The Journal of Nutrition, Health & Aging©
Volume 17, Number 4, 2013

SCREENING FOR MALNUTRITION AMONG NURSING HOME RESIDENTS - A COMPARATIVE ANALYSIS OF THE MINI NUTRITIONAL ASSESSMENT, THE NUTRITIONAL RISK SCREENING, AND THE MALNUTRITION UNIVERSAL SCREENING TOOL

R. DIEKMANN, K. WINNING, W. UTER, M. J. KAISER, C.C. SIEBER, D. VOLKERT, J.M. BAUER

Institute for Biomedicine of Aging, Friedrich-Alexander-Universität Erlangen-Nürnberg, Heimerichstr. 58, D-40419 Nürnberg, Germany

Abstract: *Background:* The European Society for Clinical Nutrition and Metabolism (ESPEN) has recommended the Mini Nutritional Assessment (MNA®), the Nutritional Risk Screening 2002 (NRS), and the Malnutrition Universal Screening Tool (MUST) for nutritional screening in various settings and age groups. While in recent years all three tools have been applied to nursing home residents, there is still no consensus on the most appropriate screening tool in this specific setting. *Aim:* The present study aims at comparing the MNA, the NRS, and the MUST with regard to applicability, categorization of nutritional status, and predictive value in the nursing home setting. *Method:* MNA, NRS, and MUST were performed on 200 residents from two municipal nursing homes in Nuremberg, Germany. Follow-up data on infection, hospitalization, and mortality were collected after six and again after twelve months. *Results:* Among 200 residents (mean age 85.5 ±7.8 years) the MNA could be completed in 188 (94.0%) and the NRS and MUST in 198 (99.0%) residents. The prevalence of 'malnutrition' according to the MNA was 15.4%. The prevalence of 'risk of malnutrition' (NRS) and 'high risk of malnutrition' (MUST), respectively, was 8.6% for both tools. The individual categorization of nutritional status showed poor agreement between NRS and MUST on the one hand and MNA on the other. For all tools a significant association between nutritional status and mortality was demonstrated during follow-up as classification in 'malnourished', respectively 'high risk of malnutrition' or 'nutritional risk', was significantly associated with increased hazard ratios. However, the MNA showed the best predictive value for survival among well-nourished residents. *Conclusion:* The evaluation of nutritional status in nursing home residents by MNA, NRS, and MUST shows significant differences. This observation may be of clinical relevance as nutritional intervention is usually based on screening results. As the items of the MNA reflect particularities of the nursing home population, this tool currently appears to be the most suitable one in this setting.

Key words: Malnutrition, screening tool, nursing home, nutrition, outcome.

Introduction

Older persons are considered to be at high risk of malnutrition. Apart from its relevance for morbidity and mortality (1), malnutrition is associated with worsening functionality and quality of life (2-5).

Nursing home residents regularly show low functionality and often suffer from disability. In addition a high prevalence of dementia and depression has been documented in this setting posing an additional threat for well-being (6). Depending on the criteria applied the prevalence of malnutrition among nursing home residents ranges from 5% up to 70% (7, 8). A gold standard for the diagnosis of malnutrition still does not exist and it is unlikely that there will be one in the near future. In 2003 the European Society for Clinical Nutrition and Metabolism (ESPEN) has recommended three nutritional screening tools, the Mini Nutritional Assessment (MNA), the Nutritional Risk Screening 2002 (NRS), and the Malnutrition Universal Screening Tool (MUST) (9). The debate on the most appropriate nutritional screening tool for nursing home residents has not been settled yet. The present study therefore aimed at the comparison of MNA, NRS, and MUST with regard to applicability, categorization of nutritional status, and predictive value.

Methods

Between June and December 2007, all residents and/or their legal proxies from two municipal nursing homes in Nuremberg, Germany, were approached by a nutrition scientist (DR) and a physician (WK). Residents were considered ineligible if under 65 years of age, terminally ill or if unwilling to give informed consent (or the legal proxy respectively). The study protocol was approved by the ethics committee of the Friedrich-Alexander-Universität Erlangen-Nuernberg, Germany, and also by the ethics committee of the Rheinische Friedrich-Wilhelms-Universität Bonn, Germany.

