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Perceived health and risk of undernutrition: a comparison of different nutritional screening results in older patients

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Aims and objectives. To compare screening results using different nutritional screening instruments with respect to nutritional risk and associations with perceived health and health-related issues in a group of older hospital patients.
Background. The association between lower perceived health and nutritional risk in older people is widely known. It is advised to use a screening instrument to identify nutritional at-risk patients.
Design. A cross-sectional study design was used.
Methods. One hundred and fifty-eight older patients, in three medical hospital wards in two hospitals in southern Norway, were interviewed using a questionnaire containing questions about background variables, perceived health and health-related issues and the nutritional screening instruments Nutritional Form for the Elderly and Mini Nutritional Assessment (including Mini Nutritional Assessment-Short Form). Data were also collected regarding the screening instrument Nutrition Risk Screening 2002. All data were analysed using statistical methods.
Results. Many patients were at nutritional risk independent of instrument used. Nutrition Risk Screening 2002 identified fewer nutritional at-risk patients than the other instruments did. Perceived ill health was significantly associated with nutritional risk using instruments specifically designed for older people. Feeling satisfied with life and lower risk of undernutrition were two important predictors for perceived good health.
Conclusions. Nutritional Form for the Elderly, Mini Nutritional Assessment and Mini Nutritional Assessment-Short Form could identify approximately the same number of nutritional at-risk patients. Being at nutritional risk had a negative impact on older patients' perceived health.
Relevance for practice. Corresponding nutritional screening results can be obtained using either Nutritional Form for the Elderly or Mini Nutritional Assessment, as well as Mini Nutritional Assessment-Short Form. Instruments designed for older people should be used to screen older patients. Factors associated with nutritional risk can aid nurses in becoming aware of nutritional at-risk patients. Preventing undernutrition is important for overall health enhancement.

Key words: nurses, nursing, nutritional risk, nutritional risk factors, older people, screening instrument

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Introduction

An association between lower perceived health and being at nutritional risk is widely known in older people (Chen *et al.* 2001, Margetts *et al.* 2003). In several recent studies, this association regarding older people has been found when a nutritional instrument, the Mini Nutritional Assessment (MNA®), was used to identify those at nutritional risk (Johansson *et al.* 2007, 2009). In addition to impaired perceived health (Johansson *et al.* 2009), lower functional status (Chen *et al.* 2007) was found to predict poor nutritional status in older people. Other factors associated with undernutrition, when using MNA® in a small group of hospitalised older patients with chronic obstructive pulmonary disease, were found to be lower body mass index (BMI) and being dependent on daily community services (Odencrants *et al.* 2008). Furthermore, when using MNA®, lower level of life satisfaction was found in older people at nutritional risk (Johnson 2005).

Many hospital patients are undernourished on admission and become even more so during their hospital stay. To detect undernutrition or risk of undernutrition, the European Society for Clinical Nutrition and Metabolism (ESPEN) recommends using a nutritional screening instrument at admission (Kondrup *et al.* 2003a). The ESPEN guidelines regarding the choice of screening tools in different clinical settings have been followed in Scandinavia, for example, as national guidelines in Norway (Norwegian Directorate of Health 2009). Recommended nutritional screening instruments, according to ESPEN guidelines, are MNA® for screening older people and Nutrition Risk Screening 2002 (NRS-2002) for hospital screening (Kondrup *et al.* 2003a). NRS-2002 was developed to be used in hospitals in an acute care setting but was not specifically developed for older patients, while MNA® was designed for older people. MNA®, however, can be used in the community in both long-term care and acute care settings (Sieber 2006).

When choosing an instrument, it is important to use the most appropriate tool regarding the actual health care setting (Anthony 2008). This choice should also be considered carefully, and the criteria for reliability, validity, sensitivity and specificity should be met (Green & Watson 2006). Studies have been performed to compare different nutritional instruments in hospital settings. In a study by Raslan *et al.* (2010), NRS-2002 and Mini Nutritional Assessment-Short Form (MNA-SF), which is an abbreviated form of the complete MNA®, were compared regarding their identifying abilities as tools for predicting unfavourable outcomes in hospital patients. NRS-2002 was found to be the best, even in older patients. MNA® and NRS-2002 were compared among geriatric hospital patients by Bauer *et al.* (2005). MNA® could identify more patients who were at nutritional risk or undernourished than NRS-2002 could. NRS-2002 was found to be completed in more patients than MNA®.

