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Relationship between cognitive impairment and nutritional assessment on functional status in Calabrian long-term-care

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Video abstract

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Objective: The interaction between dementia and nutritional state is very complex and not yet fully understood. The aim of the present study was to assess the interaction between cognitive impairment and nutritional state in a cohort of residential elderly in relationship with functional condition of patients and their load of assistance in long-term-care facilities of the National Association of Third Age Structures (ANASTE) Calabria.

Methods: One hundred seventy-four subjects (122 female and 52 male) were admitted to the long-term-care ANASTE Calabria study. All patients underwent multidimensional geriatric assessment. Nutritional state was assessed with the Mini Nutritional Assessment (MNA), whereas cognitive performance was evaluated by the Mini-Mental State Examination (MMSE). The functional state was assessed by Barthel Index (BI) and Activity Daily Living (ADL). The following nutritional biochemical parameters were also evaluated: albumin, cholesterol, iron, and hemoglobin. All patients were reassessed 180 days later.

Results: A severe cognitive impairment in MMSE performance was displayed in 49.7% patients, while 39.8% showed a moderate deficit; 6.9% had a slight deficit; and 3.4% evidenced no cognitive impairment. In MNA, 30% of patients exhibited an impairment of nutritional state; 56% were at risk of malnutrition; and 14% showed no nutritional problems. Malnutrition was present in 42% of patients with severe cognitive impairment, but only 4% of malnourished patients showed moderate cognitive deficit. The statistical analysis displayed a significant correlation between MNA and MMSE ($P<0.001$), as did MMSE correlated with Activity Daily Living ($P<0.001$) and BI ($P<0.05$). MNA correlated with BI ($P<0.001$) and albumin ($P<0.001$). The follow-up showed a strong correlation between cognitive deterioration and worsening of nutritional state ($P<0.005$) as well as with the functional state ($P<0.05$) and mortality ($P<0.01$).

Conclusion: The present study clearly shows that malnutrition may play an important role in the progression of cognitive loss.

Keywords: nutritional state, dementia, elderly, nursing home, disability

Introduction

The elderly are particularly vulnerable to nutritional change deficits. Malnutrition in elderly patients has a large number of negative consequences on health: it can often influence the prognosis of different pathologies, reduce health-related quality of life, and increase morbidity/mortality and hospital admissions.[1,2] Malnutrition is common among residents in hospitals and nursing homes. In Europe, considering the time of admission to hospital, prevalence of malnutrition ranges from 10%–80%, with an average value of 35% upon hospital admission, and it tends to worsen in most cases during hospitalization, while, in long-term-care (LTC) settings and in nursing homes, the average prevalence is 30%.[3] The malnutrition prevalence has been reported to be 3%–5% of

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free-living older adults[4,5] and 21.3% in home care patients.[6] The etiology is multifactorial and involves physiological aging[7] and socioeconomic and psychological factors,[8] as well as comorbid conditions typical of the elderly.[9,10] Dementia is itself a risk factor for malnutrition. A recent study shows that the nutritional state of institutionalized dementia patients is worse than those not institutionalized of the same age and with a normal cognitive state or mild cognitive impairment.[11] The relationship between weight loss and dementia is complex and not completely clear; in fact, weight loss can be different according to the type of dementia, the stage of the disease, and the living situation of the patients. Studies examining food intake in the dementia population report varying results regarding the extent of weight loss and the adequacy of diet and/or energy intake.[12,13] Grundman et al found a significant association between low body mass index and cerebral cortex atrophy in the areas involved in control of eating behavior among patients with Alzheimer's disease (AD).[14] White et al explored the association between AD and weight changes, studying 362 subjects affected by AD and 317 control subjects for 2 years.[15] They found that almost twice as many patients with AD lost more than ≥5% total body weight compared to controls, and that patients with more severe forms of AD are six to seven times more likely to suffer progressive loss of weight.[15] Poor nutritional status further undermines the functional state of dementia promoting musculoskeletal damage (sarcopenia and osteopenia), causing immunosuppression and, ultimately, decreases in respiratory and cardiac capacity.[16] Malnutrition becomes more evident in later stages of the disease when dysphagia or complications, such as pressure ulcers, repeated infections, and immobility syndrome, that further worsen the nutritional state of the patient, occur.[17] About 78% of residents in nursing homes and extensive rehabilitation organizations associated with the National Association of Third Age Structures (ANASTE) Calabria (an Italian association of nursing home and rehabilitation to care for third age) were found to suffer from cognitive deterioration of different etiologies and gravities, of which 52% had severe dementia. Diagnostic reevaluation of these patients, according to the criteria of the National Institute of Neurological and Communicative Disorders and Stroke and the Alzheimer's Disease and Related Disorders Association (NINCDS-ADRDA),[18] showed that 56.14% were suffering from AD: in particular, 45.45% met the criteria for possible AD; 28.12% met the criteria for probable AD; and 37.5% met the criteria for probable-uncertain AD.[19] Few studies have focused on the relationship between patients' nutritional states and severity of dementia, comorbidity and functional state in institutionalized demented.[16] Patients suffering from malnutrition have an increased need for nursing care due to the increased incidence of complications and reduced quality of life.[20] The need for assistance may be calculated by an index of case mix and load assistance, expressed in minutes of assistance/day and multidisciplinary team in LTC.[21,22]

The purpose of the present study was to investigate the relationship between cognitive deficit and nutritional state in a cohort of elderly residents in LTC on functional state and the load of assistance.

