


RESEARCH ARTICLE

Influence of cognitive function and nurse support on malnutrition risk in nursing home residents

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Abstract

Aim: To predict malnutrition risk of older residents by cognitive function, nurse support and self-care capacity as primary measures of interest.

Design: Cross-sectional, correlation design with linear regression analysis.

Methods: Older residents over 60 years of age were randomly selected from nursing homes. Mini Mental State Exam and the Mini Nutritional Assessment were used as main measures.

Results: Lower malnutrition risk was associated with better cognitive functioning. Improved independence of self-feeding was also linked to reduced nutritional risk. Nurse support was positively related to BMI and cognitive impairment. General self-care capacity and 'appetite the week before' were key predictors of malnutrition risk; 1-point increase in both variables caused nutritional risk to decrease by 1.73 and 1.38 points, respectively. That is, a 1-point increase in self-care capacity and appetite would decrease malnutrition risk by 5.76% and 4.6%. The regression model explained significant amount (65.6%) of variance in malnutrition risk.

KEYWORDS

Cognitive impairment, elderly, malnutrition risk, nurse support, nursing home

1 | INTRODUCTION

Malnutrition in older people is a global challenge recognized by the World Health Organization (2020). As WHO argues, older people may particularly be vulnerable to malnutrition because their nutritional needs are not clearly understood and defined. Moreover, micronutrient deficiencies can easily lead to non-communicable diseases such as declining cognitive function. Since the number of senior persons is growing worldwide, the problem of providing balanced and healthy nutrition for an ageing population is of increasing importance. Droogsma et al. (2013) estimated the prevalence of malnutrition risk up to 14% in older people with Alzheimer's disease.

Guerin (2005) reported similar results for malnutrition in Alzheimer's patients in a French national survey. Kimura et al. (2019) supported that geriatric malnutrition causes dementia, especially in elderly women. Because a substantial number of elderly live in nursing homes who may suffer from malnutrition, Serrano-Urrea and Garcia-Meseguer (2013) emphasized nutritional screening of nursing home residents. They noted nursing home residents may be at higher risk of malnutrition than anticipated. Cereda et al. (2016), having performed a meta-analysis, estimated the prevalence of malnutrition at 17.5% for nursing homes. Stange et al. (2013), studying nursing home residents in Germany, also found that 18% of residents were malnourished. Guigoz (2006), however, estimated undernutrition at

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37% of institutionalized older people. Considering that cognitive and nutritional status may be linked, screening for low nutritional status in nursing home residents should be part of routine care.

As for measuring malnutrition, a great number of studies used the Mini Nutritional Assessment (MNA) as their primary assessment tool (Castro-Vega et al., 2018, Guerin et al., 2005, Cereda et al., 2016, Guigoz, 2006, Guigoz et al., 2002 and Tsai et al., 2010). The MNA has been validated and has the ability to screen for malnutrition both in acute and long-term facilities (Guigoz et al., 2002; Nakatsu et al., 2015; Oh et al., 2019). While the MNA has been a good predictor of nutritional status, BMI and calf circumference measures improved outcomes of the MNA (Tsai et al., 2010). Like the MNA, the Malnutrition Universal Screening Tool (MUST) and the Short Nutritional Assessment Questionnaire 65+ (SNAQ 65+) (Bapen, 2003; Wijnhoven et al., 2012) are also used. When considering these instruments for our research, we saw that the SNAQ identified fewer undernourished patients whereas the MUST over diagnosed malnutrition (Leistra et al., 2013). In prior research, the SNAQ was reported less precise while the MNA predicted malnutrition status with greater accuracy for nursing home residents (Diekmann et al., 2013, Donini et al., 2016 and Rolland et al., 2012). Based on our review, we conclude that malnutrition risk and cognitive impairment in nursing home residents is prevalent and deserves further investigation. However, the role of nurse support, in relation to nutritional and cognitive status, has been less studied. Therefore, the primary purpose of this research was to predict elderly malnutrition risk as a function of nurse support feeding residents, cognitive functioning, self-care and self-feeding capacity. For purposes of the current study and based on the literature reviewed above, authors selected the MNA and the Mini Mental State Exam (MMSE) to identify malnutrition risk and cognitive functioning in the selected population.

2 | METHODS

The study used exploratory, correlational and cross-sectional research design. The study was implemented in three phases in sixteen nursing homes from March to September 2019. Authors offered no incentive for participation. A trained geriatric nurse practitioner and a dietitian, employed by the research team to avoid respondent bias, approached all subjects in their residential rooms away from nursing home staff, and performed the cognitive and nutritional assessments and recorded additional research questions. Recognizing that cognitive impairment may result in item non-response (Kutschar et al., 2019), researchers performed personal interviews, verbally explained scoring to residents for each item, and the nurse practitioner recorded actual scores for each item. To minimize impact of subjects with severe cognitive impairment, post hoc statistical control (outlier detection and removal), explained under 'statistical analyses', was performed on data. The geriatric nurse did physical assessment, both professionals assessed nutritional status and recorded final scores when they reached agreement. The majority of assessments were performed during weekdays in morning hours and early afternoon.