As perceived ill health is concomitant with nutritional risk in older people (Chen *et al.* 2001, Margetts *et al.* 2003), it should be of interest to investigate this association by using and comparing a new nutritional screening instrument, the Nutritional Form For the Elderly (NUFFE) (Söderhamn & Söderhamn 2001, 2002), with established, recommended nutritional screening instruments as MNA®, MNA-SF and NRS-2002 among a group of older Norwegian patients in an acute care setting. To have knowledge about different nutritional screening instruments, nutritional screening results and factors associated with nutritional risk in older patients should aid nurses in becoming aware of and highlight these patients as a risk group for undernutrition.

Aim

The aim of this study was to compare screening results using different nutritional screening instruments with respect to nutritional risk and associations with perceived health and health-related issues in a group of older hospital patients.

Methods

Design and sample

A cross-sectional design was used in this study, which was carried out in three medical hospital wards in two different hospitals in southern Norway during a period of six months, from November 2008–April 2009. Convenience sampling was used to recruit participants. The inclusion criteria were the following: 65+ years of age and having the ability to communicate and cooperate in an interview situation. Nurses in the three hospital wards selected the patients who met the inclusion criteria. A total sample of 158 newly admitted older patients were included in the study. Eighty-eight patients were recruited from one ward in one of the hospitals and 50 and 20 patients, respectively, from two wards in the other hospital.

Data collection

The patients were interviewed using a questionnaire that included background variables, such as age, sex and main diagnoses, perceived health and health-related questions as well as the following nutritional screening instruments: Norwegian versions of NUFFE (NUFFE-NO) (Söderhamn

et al. 2009) and MNA® (Guigoz et al. 1996, Fossum et al. 2009). Data were collected from the patients' records regarding the current nutritional screening routine in the hospital wards, the NRS-2002 (Kondrup et al. 2003a, Norwegian Directorate of Health 2009), which also included weight, length and calculation of BMI, which also is a part of the MNA®. The health-related questions concerned the following areas: receiving regular help from another person to manage daily life, perceived helplessness, being active and feeling satisfied with life. These questions and the question about perceived health could be answered with either 'yes' or 'no'. The interviews with the questionnaire were performed during the patients' first days in the wards.

Screening instruments

The Mini Nutritional Assessment

Mini Nutritional Assessment can be seen as a combined screening and assessment instrument (Kondrup et al. 2003a). The items of MNA® are ranked on ordinal and nominal scale levels. The instrument is composed of 18 items involving anthropometric measurements (BMI, mid-arm and calf circumferences), questions about appetite, weight loss, mobility, psychological stress or acute disease, neuropsychological diseases, type of dwelling, medication, pressure sores or skin ulcers, number of meals, food and fluid intake, autonomy of feeding and self-perception of health and nutrition. Maximum score is 30. The scoring categorises the subjects as being well nourished (24–30 points), at risk of undernutrition (17–23·5 points) or undernourished (< 17 points) (Guigoz et al. 1996). MNA® has been used in several studies and is considered to be a reliable (Guigoz 2006) and valid screening instrument for use in Europe and Western health care practice settings (Chumlea 2006). The English version of MNA® has been translated into Norwegian. The Norwegian version of MNA® has been tested regarding reliability and validity in a small group of older nursing home patients, where supports for reliability and validity were shown in the study group (Fossum et al. 2009).

The Mini Nutritional Assessment–Short Form

The MNA-SF contains six of the items in the full MNA®, i.e. questions about appetite, weight loss, mobility, psychological stress or acute disease, neuropsychological diseases and BMI. Maximum score is 14. Scores of 12 and above indicate satisfactory nutritional status. A score of 11 or below suggests a risk of undernutrition. MNA-SF seems to be as effective as the full MNA® for nutritional screening (Guigoz et al. 2002), and according to Guigoz (2006), both instruments are sensitive, specific and accurate in identifying nutritional risk.