Materials and methods

Study setting

A network of LTC facilities for the care of frail elderly, consisting of nursing homes and extensive rehabilitation organizations, operates in Calabria, Italy. Access to these facilities is regulated according to the guidelines provided by the Calabria region (DGR 685/2002, DGR 695/2003, LR 29/2008, DGR 3137/1999). The present study was a 6-month observational, descriptive study carried out on residents across ten ANASTE Calabria nursing homes in January 2010. The customary care practices provided to all patients who belong to ANASTE Calabria LTC facilities were conducted throughout the study. At the moment of admission to LTC, informed consent of the patients and/or their caregiver was acquired for daily care practices and use of their personal data. All patients underwent multidimensional geriatric assessment. Baseline and follow-up data comprised a battery of validated indices chosen to establish an overview of health state.

Subjects and measurements

A sample of 174 residents, 122 female (70.1%) and 52 male (29.8%), was subjected to multidimensional and multidisciplinary evaluation. All patients underwent clinical, neuropsychological, and biological investigations. The diagnosis of dementia was investigated in an interview covering detailed personal and family history and was subsequently confirmed by the administration of psychometric tests. All patients fulfilled the criteria for dementia as described in the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision* (DSM-IV-TR).[23] Cognitive evaluation was conducted by a neuropsychologist who used Folstein et al's Mini-Mental State Examination (MMSE).[24] The patients were assessed as affected by severe, moderate, or slight cognitive impairment, based on MMSE scores (0–10, 10–20, and 20–23, respectively). Functional state was evaluated with the use of the Activity Daily Living (ADL)[25] and Barthel Index (BI),[26] in each of which a lower score indicates a worse functional state. The affective state was scored using the Geriatric Depression Scale (GDS), in which a high score (>6) denotes a depressive

state.[27] Comorbidity was examined according to the indices of severity and complex comorbidity of Cumulative Illness Rating Scale (CIRS), in which higher scores indicate greater comorbidity.[28] Health care need was calculated in terms of minutes of assistance through evaluation by Resource Utilization Groups (RUG)-III.[22] Finally, the number of different medications per patient was determined. The nutritional state evaluation included several biochemical values in serum, albumin (g/dL), cholesterol (mg/dL), iron (µg/dL), and hemoglobin (g/dL), quantified by the Mini Nutritional Assessment (MNA).[29,30] The MNA has been previously validated for screening and assessment of malnutrition in older people. Harris et al noted that the MNA test demonstrates 80% sensitivity and 90% specificity.[31] Patients are classified in MNA as follows: normal nutritional state (score of <24 to >30); at risk of malnutrition (score of 17–23.5); and malnutrition (score of <17). Of the enrolled patients, 142 were reassessed after 6 months by MMSE and MNA only.

Statistical analysis

Data were collected from a database generated and managed by ANASTE Calabria from 2010. Data are presented as mean ± standard error of mean (SEM) and were analyzed using GraphPad Prism statistics software package (version 6; GraphPad Software, Inc., La Jolla, CA, USA). Comparison was performed between multiple parameters using analysis of variance (ANOVA), while categorical variables were compared using Wilcoxon–Mann signed-rank test for multiple comparisons. Spearman's rank correlation coefficient and Student's *t*-test were used to find a correlation between different measures. Tests with $P<0.05$ were considered statistically significant.