2.1 | Sample

Study subjects were randomly selected from sixteen nursing homes in the Southern region (Baranya and Bács-Kiskun counties) of Hungary. The sampling frame was 949 residents, out of whom 300 subjects met inclusion criteria and were randomly selected. All subjects were nursing home residents. Researchers collected data only in nursing homes. Residents who had been above the age of 60 years, had been a nursing home resident at least for a year before study launch and were mentally capable to cooperate with the study team were included in the study. Exclusion criteria were as follows: 1) serious mental health condition; 2) parenteral feeding; and 3) subject refused to participate in the study. A priori sample size estimation for linear regression using the G*Power software (2020) calculated that with 6 independent variables, power being 0.8, significance 0.5 and effect size 0.15, a total number of 98 subjects were required. A final sample of 268 subjects completed the study ensuring that the sample size criterion was met.

2.2 | Statistical analyses

Descriptive analyses were used to present data characteristics. One-sample Kolmogorov-Smirnov test was employed to evaluate normal distribution. In case of non-normal distribution, authors made no attempt to transform data and used non-parametric methods. Level of significance was set at 5%, one-sided hypothesis testing was performed. To establish relationships, Spearman correlational coefficients were calculated. Wilcoxon-signed test was used to evaluate differences between groups. Linear regression analysis was performed to predict malnutrition risk. To minimize coefficient estimation bias, outliers whose standardized residuals exceeded > 2 and < -2 were removed from the analysis. Multicollinearity did not affect coefficient estimations. SPSS version 25.0 for Mac OS was used to perform all statistical tests.

2.3 | Instruments

To measure cognitive functioning, the Mini Mental State Exam (MMSE) was used. The test is a 30-point instrument that is used both for clinical and research reasons to measure cognitive impairment (Pangman et al., 2000). The MMSE is to be primarily used as a screening device for cognitive impairment. A low score (range 0-17) indicates the patient must be referred for further evaluation. While the MMSE is not immediately functional for diagnosing dementia, MMSE scores may be used to classify the severity of cognitive impairment (0-17 = severe cognitive impairment, 18-23 = mild and 24-30 = no cognitive impairment). Reliability was 0.89 in this research.

The Mini Nutritional Assessment (MNA) has been reported a valid measure administered by health professionals in hospitals or nursing homes for early detection of malnutrition risk (Guigoz et al., 2002). The MNA is an 18-item questionnaire which contains

anthropometric measures such as BMI, mid-arm and calf circumference and weight loss. It is also combined with items related to dietary intake (number of meals per day, food and fluid intake and independence of feeding) and global health assessment (lifestyle, medication, mobility, presence of acute stress and presence of dementia or depression). Finally, self-perception of one's health and nutrition is evaluated. Malnourishment is diagnosed when the person receives 17 or less points. Points ranging between 17 and 23.5 denote "at risk malnutrition"; 24–30 points imply normal nutritional status. Reliability has been reported between 0.74 and 0.89 (Bleda et al., 2002), we report 0.95 for the current study. Greater scores indicate better nutrition.

Residents were also asked about how well they ate the previous week ("How was your appetite the week before?" on a 6-point Likert scale from "very bad" to "very good") and how satisfied they had been with food quality ("Are you generally satisfied with the quality of food?" 1 = very dissatisfied, 7 = very satisfied). We also asked residents about self-care capacity and independence of feeding ("How well are you able to care for yourself, How well are you able to feed yourself?" 1 = completely unable, 2 = partially able, 3 = fully independent), about how important eating was (1 = not important, 7 = very important) and whether nurses provided enough support in feeding ("How helpful are nurses in feeding you?" 1 = very unhelpful, 7 = very helpful). Additional to the above, we recorded number of chronic diseases, BMI, body fat percentage (%), upper arm and hip circumferences as well. All instruments were available in Hungarian and in the public domain, prior validity was established in local research (Kálmán et al., 1995; Rurik & Antal, 2003).