The Nutritional Form For the Elderly

The nutritional screening instrument NUFFE is developed in the Swedish language with older people in mind to be a simple and easily used instrument for nurses. It is an ordinal scale containing 15 three-point items: weight loss, changes in dietary intake, appetite, intake of prepared food, portion size, intake of fruit or vegetables, possibility of obtaining food products, company at meals, activity, dental and swallowing difficulties, fluid intake, gastrointestinal problems, eating assistance, number of drugs and difficulties in eating because of impaired health. The Swedish version of NUFFE has been tested concerning reliability and validity. Cronbach's alpha was found to be 0·70–0·72, and evidence of validity was shown. Each item score ranges between 0–2. The most favourable option produces a score of 0, and the most unfavourable option a score of 2. Maximum score is 30. Higher screening scores indicate higher risk of undernutrition (Söderhamn & Söderhamn 2001, 2002).

Nutritional Form for the Elderly has been translated into the Norwegian language (NUFFE-NO) in accordance with the procedure recommended by Streiner and Norman (2003). It has been tested regarding reliability (homogeneity and stability), validity (criterion-related, concurrent and construct validity), sensitivity and specificity in a group of older hospital patients. MNA® was used as a criterion to determine cut-off points of NUFFE-NO for identifying individuals at low, medium and high risk of undernutrition. For identifying individuals at medium or high risk of undernutrition, MNA® scores ≤ 23·5 (indicating risk of undernutrition) and < 17 (indicating undernutrition), respectively, were used. Following cut-off points of NUFFE-NO were found: < 6 (indicating low risk of undernutrition), ≥6 (indicating medium risk of undernutrition) and ≥11 (indicating high risk of undernutrition). The cut-off point ≥6 was based on the sensitivity and specificity values 83 and 73%, respectively, and the cut-off point ≥11 was based on the sensitivity and specificity values 77 and 83%, respectively. The areas under receiver operating characteristic curves for the cut-off points 6 and 11 were 0·79 and 0·80, respectively. Sufficient psychometric properties for institutional screening of older patients were found in these testing procedures (Söderhamn et al. 2009).

The Nutrition Risk Screening 2002

Nutrition Risk Screening 2002 is recommended as a nutritional screening instrument in Norwegian hospitals. The Norwegian version of NRS-2002 used in this study contains four questions as an initial screening, i.e. BMI < 20·5, weight loss within the past few weeks, reduced dietary intake over the past few weeks and severe disease. If the patient answers 'yes' to any question, the screening continues with a

final screening step, which contains an assessment about impaired nutritional status (weight loss in percentage, reduced food intake in percentage and/or BMI) and disease severity. Each of these two categories awards scores from 0–3 (0 indicating normal nutritional status and normal nutritional requirements; 3 indicating the severity of both nutritional status and disease as a reflection of increased nutritional requirements). An additional score is given if the patient is ≥70 years old. A total score ≥3 indicates that the patient is at nutritional risk (Norwegian Directorate of Health 2009). Predictive validity for the screening system NRS-2002 has been based on an analysis of controlled clinical trials to identify patients who benefit of nutritional support (Kondrup *et al.* 2003a,b). Reliability has been shown by interobserver variation between a nurse, dietician and physician with a kappa value of 0·67. It has been used in a two-year implementation study in three hospitals in Denmark and is considered to be a practical screening tool (Kondrup *et al.* 2003a). To compare the number of patients screened using NRS-2002 and the other screening instruments more easily, a score of 0 was given to those patients who answered 'no' in response to the four questions in the initial screening.

Statistics

All data were analysed using the Statistical Package for Social Sciences, (SPSS®), for Windows, version 16.0 (SPSS Inc., Chicago, IL, USA). Statistical significance was set at p-value $< 0{\cdot}05$. Descriptive statistics were used to describe the study group and the nutritional screening results. Data at nominal level were presented with numbers (n) and percentages (%). Ordinal data were presented with medians and interquartile ranges and interval data with mean values and standard deviations (SD). To be able to compare the screening results more easily when using all the screening instruments, the results have been dichotomised into no risk of undernutrition (MNA® scores ≥24, MNA-SF scores ≥12, NUFFE-NO scores < 6 and NRS-2002 scores < 3) and risk of undernutrition (MNA® scores ≤23·5, MNA-SF scores ≤11, NUFFE-NO scores ≥6 and NRS-2002 scores ≥3), respectively.

