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USE OF THE MINI NUTRITIONAL ASSESSMENT TOOL IN ELDERLY PEOPLE FROM LONG-TERM INSTITUTIONS OF SOUTHEAST OF BRAZIL

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Abstract: *Background:* the Mini Nutritional Assessment (MNA) is a multidimensional method of nutritional evaluation that allows the diagnosis of malnutrition and risk of malnutrition in elderly people, it is important to mention that this method has not been well studied in Brazil. *Objective:* to verify the use of the MNA in elderly people that has been living in long term institutions for elderly people. *Design:* transversal study. *Participants:* 89 people (≥ 60 years), being 64.0% men. The average of age for both genders was 73.7±9.1 years old, being 72.8±8.9 years old for men, and 75.3±9.3 years old for women. *Setting:* long-term institutions for elderly people located in the Southeast of Brazil. *Methods:* it was calculated the sensibility, specificity, and positive and negative predictive values. It was data to set up a ROC curve to verify the accuracy of the MNA. The variable used as a "standard" for the nutritional diagnosis of the elderly people was the corrected arm muscle area because it is able to provide information or an estimative of the muscle reserve of a person being considered a good indicator of malnutrition in elderly people. *Results:* the sensibility was 84.0%, the specificity was 36.0%, the positive predictive value was 77.0%, and the negative predictive value was 47.0%; the area of the ROC curve was 0.71 (71.0%). *Conclusion:* the MNA method has showed accuracy, and sensibility when dealing with the diagnosis of malnutrition and risk of malnutrition in institutionalized elderly groups of the Southeastern region of Brazil, however, it presented a low specificity.

Key words: Mini Nutritional Assessment, elderly people, nutritional status, malnutrition.

Introduction

The institutionalized elderly people are characterized by the increase of their fragility and vulnerability state. The main factors regarding a malnutrition status, in such age, are: their severe incapability and dependency, the use of multiple medicaments, the frequency of their infection related problems, the development of pressure sores and the institutionalized environment where they live (1).

The most important nutritional disturbance that was noticed in such group was the malnutrition, and it could be associated to their high morbity and mortality rates (2). The malnutrition prevalence in Brazil regarding the elderly in dwelling community is around 10.0% (3), in hospitals, 27.0% (4), and in long-term institutions, 50.0% (5). In developed countries this numbers are between 1.0 and 7.0% in dwelling community; between 22.0 and 59.0% in hospitals; between 10.0 and 85.0% in long-term institutions (6). Based on such information, the great majority of malnutrition prevalence, in developed and developing countries, are found in institutionalized elderly people, that lack of the appropriate health care and support. (5, 7-9).

The malnutrition status presents a great variation in elderly people from different places, and it depends mostly on: the environment where the elderly person is, the methods and the techniques used to evaluate their nutritional status, and the standards that were applied (2).

The scientific efforts to find out a reliable method regarding the nutritional analysis and the diagnosis of elderly people is considerable, and the anthropometry has been the method used by the researchers to evaluate their nutritional status. Landi et al. (10), have presented the association of the body mass index (BMI) to mortality in elderly people. However, the BMI presents limitations to identify malnutrition, since it does not allow the evaluation of body composition, making the malnutrition diagnosis a difficult task. Moreover is quite common in elderly groups, some diseases that can cause edemas and other physical disabilities leading them to bedridden situations or put them in wheels chairs, fact that can jeopardize the weight and height measurements according to what is established memorandum of understanding, necessary to BMI calculation. In such cases, an estimated is taken using math equations that could help to provide a suitable data (11).

The protein reserves indicators, such as the corrected arm muscle area (AMAc), are better considered for the protein malnutrition estimative. However, as in other anthropometrics variables, it does not allow the identification of risk factors that can lead to malnutrition (3).