Individual variables of the participants (gender, age) were collected with the help of the nursing staff and from the residents` files using a purpose-built questionnaire. Data on infectious diseases, hospitalization and mortality were recorded at a six month and one year follow-up evaluation. Emotional and cognitive status were assessed by the 15-item Geriatric Depression Scale (GDS) (10) and the Mini Mental State Examination (MMSE) (11) performed by either DR or WK. Barthel's Index of Activities of Daily Living (ADL) was

Received August 22, 2012
Accepted for publication September 28, 2012

carried out by the nursing staff. Residents were thereafter graded as independent (65-100 points), needing assistance (35-60 points) or a high level of care (0-30 points) (12). All anthropometric measurements such as weight, knee height, body mass index (BMI), mid-arm circumference (MAC) and calf circumference (CC) were performed by DR. The exact procedure has been described elsewhere (13).

The MNA was completed by the attending nursing staff. DR and WK completed NRS and MUST using data from the residents' files.

The MNA was specifically developed for nutritional screening of older people (14, 15). It consists of 18 items reflecting anorexia, weight loss, anthropometric parameters, dietary and subjective assessment and geriatric particularities such as mobility, living situation, cognitive and mood disorders, acute disease, and drug intake. The MNA classifies into three categories: 'well-nourished' (24-30 points), 'risk of malnutrition' (17-23.5 points), and 'malnourished' (< 17 points).

The NRS was created for identification of hospital patients who might benefit from nutritional intervention (16). Predictive value of NRS has been documented by a retrospective analysis of 128 RCTs and prospectively by a controlled trial with 212 patients (9). The NRS estimates nutritional risk by combining nutritional key items with the morbidity associated risk for further impairment. The initial screening includes four questions on BMI, weight loss within the last three months, reduced dietary intake in the last week, and presence of acute disease. If at least one of the questions is answered with yes, the final screening is initiated which further investigates impairment of nutritional status and disease severity. Scores between 0 and 3 points are given for each component; an additional point is added for age above 70. A total score of ≥ 3 points interprets as 'nutritional risk', at < 3 points a 'weekly re-screening' is recommended. 'No risk' was present if all questions in the initial screening were answered with 'no'.

The MUST was primarily developed for the screening of adults to identify underweight and malnutrition as well as overweight and obesity, but not vitamin deficiencies in a rapid and simple way (17-19, 38). Even if MUST is recommended for the screening of adults in the community by ESPEN (9), it is currently used across all settings including hospital and long-term care (20). Using the MUST tool presumes application by professionals (nurses, physicians, dieticians) to assure expertise (38, 19). The MUST consists of three items: BMI, involuntary weight loss in the previous three to six months, and presence of acute disease or absent nutritional intake for at least five days. Advantage of the MUST is, that it can be used even in patients without available height and weight, as a range of alternative measures and subjective criteria (as knee height, demi-span, mid upper arm circumference, etc.) are provided and practical accomplishment is explained in the MUST booklet (38). The MUST results in a score of either 0 ('low risk'), 1 ('medium risk') or ≥ 2 points ('high risk').

The MNA, NRS, and MUST make use of a semantically different three-category scale. However, as these categories are corresponding regarding the intended therapeutic consequences, comparison of the respective categories may be seen as meaningful.

Statistics

Statistical analysis was performed using SPSS© version 20.0 (SPSS for Windows, SPSS Inc., Chicago, IL, USA) and SAS version 9.1 (SAS Institute, Cary, NC, USA). Data were given as mean ± standard deviation (SD) or as prevalence (%). In case of normally distributed data, T-test for independent samples was used to compare differences between participants and non-participants and between men and women. Agreement between the screening tools, i.e. MNA vs. NRS, MNA vs. MUST and MUST vs. NRS, was quantified with regard to the classified outcome by weighted kappa index (21). The existence of a trend regarding outcome (mortality, infection, hospitalization) among the result categories was tested by Mantel-Haenszel Chi^2-test. Survival analysis, including Kaplan-Meier curves (log-rank test) and Cox regression analysis were used to estimate the age-adjusted hazard ratios of one year mortality associated with categories of MNA, NRS, and MUST.