Results

At baseline, the average age was 74 years for men and 81 for women. Patients scored 1.4±2.4 in ADL performance and 28±13 in BI (mean ± standard deviation). Calculation of complex comorbidity, according to the CIRS, showed an average number of illnesses of 2.99±2.2, with severity of comorbidity averaging 2.04±1.9. Only 59 patients (34%) were subjected to GDS and showed no depressive state (4.73±3.3); it was not possible to administer GDS in 115 patients (64%) because of cognitive impairment. The assessment of care need expressed in minutes of assistance according to RUG-III showed an average burden of 327.2 minutes/day of care for patient. The enrolled patients took an average of 5.7±3.5 different medications (Table 1). The 86 patients of the total number (49.7%) had a severe cognitive impairment as assessed by MMSE; 69 patients (39.8%) showed a moderate deficit; 12 patients (6.9%) exhibited slight deficit; and only six patients (3.4%) presented no cognitive impairment (Figure 1; Table 2). Twenty-five patients (14%) had no nutritional problems as assessed with MNA; 97 patients (56%) were at risk of malnutrition; and 52 patients (30%) had an impaired nutritional state (Figure 2; Table 2). Among patients with severe cognitive impairment, 36 (42%) presented with malnutrition; 48 were at risk of malnutrition; and nine (10%) showed no nutritional impairment. At follow-up, 142 patients, 47 male (33%) and 95 female (67%), were assessed. Seventy-eight patients (55%) showed a severe cognitive impairment in MMSE; 52 patients (36%) showed a moderate deficit; and ten (19%) had a slight deficit. In MNA, 32 patients (22%) demonstrated no nutritional problems; 69 (48%) were at risk of malnutrition; and 41 (29%) had an impairment of nutritional state (Table 2).

Table 1 Population and measurement characteristics

Subjects	n
Males	52 (n)
Females	122 (n)
Average age (years)	
Males	74
Females	81
Measures	**Mean + standard error of the mean**
Complex Comorbidity Index[28,a]	2.99±2.2
Severity of Comorbidity Index[28,a]	2.04±1.99
Activities of Daily Living[25]	1.4±2.4
Barthel Index[26]	28±13
Geriatric Depression Scale[27]	4.73±3.3
Number of drugs	5.7±3.5
Medium care need (minutes/day)[b]	327.2

Notes: [a]Index of the Cumulative Illness Rating Scale;[28] [b]per person, as per Resource Utilization Groups-III.[22]

The linear regression analysis showed a statistically significant correlation between MNA and MMSE ($r=0.39$; $P<0.001$) (Figure 3; Table 2), MMSE and ADL ($r=0.39$; $P<0.001$), MMSE and BI ($r=0.15$; $P<0.05$), and MNA and BI ($r=0.27$; $P<0.001$). MNA in our study does not correlate

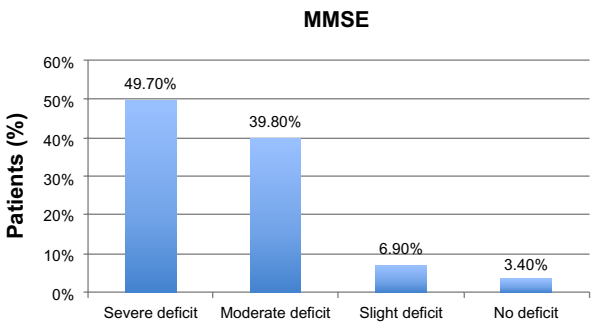

Figure 1 Evaluation of cognitive impairment at baseline using Mini-Mental State Examination (MMSE).

Table 2 Evaluation of and correlation between nutritional state and cognitive impairment

Test	T0 (start)		T1 (6 months)	
	n	%	n	%
MMSE				
<10	86	49.7	78	55
>10<20	69	39.8	52	36
>20	12	6.9	10	19
MNA				
<17	52	30	41	29
>17<23	97	56	69	48
>23	25	14	32	22
MMSE vs MNA	r=0.39		r=0.37	
	P<0.001		P<0.01	

Abbreviations: MMSE, Mini-Mental State Examination; MNA, Mini Nutritional Assessment; vs, versus.

with blood tests evaluated except with albumin (r=0.59; P<0.001). There was no statistically significant correlation between cognitive impairment, nutritional state, comorbidity, and use of drugs, but there was a weakly significant trend between severe cognitive impairment, impaired nutritional state, and care need in minutes of assistance. Follow-up at 6 months confirmed a statistically significant correlation between MNA and MMSE (r=0.37; P<0.01) (Figure 3; Table 2). In the malnourished group, there was no correlation between MMSE and MNA (r=0.25; P>0.05), whereas there was a significant correlation between the group with severe cognitive deficit and the group with moderate cognitive impairment (r=0.33; P<0.05).

These results indicate that the improvement of nutritional condition is accompanied by an improvement of cognitive function. The analysis with the rank correlation coefficient for the Spearman and Student's t-test showed a strong correlation between levels of cognitive deterioration and worsening of nutritional state (P<0.05), functional state (P<0.05), and mortality (P<0.01).

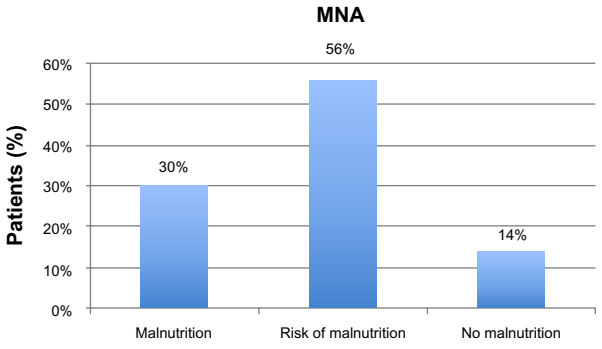

Figure 2 Evaluation of nutritional state at baseline using Mini Nutritional Assessment (MNA).