It is important to mention that the Mini Nutritional Assessment (MNA) is a suitable method that could identify the malnutrition risk factors and can overcome such difficulties found by the health professionals, in special the nutritionists. Such assessment was developed for the malnutrition and malnutrition risk diagnosis when dealing with elderly people, even if they were institutionalized or not, allowing the identification of main causes and early approaches. (6, 12-14). And it assessment has been recommended for the evaluation and accompaniment nutritional of this population (16, 17).

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The MNA contains 18 questions, along 4 sections and it is based on a anthropometric evaluation (BMI, arm and calf circumferences and weight loss during a specific period of time), global evaluation (housing, medicament consumption, acute illnesses presence, neurological disturbances, pressure sores, and mobility degree), diet evaluation (amount of daily meals, food consumption, liquid daily ingestion and autonomy to feed), and a subjective evaluation (their self-perception of their health and nutritional condition) (6).

The MNA has been used to evaluate about 10.000 elderly people in many different places (home residents, institutionalized or hospital patients) and in many countries (Belgium, Demark, France, Greece, Ireland, Israel, Italy, Poland, Spain, Sweden, Switzerland, United Kingdom, United States) (14). And it has been studied the performance of its diagnosis through the analysis of its sensibility and specificity (18-20).

It has been found in Brazil just one research that analyzed the MNA, however, its application in the elderly people in a local community (21).

This research is the first study developed to verify the MNA accuracy in institutionalized elderly people regarding their nutritional diagnosis.

Methods

It is a transversal study, developed in all the institutionalized elderly people of a specific city located at the Southeast of Brazil, in 2004.

It is important to mention that the southeast region of Brazil includes 4 important Brazilian States (São Paulo, Rio de Janeiro, Minas Gerais and Espírito Santo) and is considered an economic polar region of great migration and the most populated area, representing 42.6% of the national population. And it has the biggest ratio of elderly people of country (46.3%) (22).

The elderly people ratio of the studied city is according to the Southeast and Brazil ratio (Table 1).

Table 1
Distribution of the elderly people and the total population. Brazil, 2001

	Elderly people population (≥ 60 years old)	Total population
Brazil	14.721.832 (8.5%)	172.385.776
Southeast - Brazil	6.818.767 (9.3%)	73.470.738
Studied City	10.500 (10.0%)	105.000

Source: IBGE/population counting and preliminary demographic projections. 2001.

The studied population was composed of 89 elderly people (≥ 60 years old) – from 94 residents in long term institutions -, of both genders (64.0% men), with an average age of 73.7±9.1 years old (72.8±8.9 years old for men and 75.3±9.3 years old for women).

The main reasons for exclusion were: refusal (3 elderly people), hospital internment (1 elderly person), and terminal stage (1 elderly person).

This research was approved by the Committee of Ethics in Research of the College of Public Health of the University of São Paulo, Brazil.

The nutritional diagnosis was identified by means of Shorts Mini Nutritional Assessment (23), translated in Brazil as "Mini Avaliação Nutricional" (Nestlè Nutrition Services), and by the corrected arm muscle area (AMAc) (24), that used it as a standard. The AMA used formulas were proposed by Heymsfield et al. (24), according to the respective gender:

$$\text{Men: } \frac{[AC^{*}\ (cm) - \pi\ TST^{**}\ (cm)]^2\ - 10}{4\pi}$$

$$\text{Women: } \frac{[AC^{*}\ (cm) - \pi\ TST^{**}\ (cm)]^2\ - 6{,}5}{4\pi}$$

*AC: arm circunference
**TST: triceps skinfold thickness

The MNA contains 18 questions that can lead to 30 points. It is divided in two phases; having been the first one named screening and the second one evaluation, respectively (23).

The elderly people were diagnosis and classified as malnutrition when the MNA results were below the number of 17, at risk of undernutrition, between 16 and 24, and non malnutrition, above 23.5 points. So that the main goal of this research was reached, the global evaluation was carried through in all the aged groups, independently of the screening results.