Results

Study population

Among 322 residents living in the two nursing homes, 122 persons (98 women, 24 men) were not eligible. In 56 residents the proxy did not agree on participation or could not be contacted. 28 residents were personally unwilling to participate, ten residents were terminally ill and ten residents were under age 65. Another 18 residents did not participate due to acute hospitalisation, infections with multi-resistant bacterial strains and other reasons. Non-participating residents were significantly younger than participating residents (82.8 ±11.5y vs. 85.5 ±7.8y; $p < 0.05$).

Of the 200 residents included, 147 were female (mean age 86.5 ±7.4 y), and 53 were male (mean age 83.0 ±8.5 y). All participants were white. Women were significantly older than men ($p < 0.05$). Arterial hypertension was present in 76.5%, chronic heart failure in 74.0%, diabetes mellitus in 36.0%, residual symptoms after cerebral ischemia in 29.0%, and osteoarthritis in 31.0% of the subjects.

The baseline characteristics (age, prevalence of depression, cognitive and functional impairment) and anthropometric data of the residents are shown in table 1.

Applicability of MNA, NRS, and MUST

The MNA could be completed by the nursing staff in 94.0% of the cases (n=188). In 12 cases the MNA was not applicable due to tube feeding (5%) or lower limb amputations (1%). Both the NRS and the MUST could be successfully applied in 99.0% (n=198). Two participants stayed less than three months in the nursing home and therefore lacked weight data for the required period.

Table 1
Subjects' baseline characteristics

		% Valid of total
Subjects (n)	200	100.0
Age [y]°	85.5 (±7.8)°	100.0
GDS ≥ 5 pts., n (%)	71 (50.0)	71.0
MMSE < 25 pts., n (%)	133 (73.1)	91.0
ADL < 35 pts., n (%)	85 (42.5)	100.0
BMI < 20 kg/m2, n (%)	17 (8.5)	100.0
MAC < 23 cm, n (%)	18 (9.0)	100.0
CC < 31 cm, n (%)	76 (38.8)	98.0

°mean ± SD, GDS = Geriatric Depression Scale, MMSE = Mini Mental State; Examination, ADL = Activities of Daily Living (Barthel), BMI body mass index, MAC = mid-arm circumference, CC = calf circumference

Result categorization of MNA, NRS, and MUST

The distribution of study participants across result categories is presented in table 2. The prevalence of the respective categories attributed by the three screening tools showed major differences. Only when comparing the category 'risk of malnutrition' of the NRS and the category 'high risk' of the MUST no difference of prevalence could be found. Both categories were attributed to 8.6% of participants. Table 3 illustrates the agreement between MNA vs. MUST and MNA vs. NRS and NRS vs. MUST. Weighted kappa was low for both former pairs ($\varkappa$=0.16 and 0.13, respectively), indicating low agreement. The highest agreement of screening results was detected between MUST vs. NRS ($\varkappa$=0.40). In two cases however, there was complete disagreement between the tools, which means that participants were classified to low risk by MUST and risk of malnutrition by NRS. For example, sixteen residents who were identified as 'malnourished' by the MNA were categorized as being at low risk by the MUST. Furthermore according to the NRS 95 residents were at 'no risk of malnutrition'. The MNA, however, classified six of this group as 'malnourished' and 49 as 'at risk of malnutrition'.

Table 2
Applicability of screening tools and distribution into result categories

Tool Applicability	Nutritional Status		
MNA	Malnourished	Risk of malnutrition	Well nourished
94.0% (188/200)	15.4%	57.4%	27.1 %
NRS	Risk of malnutrition	Weekly screening	No risk of malnutrition
99.0% (198/200)	8.6%	40.9%	50.5%
MUST	High Risk	Medium Risk	Low Risk
99.0% (198/200)	8.6%	7.6%	83.8%

