %	19.5	14.6	16.7	21.1
Overweight and Obesity, %	25.6	35.3	24.8	53.4**

BMI= Body mass index; TSF= Triceps skinfold; FFM= Fat-free mass; MUAC= Mid-upper arm circumference.*p<0.05;**p<0.01

Table 2
Individual indicators of nutritional status in older men and women subjects

Variables	Men		Women	
	Without Risk of Undernutrition	With Risk of Undernutrition	Without Risk of Undernutrition	With Risk of Undernutrition
Weight, kg	70,6±12,3	58,7±13,0**	66,3±13,4	57,7±14,3**
BMI, kg/m^2	26,7±3,7	23,7±4,3**	30,6±6,0	27,3±5,8**
Waist, cm	92,4±9,7	86,9±9,5*	91,5±13,6	83,5±9,8**
TSF, mm	12,3±5,6	13,2±8,1	20,3±8,5	18,7±8,3
MUAC, cm	27,8±3,2	25,4±3,4**	29,3±4,5	26,3±4,6**
Calf circumference, cm	35,2±9,2	31,1±3,5*	33,9±7,5	31,9±5,0
Fat mass, kg	22,0±8,2	15,2±7,9**	28,1±9,3	23,7±9,9**
FFM, kg	48,5±4,6	43,4±5,8**	38,1±5,5	34,0±6,2**

BMI= Body mass index; TSF= Triceps skinfold; FFM= Fat-free mass; MUAC= Mid-upper arm circumference. *p<0.05;**p<0.01

Table 3
Relationship between nutritional status and body composition*

Nutritional status	Fat mass kg	FFM kg	Body weight kg
Undernutrition	15.8±1.9^{c,d,e}	35.2±1.3^{d,e}	51.0±2.8^{c,d,e}
Risk of undernutrition	17.6±1.3^{c,d,e}	37.2±0.9^{d,e}	54.9±1.8^{c,d,e}
Normal Nutritional Status	22.8±0.7^{a,b,e}	38.1±0.5^{d,e}	61.0±1.3^{a,b,e}
Overweight	23.4±0.8^{a,b,e}	40.3±0.5^{a,b,c,d}	63.8±1.2^{a,b,e}
Obesity	32.0±0.8^{a,b,c,d}	44.6±0.6^{a,b,c,d}	76.7±1.2^{a,b,c,d}

*Data presented are adjusted means ± standard error; significant differences are depicted by different letters by category in each column (p<0.05); FFM= Fat-free mass. a. Undernutrition; b. Risk of undernutrition; c. Normal Nutritional Status; d. Overweight; e. Obesity

First, a high rate of risk of undernutrition in this non-randomized, cross-sectional study was found, as 31% of these elderly men and women fell into this category, according to the MNA. This rate is similar to the reported of 31.8% in free-living elderly people from Mexico City using the same survey (25); though, both are lower than the prevalence of risk of undernutrition determined by the MNA among elderly people in northeast Mexico (50.5%) (26). The authors of the latter study found no effect of gender on prevalence. Our study found no effect of place of residence on the prevalence of the risk of undernutrition as, regardless of place of residence, the risk of undernutrition was relatively high. As expected, most of the anthropometric variables for this group scored significantly lower compared to the parameters for the group of elderly men and women that were not at risk (Table 2). Also, the body composition compartments were lower in the subjects at risk of undernutrition. The prevalence of undernutrition according to the MNA was low (4.9%); indeed quite close to that reported previously for elderly people living in community, which was 5.8% based on the same questionnaire (4).

In general, these two earlier studies in Mexico (25, 26) and our results all indicate the need to consider specific socioeconomic, psychological and health determinants of the risk of undernutrition in order to implement effective interventions designed to reverse this tendency and prevent undernutrition. Such interventions must receive high priority because of the elevated prevalence of overweight and obese individuals found in this study. It is also important to take into account that undernutrition and obesity are strongly associated with physical disability among the elderly (13, 27). Finally, interventions must be gender specific, since elderly women were more susceptible to obesity than men (Table 1), and this condition was significantly higher among free-living, elderly women than those in assisted-living situations.