It was adopted the described values for Barbosa et al. (25) as reference regarding the AMAc nutritional diagnosis. Such not institutionalized elderly group were from São Paulo, located in the Southeastern region of Brazil, at located at 180 km from this studied was developed. These values have been used as reference for the nutritional evaluation of institutionalized elderly people, since we don't have specific values for such population.

The AMAc reference values are distributed in percentiles (5, 10, 25, 50, 75, 90 and 95) and presented according to each gender (25). The following criteria were adopted when dealing with the determination of the nutritional state of the elderly people:

- malnutrition = AMAc < P5, according to AMAc < 27,33 cm^2 to women and AMAc < 32,30 cm^2 to men;
- risk of malnutrition = P5 ≤ AMAc < P25, according to 27,33 cm^2 ≤ AMAc < 34,77 cm^2 to women and 32,30 cm^2 ≤ AMAc < 42,25 cm^2 to men;
- non malnutrition = AMAc ≥ P25, according to AMAc ≥ 34,77 cm^2 to women and AMAc ≥ 42,25 cm^2 to men.

The arm circumference (AC) and the triciptal skinfold thickness (TST) were measured for the calculation of the AMAc, both in body right side, using non-elastic ribbon and the LANGE compass (constant pressure of 10g/mm2), respectively. The AC was carried in accordance with Callaway et al. (26) standardization and the TST, according to Harrison et al. (27) standardization. The measurements were taken three times and the average of each of them was used for analysis.

The sensibility and specificity were calculated and their relationship was verified by the ROC curve - Receiver Operating Characteristics. The area below the curve shows the test accuracy. It was developed the calculations of the positive and negative predictive values.

For a suitable analysis of the sensibility and specificity of the MNA, it was considered two groups of individuals according to their nutritional status, that are malnutrition and no malnutrition; the elderly group that was with risk of malnutrition was put together with the malnutrition group, following the same way applied by Christensson et al. (20).

The information was organized using the Microsoft Office Excel 7.0 and the statistic information was gathered using the Epi Info 6.04 and Origin.

Results

According to the MNA nutritional status assessment, there were diagnosed 25 (28.1%) malnutrition elderly people, 45 (50.6%) with risk of malnutrition and 19 (21.3%) no malnutrition for both genders (Table 2).

Table 2
Distribution of the elderly group studied, according to the nutritional diagnostic and evaluation methods. Brazil, 2004

MNA	AMAc			
	Malnutrition	Risk of malnutrition	No malnutrition	Total
Malnutrition	16	6	3	25
Risk of malnutrition	13	19	13	45
No malnutrition	5	5	9	19
Total	34	30	25	89

According to the AMAc, there were diagnosed 34 (38.2%) malnutrition elderly people, 30 (33.7%) with risk of malnutrition and 25 (28.1%) no malnutrition for both genders (Table 2).

It is verified that the MAN have diagnosed less cases of malnutrition and no malnutrition (28.1% and 21.3%, respectively) among the elderly ones when compared with the AMAc (38.2% and 28.1%, respectively), however, more cases of malnutrition risk (50.6%) were identified by the MAN.

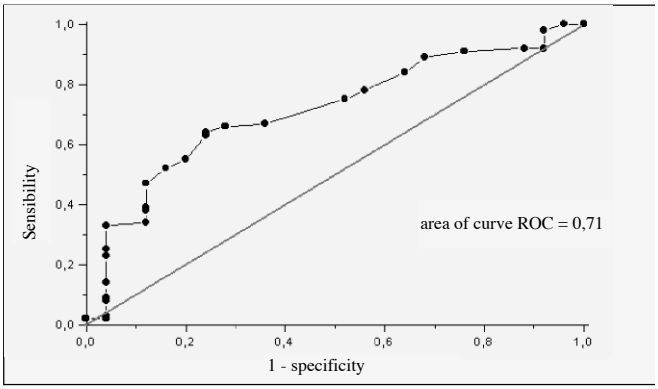
Putting together the elderly people with the risk of malnutrition and the malnutrition ones, according to the MNA and the AMAc (Table 3), we had the following results: sensibility 0.84 (84.0%), specificity 0.36 (36.0%), positive predictive value 0.77 (77.0%) and negative predictive value 0.47 (47.0%).