Non-parametric statistics were used for data on nominal level. Bonferroni's correction was used to adjust the p-values, when relating perceived health and health-related issues to the different screening results, to control the type 1 error rate at no more than 5% (Altman 1999). Parametric statistics were used for data on interval level. Six multiple forward stepwise (conditional) logistic regression analyses, including odds ratios (OR) with confidence intervals (CI), were performed to investigate possible predictors for perceived good health. The dependent variable in all these analyses was perceived good health (coded 1) or ill health (coded 0). The following independent variables were included: age, BMI, sex, marital status, type of dwelling, profession, cancer diagnosis, infection diagnosis, heart or kidney diagnosis, receiving regular help from another person to manage daily life, perceived helplessness, being active and feeling satisfied with life. In the first regression analysis, NUFFE-NO scores were included as an independent variable, in the second analysis MNA® scores, in the third analysis MNA-SF scores and in the fourth analysis NRS-2002 scores. In the fifth analysis, scores from all the instruments were included. In the sixth analysis, all variables were included with the exception of BMI, which was excluded as it is a variable in MNA® and MNA-SF and also has a role in the screening with NRS-2002.

Research ethical considerations

The study was carried out in concordance with important ethical principles (NNF 2003, Beauchamp & Childress 2009) and in compliance with the Declaration of Helsinki (WMA 2008). Permission was obtained from the responsible physicians and hospital research unit to perform the data collection in the hospital wards. Patients who fulfilled the criteria for participating in the study received oral and written information. Written consent was obtained. The study was approved by the Regional Committee for Medical Research Ethics in southern Norway (REK sør-øst C, registration number 420-08569c, 2008/14093) and by the Norwegian Social Science Data Services (Project Number 19761).

Results

The study group ($n = 158$) ranged in age between 65–94, with a mean age of 78·0 (SD 8·0). Background variables of the participating patients are shown in Table 1. The women (mean age 79·3, SD 7·6) were older than the men (mean age 76·0, SD 7·4, $p = 0{\cdot}007$). The mean value of BMI ($n = 154$) was 24·1 kg/m^2 (SD 4·9). The women had a lower BMI (mean 22·9 kg/m^2, SD 4·6) than the men (mean 25·3 kg/m^2, SD 5·0, $p = 0{\cdot}002$).

Perceived health and nutritional screening results

Of the patients in the total study group ($n = 158$), more patients perceived ill health than those who perceived good health. In Table 2, the results are displayed considering perceived health and health-related issues. There was no difference between women and men ($p = 0{\cdot}5$) regarding perceived health, but more women than men perceived themselves as being helpless ($p = 0{\cdot}005$).

Table 1 Background variables in the study group (n = 158)

Background variables		n (%)
Sex	Male	83 (52·5%)
	Female	75 (47·5%)
Civil status	Single or widow/-er	75 (47·5)
	Married/cohabitant	83 (52·5)
Type of dwelling	Own home	127 (80·4)
	Residential living	31 (19·6)
Former profession	House wife	1 (0·6)
	Blue-collar workers	115 (72·8)
	White-collar workers	36 (22·8)
	Professionals	6 (3·8)
Main medical diagnosis	Infections	69 (43·7)
	Lung diseases	34 (21·5)
	Cancer diseases	31 (19·6)
	Heart/kidney diseases	13 (8·2)
	Other diagnoses	11 (7·0)

Table 2 Perceived health and health-related issues in the study group (n = 158)

Perceived health and health-related issues	Yes % (n)	No % (n)
Perceived good health	46·8 (74)	53·2 (84)
Regularly help to manage the daily life	46·8 (74)	53·2 (84)
Perceived helplessness	36·7 (58)	63·3 (100)
Being active	64·6 (102)	35·4 (56)
Feeling satisfied with life	72·0 (113)	28·0 (44)
		1 missing