The results of this study establish the need to combine MNA with other methods in order to more accurately diagnose overweight and obese conditions, because the majority of the elderly people classified as a normal nutritional status by the MNA scored as overweight or obese on the BMI; thus, the former measurement alone may mask serious nutritional problems in the elderly. However, by combining the MNA, to categorize undernutrition, risk of undernutrition and subjects with normal nutritional status, and the BMI, to classify overweight and obesity, this study was able to identify a significant association between fat mass and body weight in the study sample. Our results indicate that values of fat mass and body weight ≤15.8 kg and ≤51.0 kg, respectively, can be indirect markers of undernutrition.

The strengths of this study are that nutritional status, particularly undernutrition and risk of undernutrition, were assessed by the MNA, a scale with a sensitivity of 96% and a specificity of 98% in detecting the risk of undernutrition among the elderly (28, 29). Also, assessments of body composition were determined by a predictive anthropometric equation developed and validated with the four-compartment model as a reference method in a sample of Mexican elderly men and women. However, the use of a non-random sample in a non-population-based study, and the fact that specific demographic determinants of the risk of undernutrition were not assessed do limit the possibility of generalizing the results of the present study. Also, we are aware that the association between nutritional status and body composition compartments reported herein could be underestimated due to the study's cross-sectional design and the number of subjects included.

Conclusions

Malnutrition, especially the risk of undernutrition and overweight and obesity, is a frequent and serious problem for the elderly Mexican subjects studied. Most of the men and women classified as a normal nutritional status by the MNA were actually overweight or obese. The combination of methods used to assess their nutritional status assures a better understanding of the alterations in nutritional status in elderly populations at a higher risk of suffering excess weight. The inclusion of body composition assessment appears to be a good option for identifying elderly subjects who are at risk of undernutrition, those with a normal nutritional status, and those who are prone to obesity. Intervention studies designed to improve the nutritional status of the elderly Mexican population are clearly warranted.