2.4 | Ethics

The study was reviewed and approved by the research ethics committee of the Faculty of Health, University of Pécs before its final implementation (decision # ETKB/PTE-ETK/12-2019). Individual research sites (nursing homes) also gave their prior consent for the research. Participation in the study was strictly voluntary and anonym. Researchers obtained prior consent from participant or from their family/relatives and official guardians were applicable. Participants were asked to fill out instruments individually or with support from research assistants but did not reveal responses to anyone. Completed instruments were placed in sealed, unmarked envelopes by respondents before returning for collection. Subjects received no monetary or in-kind compensation for their participations. No individual consent form was signed, filling the instruments was considered consent to participate.

3 | RESULTS

Of the final 268 subjects, 73% were females and 27% were males. The average age was 81.24 years (*SD* 8.75), the youngest participant being 61, the oldest 96 years old. As for physical indicators, an

TABLE 1 Descriptive statistics (*N* = 268)

	Minimum	Maximum	Mean	Std. Deviation
Mini Nutritional Assessment	8	27	22,68	3,87
Mini Mental State Exam	7	30	17,65	8,50
Body Mass Index (BMI)	11	45	26,22	5,86
Body fat %	20	49	35,44	7,03
Upper arm circumference	20	40	28,68	4,36
Hip circumference	43	126	94,50	18,60
Self-care capacity	1	3	2,04	0,64
Independence of feeding	0	2	1,66	0,63
Number of chronic conditions	2	13	6,91	2,71
Appetite last week	1	6	4,58	1,13
Satisfaction with food quality	1	7	4,03	1,65
Nurses' support	3	7	4,87	0,69
Importance of eating	4	7	6,10	0,99

average BMI score of 26.21 (*SD* 5.86) was recorded. The average body fat percentage was 35.43 (*SD* 7.02), upper arm and hip circumferences were 28.68 (*SD* 4.35) and 94.50 (*SD* 18.60), respectively. Final scores of main measures are displayed in table 1.

Using cut-off scores on the MMSE to establish cognitive status, 26% was categorized as having "no cognitive impairment," 51% had "mild" and 23% "severe cognitive impairment." As per scale definition, the MNA identified 8% of residents with high risk of malnutrition, 42% were "at risk" and 49% of our sample was not undernourished. However, 47% of residents whose cognitive function was severe were classified as malnourished.

Table 2 presents correlation matrices of main measures of interest. Except for BMI ($p = .20$), all other variables showed non-normal distributions (K-S test results with $p < .001$), therefore Spearman coefficients were calculated.

Apart from BMI (which is part of the MNA assessment, therefore, is not considered here), Mini Mental scores showed the strongest positive correlation with malnutrition risk followed by independence of feeding and appetite the week before. Greater scores on the MMSE (better cognitive functioning) resulted in greater scores on the MNA. That is, better cognitive capacity was associated with less malnutrition risk (greater scores on the MNA defined less risk and vice versa). The same relationship held for independence of feeding and appetite (greater independence and appetite resulted in

TABLE 2 Correlation matrix of main measures

	Mini Nutritional Assessment	BMI	Appetite last week	Mini Mental State Exam	Nurses' support	Independence of feeding
Spearman's rho						
Mini Nutritional Assessment	1,000	,569**	,357**	,428**	0,079	,384**
Body Mass Index (BMI)	,569**	1,000	,320**	,289**	,275**	,377**
Appetite last week	,357**	,320**	1,000	0,026	0,008	,307**
Mini Mental State Exam	,428**	,289**	0,026	1,000	,245**	,267**
Nurses' support	0,079	,275**	0,008	,245**	1,000	0,060
Independence of feeding	,384**	,377**	,307**	,267**	0,060	1,000

**Correlation is significant at the 0.01 level (1-tailed).

*Correlation is significant at the 0.05 level (1-tailed).

Model	Unstandardized Coefficients	Standardized Coefficients	t	Sig.
	B	Beta		
(Constant)	13,131		3,300	0,001
Mini Mental State Exam	0,121	0,306	4,470	<0,001
Nurses' support	-0,603	-0,071	-0,905	0,368
How important eating is?	-0,311	-0,092	-1,171	0,245
Satisfaction with food quality	0,209	0,106	1,628	0,107
Independence of feeding	0,919	0,172	2,209	0,030
Appetite last week?	1,379	0,464	6,569	<0,001
Number of chronic conditions	0,118	0,096	1,483	0,142
Self-care capacity	1,732	0,320	4,590	<0,001

TABLE 3 Final linear regression model outcomes (dependent variable: MNA)

less malnutrition risk). Note that nurses' feeding support did not correlate with malnutrition risk. Nurse support, however, did positively correlate with BMI and Mini Mental scores; both variables were associated with malnutrition risk (MNA). That is, more nurse support was associated with greater BMI and better cognitive status. When we ran partial correlations between the MNA (nutrition risk) and MMSE (cognitive capacity) controlling for nurse support, the correlation coefficient changed from the original 0.428 value to 0.397 ($p < .001$), evidence for a moderating effect. Using scale definition, we established categories of normal and severely impaired cognitive status and ran Wilcoxon-signed tests to evaluate differences in nurse support between the two groups. A significant difference was revealed ($z = -2.62, p = .009$); nurse support was higher in the normal cognitive function group.