The nutritional screening results revealed that NUFFE-NO median score was 7 (interquartile range 5–12) (n = 158). NUFFE-NO identified 38% (n = 60) of the patients being at low risk of undernutrition, 29·1% (n = 46) at medium risk and 32·9% (n = 52) at high risk of undernutrition. MNA® median score was 22·5 (interquartile range 19–25) (n = 153), and the screening results, using MNA®, showed that 39·2% (n = 60) were at no risk of undernutrition, 43·8% (n = 67) at risk of undernutrition and 17% (n = 26) undernourished. MNA-SF median score was 10 (interquartile range 8–12) (n = 154), and MNA-SF identified 35·1% (n = 54) at no risk of undernutrition and 64·9% (n = 100) at risk of undernutrition. NRS-2002 median score was 2 (interquartile range 0–3) (n = 153), and NRS-2002 screened 55·6% (n = 85) to be at low risk of undernutrition and 44·4% (n = 68) at risk of undernutrition.

The dichotomised screening results, being at no risk or at risk of undernutrition, using the different screening instruments are displayed in Table 3. In Table 4, differences are shown between being at no risk and at risk of undernutrition, using different nutritional screening instruments, regarding perceived health and health-related issues.

Table 3 Screening results, using different screening instruments, dichotomised regarding the number of patients at no risk and at risk of undernutrition, respectively

	No risk of undernutrition % (n) and scores	Risk of undernutrition % (n) and scores
NUFFE-NO (n = 158)	38% (n = 60)	62% (n = 98)
	< 6 scores	≥6 scores
MNA® (n = 153)	39·2% (n = 60)	60·8% (n = 93)
	≥24 scores	≤23·5 scores
MNA-SF (n = 154)	35·1% (n = 54)	64·9% (n = 100)
	≥12 scores	≤11 scores
NRS-2002 (n = 153)	55·6% (n = 85)	44·4% (n = 68)
	< 3 scores	≥3 scores

NUFFE-NO, Norwegian version of Nutritional Form For the Elderly; MNA®, Mini Nutritional Assessment; MNA-SF, Mini Nutritional Assessment-Short Form; NRS-2002, Nutrition Risk Screening 2002.

Predictors for perceived good health

The results from the logistic regression analyses are presented in Table 5. It was found that lower risk of undernutrition using NUFFE-NO, MNA® and MNA-SF scores could predict perceived good health in the analyses 1–3, respectively. But such results from NRS-2002 scores were not obtained in the fourth analysis. When scores from all instruments were included in the fifth regression analysis, higher MNA® scores, i.e. lower risk of undernutrition, emerged as a predictor for perceived good health. When BMI was excluded in the sixth analysis, the screening scores from NUFFE-NO, i.e. lower risk of undernutrition, emerged as a predictor. Feeling satisfied with life was a positive predictor in all regression analyses. More advanced age was found to be a predictor in the first, fifth and sixth analyses. A lower BMI value was a predictor in analyses where it was included, with the exception of the fourth analysis with the NRS-2002 scores.

Discussion

Nutritional screening results

The nutritional screening results showed that many of the older hospital patients in this study were at nutritional risk independent of which of the four nutritional screening instruments were used. These results confirm the results from other studies when using NUFFE (Söderhamn *et al.* 2007), MNA® (Visvanathan *et al.* 2004, Cereda *et al.* 2008, Grieger *et al.* 2009), MNA-SF (Ranhoff *et al.* 2005, Salvi *et al.* 2008) and NRS-2002 (Martins *et al.* 2005) to identify older patients at nutritional risk.

Table 4 Comparison of nutritional screening results related to perceived health and health-related issues