Predictive value of MNA, NRS, and MUST

The prognostic quality of the screening tools was evaluated by a six month and one year follow-up evaluation that focused on infections, hospitalisations and mortality. There was no significant correlation for any of the screening tools between category at baseline and infections or hospitalizations, neither after six months nor after one year (data not shown, all $p>0.05$; Mantel-Haenszel-Chi^2). Table 4 shows overall six month and one year mortality as well as the mortality rates according to the categorizations of the screening tools. There was a significant association between mortality and categorization for each of the tested tools. In total 47 participants (23.5%) died within twelve months. Among them were two residents (NRS and MUST), respectively three (MNA) in whom screening could not be performed. The one year mortality rate was uniformly highest in subjects classified as "malnourished" by the MNA, as being at "risk of malnutrition" by the NRS, and as being at "high risk" by the MUST. On the other hand, lowest mortality rates were found in the categories indicating normal nutritional status or no nutritional risk. However, the MNA showed the best predictive value for survival among well-nourished residents.

Figures 1 illustrates one year cumulative survival stratified for MNA, NRS and MUST categorization and the associated table presents the hazard ratios, adjusted for age for the categories with the 'best' category ('well nourished', 'low risk' or 'no risk', respectively) of the respective tool as exposure reference.

Discussion

When applying MNA, NRS, and MUST in the same study population of nursing home residents we found substantial differences in the classification of nutritional status. Unlike previous studies on malnutrition in older persons (22-24, 19), residents with cognitive deficits were not excluded from the present study. As prevalence of malnutrition among nursing home residents with dementia is high, it did not seem appropriate for us to exclude this population from nutritional screening (25, 26). However, the implementation of rather complex nutritional screening tools such as the MNA may be hampered by impaired cognitive status and speech problems (e.g. in a post-stroke condition), which are frequently observed in this setting. As a consequence of our previous evaluation of interview techniques, when we found improved applicability and decreased interference with cognitive deficits compared to one-on-one interviews (6), the MNA was now exclusively applied by the nursing staff.

Applicability rates of nutritional screening tools, which are comparable to the results of the present study, were published by Bauer et al., who were able to complete the NRS in 98.3% and the MNA in 66.1% of hospitalized geriatric patients (27). In the validation study of the NRS, 99.0% of newly admitted hospital patients across all age groups could be successfully screened (16, 28). In the present study a comparable high applicability rate could be observed for MUST and NRS as well.

In the present study relevant differences between the screening tools with regard to the categorization of nutritional status were shown. Similar discrepancies have been reported in

Table 3
Contingency table: MNA vs. MUST, MNA vs. NRS and MUST vs. NRS

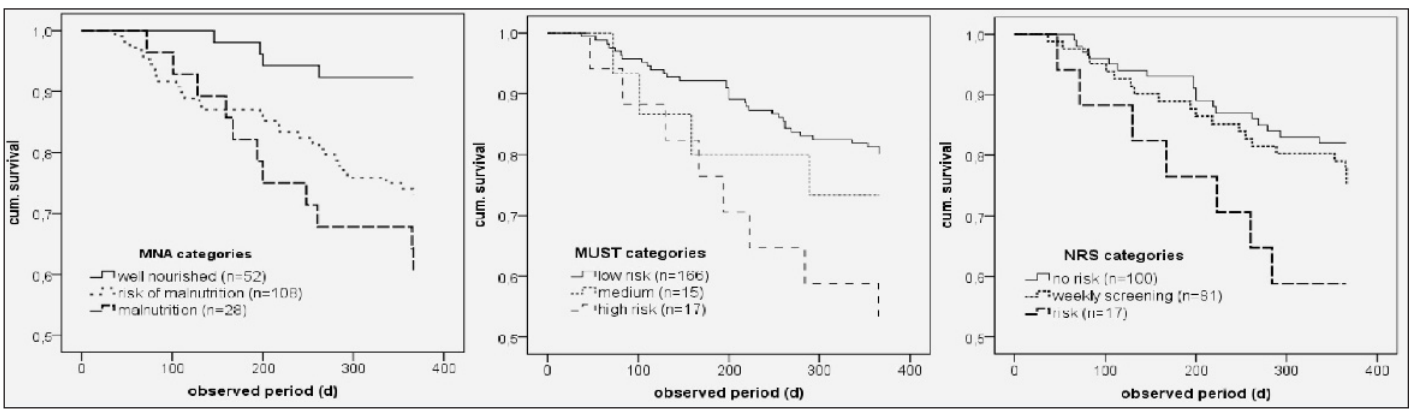
weighted ϰ=0.16		**MUST (n)**			
		Low Risk	**Medium Risk**	**High Risk**	**Total**
MNA (n)	Well nourished	51	0	0	51
	At Risk of Malnutrition	91	9	7	107
	Malnourished	16	6	7	29
	Total	158	15	14	187
weighted ϰ=0.13		**NRS (n)**			
		No Risk of Malnutrition	**Weekly Screening**	**Risk of Malnutrition**	**Total**
MNA (n)	Well nourished	40	11	0	51
	At Risk of Malnutrition	49	52	6	107
	Malnourished	6	15	8	29
	Total	95	78	14	187
weighted ϰ=0.40		**NRS (n)**			
		No Risk of Malnutrition	**Weekly Screening**	**Risk of Malnutrition**	**Total**
MUST (n)	Low risk	99	1	0	100
	Medium risk	65	11	5	81
	High risk	2	3	12	17
	Total	166	15	17	198