Table 3
Distribution of the elderly group studied, according to the nutritional diagnostic and evaluation methods. Brazil, 2004

MNA	AMAc		
	Malnutrition	No malnutrition	Total
Malnutrition	54	16	70
No malnutrition	10	9	19
Total	64	25	89

The accuracy of the test was 0.71 (71.0%), as shown in the ROC curve below area (Figure 1).

Figure 1
ROC curve of MNA. Brazil, 2004.



Discussion

Many authors have been analyzed the sensibility and specificity of the MNA in several different areas, adopting different methods as standard, since there are not a consensus in which it is the best method to be applied when dealing with nutritional diagnosis of the elderly people (6, 5, 18-21, 23).

The majority of the studies that have dealt with a method of nutritional evaluation, like the MAN, have been using biochemical examinations or a set of methods in association, such as the anthropometrics, biochemical, clinic and dietary ones, as a comparison. However, it has been searched for a fattest method, not invasive, low cost and more efficient when dealing with the nutritional evaluation of elderly people and based on the main features of each group respectively and their aging process and health conditions mainly in developing countries.

The anthropometry has played an important role, since it is simple and not invasive having a low cost when compared with other methods (biochemical, DXA, magnetic resonance,

computerized tomography). It is a reliable method for the diagnosis of the nutritional condition in the clinical and research areas.

The corrected arm muscle area (AMAc) is a index able to provide information or an estimative of the muscle reserve of a person being considered a good indicator of malnutrition in elderly people (25, 11, 29-30). It is important to mention that the institutionalized elderly people have presented a highly level of physical incapacity, differing of the BMI and such fact does not interfere during the settings of the AC and TST measurements, that are necessary for the AMAc calculation.

The corrected or not AMA has been the most anthropometric variable used for the elderly people when dealing with nutritional evaluations, more often than the body weight and the biochemical variables, and could be applied as a forecast for the mortality or morbidity levels (24, 29, 32, 33).

The SABE Study - Health, Well-being and Aging, of multicentric character, applied in 7 Latin America Capitals and the Caribbean, was co-ordinated by the Pan-American Health Organization, and it had as an objective the evaluation of life and health conditions of an aged population, and it has presented AMAc values, that could be used as a nutritional evaluation parameter, according to the study of Barbosa et al. (25).

The use of simplest methods, such as the AMAc, as a substitute for most complex methods, when performing nutritional diagnosis, is made based on the assumption that it can provide a wrong outcome. And such risk could be justified by the safety and convenience of such methods as a whole (28).

It was developed a training regarding to the measurements before the data collection to guarantee the right anthropometric variables by the researcher. And if was specified as reference values for AMAc, the available data that was gathered in a population that has the most nearly features from the ones here studied (25).

When analyzing the comparison between the MNA and the AMAc, it was verified a sensibility of 84.0%, a specificity of 33.0%, a positive predictive value of 77.0%, and negative predictive value of 47.0%.

The malnutrition is often found and more prevalent in elderly people of long term institutions when compared with the hospitalized and the ones that lived in houses, therefore it was verified a positive predictive value higher (77.0%) than negative predictive value (47.0%) (4, 5, 6, 7, 8, 34, 35).

Researches that validated the MNA, set in France and in the United States with more than 600 elderly (12) used as a reference clinical, biochemical, anthropometric and dietetic methods, showing higher results for the sensibility (96.0%) and specificity (98.0%), when compared with the information that can be found in this study. Such results can be justified by the fact that the MNA cut off point was set for Europeans and not for the Brazilian elderly people, since they have different features and because of that they could need different MNA cut offs, that could provide a reliable nutritional status of the population and therefore provide a more specific and sensible method.