Variables	NUFFE-NO No risk/risk	MNA® No risk/risk	MNA-SF No risk/risk	NRS-2002 No risk/risk
Perceived ill health % (*n*)	26·2% (22)/73·8% (62)**	26·5% (22)/73·5%(61)**	24·1% (20)/75·9% (63)*	50·0% (41)/50·0% (41)
Perceived good health % (*n*)	51·4% (38)/48·6% (36)	54·3% (38)/45·7% (32)	47·9% (34)/52·1% (37)	62·0% (44)/38·0% (27)
No regularly help % (*n*)	45·2% (38)/54·8% (46)	53·8% (49)/46·2% (42)*	44·6% (37)/55·4% (46)*	62·7% (52)/37·3% (31)
Regularly help % (*n*)	29·7% (22)/70·3% (52)	28·2% (20)/71·8% (51)	23·9% (17)/76·1% (54)	47·1% (33)/52·9% (37)
No helplessness % (*n*)	50·0% (50)/50·0% (50)**	46·9% (45)/53·1% (51)	46·4% (45)/53·6% (52)**	64·6% (62)/35·4% (34)*
Helplessness % (*n*)	17·2% (10)/82·8% (48)	26·3% (15)/73·7% (42)	15·8% (9)/84·2% (48)	40·4% (23)/59·6% (34)
Not being active % (*n*)	17·9% (10)/82·1% (46)**	20·4% (11)/79·6% (43)**	20·4% (11)/79·6% (43)*	41·5% (22)/58·5% (31)
Being active % (*n*)	49·0% (50)/51·0% (52)	49·5% (49)/50·5% (50)	43·0% (43)/57·0% (57)	63·0% (63)/37·0% (37)
Not satisfied with life % (*n*)	20·5% (9)/79·5% (35)*	23·3% (10)/76·7% (33)	20·9% (9)/79·1% (34)	37·2% (16)/62·8% (27)*
Satisfied with life % (*n*)	45·1% (51)/54·9% (62)	45·9% (50)/54·1% (59)	40·9% (45)/59·1% (65)	63·3% (69)/36·7% (40)

NUFFE-NO, Norwegian version of the Nutritional Form For the Elderly; MNA®, Mini Nutritional Assessment; MNA-SF, Mini Nutritional Assessment-Short Form; NRS-2002, Nutrition Risk Screening 2002.
*$p < 0{\cdot}05$, **$p < 0{\cdot}01$.

Table 5 Predictors for perceived good health that emerged in several logistic regression analyses

Dependent variable	Predictors	R^2 Nagelkerke	B	SE	df	*p*-value	OR (95% CI)
Perceived good health or ill health							
Nr 1	Age	0·37	0·057	0·027	1	0·032	1·059 (1·005–1·115)
	BMI		−0·094	0·044	1	0·033	0·911 (0·835–0·993)
	Satisfied with life		1·839	0·518	1	<0·001	6·290 (2·279–17·365)
	NUFFE-NO scores		−0·199	0·052	1	<0·001	0·819 (0·741–0·907)
Nr 2	BMI	0·39	−0·182	0·054	1	0·001	0·834 (0·750–0·927)
	Satisfied with life		1·754	0·508	1	0·001	5·779 (2·135–15·644)
	MNA® scores		0·264	0·064	1	<0·001	1·302 (1·149–1·475)
Nr 3	BMI	0·33	−0·131	0·048	1	0·006	0·877 (0·799–0·964)
	Satisfied with life		1·985	0·498	1	<0·001	7·276 (2·740–19·322)
	MNA-SF scores		0·291	0·086	1	0·001	1·338 (1·129–1·584)
Nr 4	Being active	0·26	0·965	0·410	1	0·019	2·625 (1·176–5·861)
	Satisfied with life		1·907	0·495	1	<0·001	6·736 (2·555–17·761)
Nr 5	Age	0·42	0·054	0·027	1	0·045	1·056 (1·001–1·113)
	BMI		−0·171	0·055	1	0·002	0·843 (0·757–0·939)
	Satisfied with life		1·880	0·524	1	<0·001	6·555 (2·349–18·292)
	MNA® scores		0·275	0·066	1	<0·001	1·316 (1·157–1·498)
Nr 6	Age	0·35	0·069	0·026	1	0·009	1·071 (1·017–1·128)
	Satisfied with life		1·856	0·516	1	<0·001	6·398 (2·325–17·606)
	NUFFE-NO scores		−0·174	0·049	1	<0·001	0·841 (0·764–0·925)

BMI, body mass index; NUFFE-NO, Norwegian version of the Nutritional Form For the Elderly; MNA®, Mini Nutritional Assessment; MNA-SF, Mini Nutritional Assessment-Short Form; NRS-2002, Nutrition Risk Screening 2002.