Table 4
Association of MNA, NRS, and MUST categorization with mortality

MNA	**Deceased total**	**Well -nourished**	**Risk of Malnutrition**	**Malnourished**	**p-value***
6 months	24/188 (12.8%)	2/52 (3.9%)	14/108 (13.0%)	8/28 (28.6%)	0.003
1 year	44/188 (23.4%)	4/52 (7.7%)	29/108 (26.9%)	11/28 (39.3%)	0.001
NRS	**Deceased total**	**No Risk of Malnutrition**	**Weekly Screening**	**Risk of Malnutrition**	
6 months	24/198 (12.2%)	8/100 (8.0%)	12/81 (14.8%)	4/17 (25.5%)	0.041
1 year	45/198 (22.7%)	18/100 (18.0%)	20/81 (24.7%)	7/17 (41.2%)	0.039
MUST	**Deceased total**	**Low risk**	**Medium risk**	**High risk**	
6 months	24/198 (12.2%)	15/166 (9.0%)	3/15 (20.0%)	6/17 (35.3%)	0.001
1 year	45/198 (22.7%)	33/166 (19.9%)	4/15 (26.7%)	8/17 (47.1%)	0.012

* Mantel-Haenszel Chi^2

Figure 1
One year survival (Kaplan-Meier-curve) in nursing home residents, stratified for MNA, NRS and MUST categories



geriatric hospital patients for MNA, NRS and Subjective Global Assessment (SGA) (27). Another study compared MUST and MNA-short form (MNA-SF) in various settings. Here more residents were classified as being 'possibly at risk of malnutrition' based on the MNA-SF than being 'at risk' by the MUST (19).

Table 5

Age-adjusted Cox regression (hazard ratios with accompanying 95% confidence interval) with the 'best' category of the respective tool as exposure reference

Tool	category	HR	95% CI
MNA	risk of malnutrition	3.79	1.32-10.80
	malnourished	5.92	1.88-18.63
NRS	weekly screening	1.45	0.75-2.80
	high risk	2.78	1.06-7.30
NRS	medium	1.36	0.48-3.87
	high risk	2.94	1.29-6.72

The observed differences in the present study may be attributed to the distinct conceptualization of the tools. The highest agreement between result categories was observed between NRS and MUST. This might be due to the fact that both NRS and MUST feature similar criteria such as BMI and weight loss, and that they both put a special emphasis on acute illness and decreased dietary intake. However, the BMI and weight loss cut-offs used in the NRS and in the MUST have not been adapted to older people. Instead, the WHO recommendation of 18.5 kg/m^2 was used to define the lowest BMI category (29). Although the WHO cut-offs are widely adopted and have been recommended for all individuals aged 18 years or older, these cut-offs were extracted from studies based on examination of morbidity risk in young and middle-aged populations. For older persons the lowest mortality rate was shown for BMI values between 25 and 30 (30) or even above 30 kg/m^2 (6). In addition the US National Research Council (NRC) currently proposes a BMI cut-off value between 24 and 29 kg/m^2 as a normal range in older persons (31). A BMI below 20 kg/m^2 may serve as a marker of malnutrition as recommended by ESPEN (32). In the present study the BMI cut-off values included in the NRS and in the MUST may have resulted in a significantly lower rate of malnutrition. The MNA, on the other hand, uses BMI cut-offs, which result in lower scoring, thereby indicating higher risk, already with BMI values below 23 kg/m^2. In addition the MNA may be regarded to be more sensitive in estimating weight loss as it scores lower already when a weight loss between one and three kilograms has been documented.