Another research was done using the same population of the previous study. It has adopted as a reference method only the clinical evaluation, and it has found similar results for sensibility and specificity (36), leading to the same analysis according to the results of this study. However, this result allows the suggestion that other nutritional evaluation methods, that it is not the biochemist method, could also be used as a parameter allowing high values of sensibility and specificity when they are analyzed facing the MNA results.

The researchers that analyzed the sensibility and the specificity of the MNA in Brazil, in a group of elderly people living in a local community, using as a reference the anthropometric, biochemical and dietetic assessments, found higher results (100.0% e 74.0%, respectively) (21). When they analyzed the sensibility and specificity of the same group, comparing with the nutritional diagnoses from the BMI and the seric levels of albumin, they verified a sensibility of 38.0%, lower than the one that was found in this study (84.0%), and the specificity of 73.0%, that is higher that the one found here (36.0%). Since there is a possibility that the fact that the BMI is not a good undernutrition indicator and undernutrition risk in elderly people, has contributed for such outcome. The same condition was verified in European elderly people studies that were living in the community, and over there it was found even lower values for the sensibility when using the BMI (12.0%) and the weight loss (8.0%) as a standard (18).

In the institutionalized elderly people from Sweden, Christensson et al. (20), it was found higher results for the sensibility (96.0%) and lower for the specificity (26.0%), when using as standards the anthropometric and biochemical methods. The same analysis is made for institutionalized elderly people from Italy, where it was verified a sensibility of 98.0% and a specificity of 16.0% 18.

In elderly people hospitalized in England, Murphy et al. (19) verified a lower sensibility when compared with this study, and when it was used biochemical (27.0%) and dietetic methods (57.0%) as standards, it was observed higher results for the specificity (biochemistry, 66.0% and dietetic, 94.0%). However, these authors put together the elderly group with risk of malnutrition with the no malnutrition, and not with the malnutrition group as it happened in this study.

Even though a method presents a maximum accuracy, or a good discriminatory level, when its sensibility and specificity are nearly 1.0, there are situations when a method could be more sensible than specific (28), as it happened in this study. And based on such information it is better that the MNA is more sensible to diagnose in a right way the malnutrition and with risk of malnutrition in the elderly people, to provide a suitable intervention, avoiding complications or risk of death.

Based on that the MNA must have a high sensibility to avoid the possibility of diagnosing malnutrition or risk of

malnutrition as no malnutrition as it has showed this study. When a method with a low specificity is used, it is important that the population shows the analyzed disease, however many false-positive diagnoses could happen . As the malnutrition is very common in institutionalized elderly people (10), the above statement justifies the reduced specificity of the MNA in this study. So, it is important that this method presents a very high sensibility (28).

The ROC curve has provided an estimative of all the efficiency regarding the method (38). It was verified that the area that is below the ROC curve was 0.71, and the MAN accuracy was 71.0%, that was much alike the ones that were found in the institutionalized elderly people from Sweden (74.4%). The great majority of the of the published studies about this subject have showed sensibility and specificity results, but few have presented accuracy values for a proper comparison.

It was concluded that the MNA had a good accuracy and it was sensible when dealing with the diagnosis of malnutrition and the risk of malnutrition of the elderly people, however it had a low specificity. Probably the settings of the malnutrition and the risk of malnutrition together was the cause of the low specificity of the MNA.

It was considered as a possible limitation of this study the low number of the people here studied, and it is recommended the settings of another tests in long-term institutions using a higher number of elderly people.