When comparing the dichotomised screening results using NUFFE-NO and MNA®, it was obvious that they were quite equal for identifying older patients at nutritional risk. One explanation for these results can be that NUFFE-NO and MNA® have a similar number of items, and some of these items are comparable. That MNA® was used as a standard to find the cut-off points of NUFFE-NO (Söderhamn *et al.* 2009) can also be a possible explanation. However, one difference between these screening instruments is that no anthropometrical measurements are included in NUFFE-NO.

Mini Nutritional Assessment and MNA-SF screened almost the same number of patients at no nutritional risk and being at nutritional risk. These results can be seen as being in agreement with Guigoz *et al.* (2002), who found that MNA-SF was equal to the complete MNA®. Wikby *et al.* (2008) have tested the sensitivity and specificity of MNA® and MNA-SF, and they concluded that MNA-

SF might be a sufficient screening tool for use in older people.

Nutrition Risk Screening 2002 did not screen as many patients as being at nutritional risk as did the other instruments. One possible explanation for this can be that the cut-off value for BMI in one of the four questions in the initial screening is low, i.e. $<20{\cdot}5$ (cf. Kondrup *et al.* 2003a). This can be compared with the BMI cut-off value <23 in MNA® and MNA-SF (cf. Guigoz *et al.* 1996, 2002). It can, therefore, be assumed that NRS-2002 identifies fewer older patients at nutritional risk when taking this particular question into account. This can be seen in line with Bauer *et al.* (2005), who found that MNA® could identify more patients at nutritional risk than could NRS-2002. Another possible explanation can be that NRS-2002 is not especially designed to screen older people. But on the other side, in the final screening step, an additional score is given if the person is ≥70 years old. To make NRS-2002 more suited for older people, a question about age (for example ≥70 years) could be included in the initial screening step. Another solution that possibly could increase the application to older people could be to include, in the initial screening, a higher cut-off value than $<20{\cdot}5$ regarding BMI for people ≥70 years old.

Nutritional screening results and health-related issues

When using NUFFE-NO, MNA® and MNA-SF, nutritional risk was found to be significantly associated with perceived ill health. The same association was found when using NUFFE among a group of geriatric rehabilitation patients in Sweden (Söderhamn *et al.* 2008). When MNA® was used in a study among older people, lower perceived health was found to be a risk factor of undernutrition (Johansson *et al.* 2009). However, such an association was not found in this study with regard to NRS-2002. In both NUFFE-NO and MNA®, a variable is included that can be seen to be associated with perceived health. In NUFFE, this variable reflects if it is difficult to eat as a result of impaired health (Söderhamn 2006). This variable in MNA® is a comparison of health status with other people of the same age (Guigoz *et al.* 1996). As the association between perceived ill health and being at nutritional risk was found even using MNA-SF, which includes no variable about health, it can be assumed that the health variable in MNA® and NUFFE-NO has not influenced the result.

Mini Nutritional Assessment and MNA-SF include variables about psychological stress or acute disease and neuropsychological problems (Guigoz *et al.* 1996), and NRS-2002 about disease severity (Kondrup *et al.* 2003a). These variables can also be seen as related to health. But according to the present results using NRS-2002, it seems not to have influenced any association with perceived health.

The screening results using NUFFE-NO and MNA-SF were found to be significantly associated with slightly more health-related issues than MNA and NRS-2002 were. To receive help regularly, to perceive helplessness, not being active and not feeling satisfied with life have been found to be associated with being at nutritional risk using NUFFE in an earlier study (Söderhamn *et al.* 2007).

Predictors for perceived good health

The reason for performing six logistic regression analyses was to investigate whether lower risk of undernutrition, using different screening instrument or the combination of instruments, could predict perceived good health. It was found that lower risk of undernutrition, using NUFFE-NO, MNA® and MNA-SF, emerged as predictors. These results indicate that being at nutritional risk has a negative impact on older patients' perceived health and subsequently in line with other studies (Chen *et al.* 2001, Margetts *et al.* 2003, Johansson *et al.* 2009).