The NRS, designed for use in hospitalized patients, and also the MUST lay strong emphasis on acute morbidity which is largely absent among nursing home residents. In addition a complete absence of nutritional intake lasting for five days or longer is exceptionally rare in nursing home residents. Nursing homes primarily accommodate residents suffering from chronic conditions especially from low functionality and disabilities, which are not adequately represented by the list of disease prototypes in the original NRS publication (16). The usefulness and applicability of the NRS in the nursing home setting might therefore be limited. On the other hand, the NRS offers an adjustment for age (an extra point is given for age above 70) which was included due to the association of higher age with an increasing risk of malnutrition (33). In the present study the minor discrepancies in classification between the NRS and MUST might have been a consequence of the age adjustment provided by the NRS.

Six and twelve month mortality rates were highest in residents who were classified as 'malnourished', at 'high risk' and at 'risk of malnutrition' by the MNA, NRS and MUST, respectively. Furthermore hazard ratios were highest for residents categorized as 'risk for malnutrition' and 'malnourished' by MNA. The MNA showed the best predictive value for survival among well-nourished residents. Similar results have been documented in previous studies. The MNA has been shown to be predictive for length of stay and mortality (20). In the developmental study of the MNA, all participants classified as 'normal' survived for at least one year, while 24% of the subjects at 'risk' and 48% of the 'malnourished' ones had died during this period (34). Among very old hospitalized patients Kagansky found a significant correlation between the MNA score and the survival rate after 2.7 years (23). Tsai and Ku demonstrated that the MNA predicted six month mortality in cognitively impaired older people (35). However, apart from the present study data on the association of MNA results with mortality are widely lacking for the nursing home setting.

Stratton reported on the predictive value of the MUST in acutely ill, hospitalized older patients. Patients with a 'medium' and 'high risk of malnutrition' had higher mortality rates and lengths of stay than patients with a 'low risk'. The MUST categories were significantly associated with mortality and clinical outcome (36). In community care, the MUST predicted hospital admission, visits to the general practitioner and a favourable outcome after nutritional intervention (20, 18). In the present study, a significant correlation was demonstrated only between MUST categorization and mortality, but not between MUST category and hospitalization. With regard to the NRS, a significant association between NRS categories and mortality was observed but not between NRS category and hospitalization. Sorensen and co-workers found a significant association between NRS 'at risk' patients and mortality as well as rate of complications in comparison to 'not at risk' patients in a multicentre study with acute hospital patients (37).

Conclusion

When reflecting on the differences between nutritional screening tools applied in the nursing home population their implications for the design and for the interpretation of intervention studies have to be considered. As the three tested screening tools – MNA, NRS and MUST - identify different

residents as being at risk or as being malnourished the effects of nutritional interventions may differ between studies as a consequence of the screening tools that were used. All study results must therefore be interpreted according to the criteria applied for the inclusion of study participants. Although no clear superiority of one screening tool over the others could be shown in the present study it has to be taken into consideration that only the MNA was specifically designed for application in older people. The MNA items reflect specific conditions relevant in older individuals and are based on age-adapted thresholds for anthropometric measurements. In addition, acute disease, which is highly relevant for the screening with NRS and also with MUST, can rarely be found in nursing home residents. Adaptations of the MNA like the MNA Short Form may serve to increase its applicability rate and to reduce the time needed for screening. The identification of residents being at risk for malnutrition is important to assure early nutritional intervention to protect their functionality and quality of life.