References

1. White JV. Risck factors for poor nutritional status. Primary Care 1994; 21 (1): 19-31.
2. Morley JE. Protein-energy malnutrition in older subjects. Proc Nutr Soc 1998; 57: 587-592.
3. Shintaku RCO. Estado nutricional de idosos internados em um hospital público geral do Estado de São Paulo. São Paulo; 2003. [Dissertação de Mestrado – Faculdade de Saúde Pública – Universidade de São Paulo].
4. Menezes TN. Avaliação antropométrica e do consumo alimentar de idosos residentes em instituições geriátricas da cidade de Fortaleza – Ceará. São Paulo; 2000. [Dissertação de Mestrado – Faculdade de Saúde Pública – Universidade de São Paulo].
5. Kerstetter HH. Malnutrition in the institutionalized older adult. J Am Diet Assoc 1992; 92: 1109-16.
6. Guigoz Y, Vellas BJ, Garry PJ. Assessing the nutritional status of the elderly: the Mini Nutritional Assessment as part of the geriatric evaluation. Nutr Rev 1996; 54(1): (II)S59-S65.
7. Roubenoff R, Giacoppe J, Richardson SH, Hoffman P. Nutrition assessment in long-term care facilities. Nutr Rev 1996; 54(1): (II)S40- S42.
8. Charles RP. Nutrition assessment methods for the older Irish adult in the clinical and community settings. Proc Nutr Soc 1998; 57: 599-602.
9. Wilson MMG, Vaswani S, Lui D, Morley JE, Miller DK. Prevalence and causes of undernutrition in out patients. J Medicine 1998; 104: 56-63.
10. Landi F, Zucalla G, Gambassi G, Incalzi RA, Manigrasso L, Pagano F, Carbonin PU, Bernabei R. Body mass index and mortality among older people living in the community. J Am Geriatr Soc 1999; 47: 1072-1076.
11. Cervi A, Franceschini SCC, Priori SE. Análise crítica do uso do índice de massa corporal para idosos. Rev Nutr 2005; 18 (6): 765-775.
12. Guigoz Y, Vellas BJ, Garry PJ. Mini Nutritional Assessment: a practical assessment tool for grading the nutritional state of elderly patients. Facts Research in Gerontology 1994; 4 (suppl 2): 15-59.
13. Söderhamn U and Söderhamn O. Reliability and validity of the nutritional form for the elderly (NUFFE). J Adv Nur 2002; 37(1): 28-34.
14. Guigoz Y, Lauque S, Vellas BJ. Identifying the elderly at risk for malnutrition the Mini Nutritional Assessment. Clin Geriatr Med 2002; 18: 737-757.
15. de Groot LCPGM, Beck AM, Schroll M, van Staveren WA. Evaluating the DETERMINE Your Nutritional Health Checklist and the Mini Nutritional Assessment as tools to identify nutritional problems in elderly Europeans. Eur J Clin Nutr 1998; 52: 877-883.
16. Thomas DR, Zdrowski CD, Wilson MM, Conright KC, Lewis C, Tariq S et al. Malnutrition in subacute care. Am J Clin Nutr 2002; 75: 308-313.
17. Garry PJ and Vellas BJ. Practical and validated use of the Mini Nutritional Assessment in geriatric evaluation. Nutr Clin Care 1999; 2 (3): 146-154.
18. Donini LM, de Felice MR, Tagliaccica A, Palazzotto A, Bernardini L, Cannella C. Valeur prédictive du Mini Nutritional Assessment en Long Séjour Gériatrique. Age & Nutrition 2000; 11(1): 3-11.
19. Murphy MC, Brooks CN, New SA, Lumbers ML. The use of the Mini-Nutritional Assessment (MNA) tool in elderly orthopaedic patients. Eur J Clin Nutr 2000; 54: 555-562.
20. Christensson L, Unosson M, Ek AC. Evaluation of nutritional assessment techniques in elderly people newly admitted to municipal care. Eur J Clin Nutr 2002; 56: 810-818.
21. Delacorte RR, Moriguti JC, Matos FD, Pfrimer K, Marchini JC, Ferrioli E. Mini Nutritional Assessment score and the risk for undernutrition in free-living older persons. J Nutr Healht Aging 2004; 8 (6): 531-534.