Feeling satisfied with life emerged as a predictor for perceived good health in all regression analyses. This result shows that feeling satisfied with life is closely related to perceived health. A lower BMI value was a predictor in four of the five regression analyses that included BMI. However, the fact that it did not emerge in the analysis with NRS-2002 was unexpected. Moreover, the fact that a lower BMI value emerged as predictor was also unexpected. Older people ought to have a higher BMI than younger individuals, as a higher BMI is associated with lower mortality rate (Dey *et al.* 2001, Janssen *et al.* 2005, Breeze *et al.* 2006). However, in the present study, a lower BMI value as a predictor for the participating patients' perceived health should not be mistaken for a causal connection. Higher MNA® scores emerged as a predictor in the fifth regression analysis where BMI was included. The fact that lower NUFFE-NO scores emerged as a predictor in the sixth analysis, when BMI was excluded, may indicate that the screening results using NUFFE-NO are important for the older patients' perceived health.

No medical diagnoses were shown to predict the patients' perceived health in this study. This can indicate that patients can have a holistic approach to health, i.e. good health can be perceived even in the presence of disease. However, in other studies, there has been found an association between illness and lower perceived health. For example, Johansson *et al.* (2007) found that older women living at home, perceiving themselves to be healthy, experienced fewer depression

symptoms, good physical mobility and good physical health. Furthermore, several illnesses and functional dependency were found by Damián *et al.* (2008) to be negative predictors of self-rated health among older people living in institutions.

More advanced age predicted perceived good health in three of the regression analyses. It is interesting to notice that the perception of good health enhances with age. While the women in this study were older than the men, there was no difference in perceived health between them. This can be compared with the study by Ortega *et al.* (2009), who found that among patients on waiting list for renal transplantation, older patients (>60 years) perceived a higher level of health compared with younger patients (<60 years). However, Kaleta *et al.* (2009) found that older people reported their health as 'poor' or 'very poor' compared with younger people.

In the fourth regression analysis, being active was found to be a predictor for perceived good health. This result can be compared with Rütten *et al.* (2001), who found a positive association between self-rated health and physical activity among adults aged 18 and older.

Nonetheless, a certain number of the dependent variables in the regression analyses can be seen to be highly correlated with each other, for example the health-related issues (r_s = 0·32–0·38) and BMI and MNA® scores (r_s = 0·54). But according to Altman (1999), it is advantageous to use a stepwise regression analysis, because misleading findings, for example high correlations, cannot occur with this regression model.

Limitations

It can be regarded as a weakness of this study that not all older patients in the actual medical hospital wards could be included in the study during the data collection period. Patients who were too sick were excluded, because they did not have the strength and/or ability to communicate and cooperate in an interview. The results in this study have to be seen as representative for the study group, i.e. older patients who can give information about their personal situation.

It might have been an advantage if consecutive sampling could be performed in this study. This sampling method was not possible because of short stays in the hospital wards and an interviewer could not be present in the wards the whole day. Convenience sampling was therefore an alternative method to use. It was performed in that way that those patients who fulfilled the criteria when an interviewer was present in the wards received an inquiry to participate in the study.

No drop-out analyses were possible to perform, as according to the Norwegian Medical Research Ethics Committees, it was not permissible to collect data, such as age and sex, from those patients who did not want to participate. However, very few patients, who fulfilled the criteria and received an inquiry for participating, refrained from participating in this study.

Conclusions

Norwegian versions of NUFFE, MNA® and MNA-SF could identify approximately the same number of nutritional at-risk patients in this study. NRS-2002 identified fewer nutritional at-risk patients. The screening results, using NUFFE-NO, MNA, MNA-SF, were associated with perceived health. Being at nutritional risk had a negative impact on older patients' perceived health.

Relevance to practice

Corresponding nutritional screening results can be obtained using either NUFFE-NO or MNA®, as well as MNA-SF. Instruments designed specifically for older people should be used to screen older patients. Factors associated with nutritional risk can aid nurses in becoming aware of nutritional at-risk patients. Preventing undernutrition is important for overall health enhancement.

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Contributions

Study design: US, OS; data collection: SF, LJ, US; data analysis: US, SF and manuscript preparation: US, SF, LJ, OS.

Conflict of interest

The authors declare that they have no conflict of interest.

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