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References

1. Enzi G, Sergi G, Coin A, Inelmen EM, Busetto L, Pisent C, Peruzza S. Clinical aspects of malnutrition. J Nutr Health Aging 2001;5:284-7.
2. Morrone A, Donini LM, Scardella P et al. Malnutrition in the elderly: clinical features, psychological and social determinants. Preliminary results. Ann Ig 2011;23:161-72.
3. Morley JE. Undernutrition in older adults. Fam Pract 2012;29:i89-i93.
4. Kaiser MJ, Bauer JM, Rämsch C et al. Frequency of malnutrition in older adults: a multinational perspective using the mini nutritional assessment. J Am Geriatr Soc 2010;58:1734-8.
5. Omran ML, Morley JE. Assessment of protein energy malnutrition in older persons, part I: History, examination, body composition, and screening tools. Nutrition 2000;16:50-63.
6. Omran ML, Morley JE. Assessment of protein energy malnutrition in older persons, Part II: Laboratory evaluation. Nutrition 2000;16:131-40.
7. Vellas B, Lauque S, Andrieu S, Nourhashemi F, Rolland Y, Baumgartner R, Garry P. Nutrition assessment in the elderly. Curr Opin Clin Nutr Metab Care 2001;4:5-8.
8. Guigoz Y. The Mini Nutritional Assessment (MNA) review of the literature--What does it tell us? J Nutr Health Aging 2006;10:466-85.
9. Beck AM, Ovesen L, Osler M. The 'Mini Nutritional Assessment' (MNA) and the 'Determine Your Nutritional Health' Checklist (NSI Checklist) as predictors of morbidity and mortality in an elderly Danish population. Br J Nutr 1999;81:31-6.
10. Shamah-Levy T, Cuevas-Nasu L, Mundo-Rosas V, Morales-Ruán C, Cervantes-Turrubiates L, Villalpando-Hernández S. Estado de salud y nutrición de los adultos mayores en México: resultados de una encuesta probabilística nacional. Salud Publica Mex 2008;50:383-9.
11. Cook Z, Kirk S, Lawrenson S, Sandford S. Use of BMI in the assessment of undernutrition in older subjects: reflecting on practice. Proc Nutr Soc 2005;64:313-7.
12. Kyle UG, Pirlich M, Schuetz T, Luebke HJ, Lochs H, Pichard C. Prevalence of malnutrition in 1760 patients at hospital admission: a controlled population study of body composition. Clin Nutr 2003;22:473-81.
13. Goya Wannamethee S, Gerald Shaper A, Whincup PH, Walker M. Overweight and obesity and the burden of disease and disability in elderly men. Int J Obes Relat Metab Disord 2004;28:1374-82.
14. Elia M. Detection and management of undernutrition in the community. A report by The Malnutrition Advisory Group (A standing committee of The British Association for Parenteral and Enteral Nutrition). Maidenhead, BAPEN 2000.
15. Alemán-Mateo H, Esparza-Romero J, Romero RU, García HA, Pérez Flores FA, Ochoa Chacón BV, Valencia ME. Prevalence of malnutrition and associated metabolic risk factors for cardiovascular disease in older adults from Northwest Mexico. Arch Gerontol Geriatr 2008;46:375-85.
16. Bahat G, Tufan F, Saka B, Akin S, Ozkaya H, Yucel N, Erten N, Karan MA. Which body mass index (BMI) is better in the elderly for functional status? Arch Gerontol Geriatr 2012; 54:78-81.
17. Gary R, Fleury J (2002) Nutritional status: key to preventing functional decline in hospitalized older adults. Top Ger Rehab 2002;17:40-71.
18. Oliveira MR, Fogaça KC, Leandro-Merhi VA. Nutritional status and functional capacity of hospitalized elderly. Nutr J 8:54.
19. Vilaça KH, Paula FJ, Ferriolli E, Lima NK, Marchini JS, Moriguti JC. Body composition assessment of undernourished older subjects by dual-energy x-ray absorptiometry and bioelectric impedance analysis. J Nutr Health Aging 2011;15:439-43.
20. Benedik B, Farkas J, Kosnik M, Kadivec S, Lainscak M. Mini nutritional assessment, body composition, and hospitalisations in patients with chronic obstructive pulmonary disease. Respir Med 2011;105:S38-43.
21. Habicht JP. Estandarización de métodos epidemiológicos cuantitativos sobre el terreno. Bol Oficina Sanit Panam 1974;76:375-84.
22. Norton K, Olds T. Anthropometrica. Sydney: University of New South Wales Press 1996.
23. WHO. Obesity: Preventing and Managing the Global Epidemic: Report of the WHO Consultation of Obesity. Geneva: World Health Organisation 1997.
24. Huerta Huerta Raquel, Esparza-Romero Julián, Urquidez Rene, Pacheco BI, Valencia ME, Alemán-Mateo H. Validity of an equation based on anthropometry to estimate body fat in older adults. Arch Latinoam Nutr 2007;57:357-65.
25. Franco-Alvarez N, Avila-Funes JA, Ruiz-Arreguí L, Gutiérrez-Robledo LM. Determinants of malnutrition risk among the older adult community: a secondary analysis of the Health, Wellbeing, and Aging Study (SABE) in Mexico. Rev Panam Salud Publica 2007;22:369-75.
26. Rodríguez-Tadeo A, Wall-Medrano A, Gaytan-Vidaña ME, Campos A, Ornelas-Contreras M, Novelo-Huerta HI. Malnutrition risk factors among the elderly from the US-Mexico border: the "one thousand" study. J Nutr Health Aging 2012;16:426-31.
27. Lee LC, Tsai AC. Mini-Nutritional-Assessment (MNA) without body mass index (BMI) predicts functional disability in elderly Taiwanese. Arch Gerontol Geriatr 2012;54:e405-10.
28. Guigoz Y, Vellas B, Garry PJ. Assessing the nutritional status of the elderly: The Mini Nutritional Assessment as part of the geriatric evaluation. Nutr Rev 1996;54(1 Pt 2):S59-65.
29. Vellas B, Guigoz Y, Garry PJ, Nourhashemi F, Bennahum D, Lauque S, Albarede JL. The Mini Nutritional Assessment (MNA) and its use in grading the nutritional state of elderly patients. Nutrition 1999;15:116-22.