22. Instituto Brasileiro de Geografia e Estatística (IBGE). Contagem populacional e projeções demográficas preliminares. 2001. Disponível em <http://tabnet.datasus.gov.br> [2006 setembro 19].
23. Rubenstein LZ, Harker JO, Salva A, Guigoz Y e Vellas B. Screening for undernutrition in geriatric practice: developing the Short-form Mini Nutritional Assessment (MNA-SF). J Ger Med Sci 2001; 56 (6): M366-M372.
24. Heymsfield SB, Mc Manus C, Smith J et al. Anthropometric measurement of muscle: revised equations for calculating bone-free arm muscle area. Am J Clin Nutr 1982; 36: 680-690.
25. Barbosa AR, Souza JMP, Lebrão ML, Marucci MFN. Relação entre estado nutricional e força de preensão manual em idosos do município de São Paulo, Brasil: dados da pesquisa SABE. Rev Bras Cineantropom Desempenho Hum 2006; 8 (1): 37-44.
26. Callaway CW, Chumlea WC, Bouchard C, et al. Circunferences. In: Lohman TG, Roche AF, Martorell R. Anthropometric standardization reference manual. Champaign, Illinois: Human Kinetics Books; 1988. p. 39-53.
27. Harrison GG, Buskirk ER, Carter JEL. Skinfold thicknesses and measurement technique. In: Lohman TG, Roche AF, Martorell R. Anthropometric standardization reference manual. Champaign, Illinois: Human Kinetics Books; 1988. p. 55-70.
28. Fletcher RH, Fletcher SW, Wagner EH. Epidemiologia clínica: elementos essenciais. 3 ed. Artes Médicas: São Paulo; 1996. p. 52-83.
29. Frisancho AR. New norms of upper limb fat and muscle areas for assessment of nutritional status. Am J Clin Nutr 1981; 34: 2540-2545.
30. Omran ML and Morley JE. Assessment of protein energy malnutrition in older people persons, Part 1: history, examination, body composition, and screening tools. Nutrition 2000; 16: 50-63.
31. Bennemann RM. Avaliação do estado nutricional de idosos com e sem distúrbios cognitivos, residentes em instituição geriátrica do município de Bragança Paulista – Estado de São Paulo. São Paulo; 2002. [Dissertação de Mestrado – Faculdade de Saúde Pública – Universidade de São Paulo].
32. Frisancho AR. New standards of weight and body composition by frame size and height for assessment of nutritional status of adults and the elderly. Am J Clin Nutr 1984; 40(4):808-19.
33. Miller MD, Crotty M, Giles LC, Bannerman E, Whitehead C, Cobiac L, Daniels LA, Andrews G. Corrected arm muscle area: an independent preditor of long-term mortality in community-dweling older adults. J Am Geriatr Soc 2002; 50: 1272-1277.
34. Marucci MFN. Avaliação das dietas oferecidas em instituições para idosos localizadas no município de São Paulo. São Paulo; 1985. [Dissertação de Mestrado – Faculdade de Saúde Pública – Universidade de São Paulo].
35. Ferreira LS. Uso da "Mini Avaliação Nutricional" para o diagnóstico de desnutrição e risco de desnutrição de idosos residentes em Instituições de Longa Permanência. São Paulo; 2005. [Dissertação de Mestrado – Faculdade de Saúde Pública – Universidade de São Paulo].
36. Vellas B, Guigoz Y, Garry PJ, Nourhashemi F, Bennahum D, Lauque S e Albarede J. The nutritional assessment (MNA) and its use in grading the nutritional state of elderly patients. Nutrition 1999; 15: 116-122.
37. Vellas B, Guigoz Y, Baumgartner M, Garry PJ, Lauque S, Albadere JL. Relationships between nutritional markers and the mini-nutritional assessment in 155 older persons. Am Geriatric Soc 2000; 48: 1300-1309.
38. Green SM and Watson R. Nutritional screening and assessment tools for older adults: literature review. J Advanced Nursing 2006; 54 (4): 477-490.