References

1. De Groot CPGM, van Staveren WA. Undernutrition in the European SENECA studies. Clin Geriatr Med 2002; 18: 699-708.
2. Amarantos E, Martinez A, Dwyer J. Nutrition and Quality of Life in older Adults. J Gerontol A Biol Sci Med Sci 2001; 56/2: 54-64.
3. Cederholm T, Jagren C, Hellstrom K. Outcome of protein-energy malnutrition in elderly medical patients. Am J Med 1995; 98: 67-74.
4. Dey DK, Rothenberg E, Sundh V, Bosaeus I, Steen B. Body Mass Index, weight change and mortality in the elderly. A 15 year longitudinal population study of 70 y olds. Eur J Clin Nutr 2001; 55: 482-492.
5. Kondrup J, Johansen N, Plum LM, Bak L, Larsen ICH, Martinsen A, Andersen JR, Baernthsen H, Bunch E, Lauesen N. Incidence of nutritional risk and causes of inadequate nutritional care in hospitals. Clin Nutr 2002; 21: 461-468.
6. Kaiser R, Winning K, Uter W, Stehle P, Lesser S, Sieber CC, Bauer JM. Comparison of two different approaches for the application of the Mini Nutritional Assessment in nursing homes: resident interviews versus assessment by nursing staff. J Nutr Health Aging 2009; 13(10): 863-9.
7. Pauly L, Stehle P, Volkert D. Nutritional situation of elderly nursing home residents. Z Gerontol Geriatr 2007; 40: 3-12.
8. Bauer JM, Kaiser MJ, Anthony P, Guigoz Y, Sieber CC. The Mini Nutritional Assessment - Its History, Today's Practice, and Future Perspectives. Nutr Clin Pract 2008; 23(4): 388-396.
9. Kondrup J, Allison SP, Elia M, Vellas B, Plauth M. ESPEN Guidelines for Nutrition Screening 2002. Clin Nutr 2003; 22(4): 415-421.
10. Lesher EL, Berryhill JS. Validation of the Geriatric Depression Scale - short form among inpatients. J Clin Psychol 1994; 50: 256-60.
11. Folstein MF, Folstein S, McHugh PR. Mini Mental State: a practical method for grading cognitive state of patients for the clinician. J Psychiatr Res 1975; 12: 189-198.
12. Mahoney FI, Barthel DW. Functional Evaluation: The Barthel Index. Md State Med J 1965; 14: 61-65.
13. Kaiser R, Winning K, Uter W, Volkert D, Lesser S, Stehle P, Kaiser MJ, Sieber CC, Bauer JM. Functionality and mortality in obese nursing home residents - An example of 'Risk Factor Paradox'? J Am Med Direc Assoc 2010, 11, (6):428-435.
14. Guigoz Y, Vellas B, Garry PJ. Mini Nutritional Assessment: a practical assessment tool for grading the nutritional state of elderly patients. Facts Res Gerontol 1994; 2: 15-60.
15. 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: 59-65.
16. Kondrup J, Rasmussen HH, Hamberg O, Stanga Z, and ad hoc ESPEN working group. Nutritional Risk Screening (NRS 2002): a new method based on an analysis of controlled clinical trials. Clin Nutr 2003; 22: 321-336.
17. Malnutrition Advisory Group (MAG). MAG-guidelines for Detection and Management of Malnutrition. British Association for Parenteral and Enteral Nutrition, Redditch, UK 2000.
18. Elia M (Chairman and Editor). Screening for Malnutrition: A Multidisciplinary Responsibility. Development and Use of the" Malnutrition Universal Screening Tool" ("MUST") for Adults. Malnutrition Advisory Group (MAG) 2003, a Standing Commitee of BAPEN.
19. Stratton RJ, Hackston A, Longmore D, Dixon R, Price S, Stroud M, King C, Elia M. Malnutrition in hospital outpatients and inpatients: prevalence, concurrent validity and ease of use of the malnutrition universal screening tool (MUST) for adults. Br J Nutr 2004; 92: 799-808.