Discussion

Prevalence of malnutrition and risk of malnutrition in institutionalized elderly patients with dementia is high and increases with progression of disease. The MNA, standardized for the elderly population,[30] is the preferred tool for nutritional assessment in LTC associated with ANASTE Calabria, although, in the literature, authors report different opinions about its use in institutionalized elderly with dementia.[32,33] The results of the present study confirm that patients affected by serious cognitive impairment are characterized by a poor nutritional state, a serious impairment of functional conditions, and increased mortality. This disorder does not appear to be associated with increased comorbidity and/or use of drugs. Previous studies have shown an inverse correlation between cognitive impairment and comorbidity in a large sample of patients admitted to nursing homes:[34,35] it was found that the prevalence of defined cardiovascular diseases, such as hypertension, decreased in relation to increased dementia severity,[36] although other authors disagree: the comorbidity is inversely correlated with the degree of cognitive impairment.[37] Moreover, some studies have shown a relationship between nutritional state and comorbidities.[38] In the present study, such an association was not confirmed, although we found a trend towards a worsening of health conditions in malnourished subjects. Generally, malnourished subjects show a greater functional impairment in ADL and higher care need.[39] Our study results are in line with the existing literature; in most studies, disability has been found to be associated with both anthropometric as well as biochemical parameters related to malnutrition.[40] Cereda et al[41] showed that a bad functional status correlates with a low MNA score. Moreover, in the present study, no correlation was found between mood disorder and nutritional state, while, in another study, depression is considered a risk factor for malnutrition in institutionalized elderly.[42] Since 52% of malnourished patients suffered from severe cognitive impairment in the present study, it was not possible to administer the GDS. The care need in these patients, calculated by RUG-III and expressed in minutes of assistance, shows a weak correlation with the prevalence of malnutrition, although it does not reach statistical significance. These data can be explained by considering that the admission of patients in nursing homes follow criteria of homogeneity of utilization of resources.[22] Patients were reevaluated after 6 months, and increased mortality was found in malnourished subjects when compared with patients who had a better nutritional status. It is well known that, in a geriatric population, loss of >4% body weight is an independent factor of morbidity and mortality.[43] The inci-

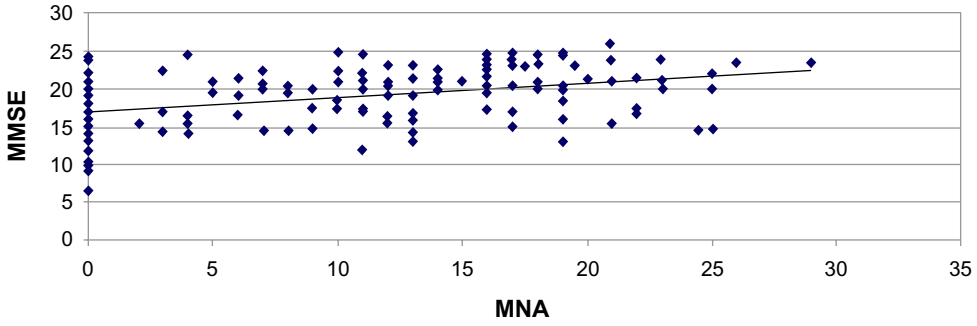

Figure 3 Correlation between nutritional state (Mini Nutritional Assessment [MNA]) and cognitive impairment (Mini-Mental State Examination [MMSE]) at 6-month follow-up.

dence of medical problems associated with malnutrition in elderly people in nursing homes is 27%, whereas it is about 16% in patients who are well nourished, although mortality is three times higher in the former.[44] In elderly patients, the effectiveness of nutritional interventions is reduced and recovery of malnutrition is difficult to achieve.[45] In patients with dementia, a state of malnutrition must be prevented or at least improved by an early and appropriate intervention strategy.[46,47] The results of the present study show that it is necessary to set appropriate nutritional interventions in patients with mild-to-moderate dementia; in fact, these patients have more opportunities for therapeutic response than patients suffering from severe dementia. In ANASTE Calabria LTCs, the multidisciplinary team is trained to carry out the assessment of nutritional state. This team is also trained to identify as risk factors for malnutrition both the cognitive impairment and worsening of functional state.

Conclusion

Malnutrition plays an important role in the progression of cognitive decline; early recognition and treatment of malnutrition or risk of malnutrition are important preventive measures to increase the quality of care and quality of life of patients with dementia.

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Disclosure

The authors report no conflicts of interest in this work.

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