20. Anthony P. Nutrition Screening Tools for Hospitalized Patients. Nutr Clin Pract 2008; 23(4): 373-382.
21. Cohen A. Coefficient of agreement for nominal scales. Educ Osychol Meas 1960; 19: 3-11.
22. Hengstermann S, Nieczaj R, Steinhagen-Thiessen E, Schulz RJ. Which are the most efficient items of the Mini Nutritional Assessment in multimorbid patients? J Nutr Health Aging 2008; 12(2): 117-122.
23. Kagansky N, Berner Y, Koren-Morag N, Perelman L, Knobler H, Levy S. Poor nutritional habits are predictors of poor outcome in very old hospitalized patients. Am J Clin Nutr 2005; 82: 784-791.
24. Norman K, Smoliner C, Valentini L, Lochs H, Pirlich M. Is bioelectrical impedance vector analysis of value in the elderly with malnutrition and impaired functionality? Nutrition 2007; 23(7-8): 564-569.
25. Abbasi AA, Rudman D. Undernutrition in nursing home: prevalence, consequences, causes and prevention. Nutr Rev 1994; 52(4): 113-122.
26. Durnbaugh T, Haley B, Roberts S. Assessing problem feeding behaviours in mid-stage Alzheimer's disease. Geriatr Nurs 1996; 17(2): 63-67.
27. Bauer JM, Vogl T, Wicklein S, Trögner J, Mühlberg W, Sieber CC. Comparison of the Mini Nutritional Assessment, Subjective Global Assessment, and Nutritional Risk Screening (NRS 2002) for nutritional screening and assessment in geriatric hospital patients. Z Gerontol Geriatr 2005; 38: 322-327.
28. Rasmussen HH, Kondrup J, Staun M, Kadefoged K, Kristensen H, Wengler A. Prevalence of patients at nutritional risk in Danish hospitals. Clinical Nutr 2004; 23: 1009-1015.
29. Internet reference: World Health Organisation (WHO) (2004): BMI-Classification: http://apps.who.int/bmi/index.jsp?introPage=intro_3.html. 23.07.2012.
30. Al Snih S, Ottenbacher KJ, Markides KS, Kuo YF, Eschbach K, Goodwin JS. The effect of obesity on disability vs. mortality in older Americans. Arch Intern Med 2007; 167: 774-780.
31. National Research Council. Diet and Health. Implications for Reducing Chronic Disease Risk. National Academy Press, Washington DC 1989: 563-592.
32. Volkert D, Berner YN, Berry E, Cederholm T, Bertrand PC, Milne A, Palmblad J, Schneider S, Sobotka L, Stanga Z, Lenzen-Grossimlinghaus R, Krys U, Pirlich M, Herbst B, Schuetz T, Schroeer W, Weinrebe W, Ockenga J, Lochs H. ESPEN Guidelines on Enteral Nutrition: Geriatrics. Clin Nutr 2006; 25: 330-360.
33. Unosson M, Larsson J, Ek A-C, Bjurulf P. Effects of dietary supplement on functional condition and clinical outcome measured with a modified Norton scale. Clin Nutr 1992; 11: 134-139.
34. Guigoz Y, Vellas B. Test d'evaluation de l'etat nutritionnel de la personne agée: le Mini Nutritionel Assessment (MNA). Med Hyg 1995; 53: 1965-1969.
35. Tsai A, Ku PY. Population-specific Mini Nutritional Assessment effectively predicts the nutritional state and follow-up mortality of institutionalized elderly Taiwanese regardless of cognitive status. Br J Nutr 2008; 100: 152-8.
36. Stratton RJ, King CL, Stroud MA, Jackson AA, Elia M. Malnutrition Universal Screening Tool predicts mortality and length of hospital stay in acute ill elderly. Br J Nutr 2006; 95: 325-330.
37. Sorensen J, Kondrup J, Prokopowicz J, Schiesser M, Krähenbühl L, Meier R, Liberda M, EuroOOPS study group, Clin Nutr 2008; 27: 340-349.
38. Todorovic V, Russell C, Elia M. The ,MUST' explanatory booklet. A guide to the, Malnutrition Universal Screening Tool' (,MUST) for adults. 2003. www.bapen.org.uk/pdfs/must/must_explan.pdf (Juli 2012).