Note that better cognitive capacity resulted in more independence of feeding, the latter being positively associated with greater BMI and appetite. Cognitive function had a visible moderating effect on the relationship between nutritional risk and independence

of feeding; when controlling for cognitive function, the original correlation coefficient of 0.384 increased to 0.516 ($p < .001$).

Finally, to predict nutritional risk, linear regression analysis was performed. The final model was significant ($F = 20.71, p < .001$), therefore, interpretation of regression coefficients was valid. The model R^2 was 0.656, that is, 65.6% of the variance in the dependent variable was explained by the independent variables in the regression. Table 3 shows the final model with all independents. Variables that were significant: Mini Mental State Exam, independence of self-feeding, appetite the week before and self-care capacity. Magnitude of beta weights informs about the relative contribution of independents to the dependent variable. In that respect, appetite the week before made the most contribution followed by self-care capacity, Mini Mental State Exam and independence of self-feeding. However, when we examined b weights (the unit change in the independent variable causing a unit change in the dependent), the order of variables was A) self-care capacity (1.73-point increase in the MNA score); B) appetite the week

before (1.38-point increase in MNA), independence of self-feeding and Mini Mental State Exam (0.92 and 0.12-point change in MAN, respectively). Note that nurse support did not emerge as a nutritional risk predictor in the model.

4 | DISCUSSION

One key objective of the research was to predict malnutrition risk for nursing home residents. In support of Verbrugge et al. (2013), results confirmed that malnutrition was prevalent, especially for those with declined cognitive functioning. Our study reached similar conclusions to that of Malara et al. (2014) who reported malnutrition at 42% in residents with severe cognitive impairment (versus 47% in our study). The magnitude of the relationship between the MNA and MMSE was also similar between the two studies ($r = 0.39$ versus $r = 0.43$ in our study, respectively) (Malara et al., 2014).

Our final regression model explained a greater proportion (65.6%) of the variance in malnutrition risk. Only 34.4% of variance remained unexplained by the current set of independent variables. Regression outcomes confirmed that, in terms of influence on malnutrition risk, self-care capacity and appetite the previous week made the greatest impact. Results coincided with that of Johansson et al. (2009) who reported self-perceived health (measured similarly to self-care) the strongest predictor of malnutrition risk. One-point increase in self-care capacity (the overall ability to care for oneself) increased the MNA score (less malnutrition risk) by 1.73 points. Likewise, one-point increase in appetite also increased MNA by 1.38 points. That is, each point of increase (improvement) in self-care capacity or appetite decreased nutritional deficit by 5.76% and 4.6%, respectively.

Based on the above, authors argue that nursing home managers and staff nurses should focus on improving self-care capacity of residents as it will have a significant effect on appetite, which substantially lowers malnutrition risk. While independence of self-feeding and cognitive status also predicted malnutrition risk, their relative contribution was less prominent (1-point increase in independence of feeding and MMSE scores resulted in 0.92-point and 0.12-point increase in MNA, a reduction in malnutrition risk by 3% and 0.4%, respectively).

Considering the role nurses may play in nutritional risk, Håkonsen et al. (2019) found that nurse attitudes towards nutritional needs of residents produce substantial differences in the quality of nursing care. Nurses' support to self-feeding, however, was unrelated to malnutrition risk (MNA) but was positively associated with BMI and cognitive function (MMSE), both of which determined nutritional risk. Using partial correlation, we confirmed that nurse support was a latent variable mediating the relationship between cognitive function and malnutrition risk. Since nurse support was associated with BMI but did not predict nutritional risk (MNA), findings indicate that outcomes require further clarification.

Of all variables tested, cognitive function showed the greatest positive correlation with nutritional risk, but when weighed together with other variables, the relative contribution of cognitive function

to malnutrition risk was less distinct. However, cognitive function was a significant mediating variable between nutritional risk and independence of self-feeding. When we controlled for cognitive function, the magnitude of the correlation between the two variables increased. Based on results, authors recommend that future research explore the contribution of cognitive capacity on malnutrition risk more in depth because cognitive function looks a relevant underlying variable for other care-related factors (i.e. self-care and nurse support).

Finally, and opposite to expectations, we observed that nurse support and cognitive function were positively correlated. Residents whose cognitive function was less impaired received more support from nurses than those with more severe cognitive status. Results of the Wilcoxon-signed test confirmed that those with normal cognitive function received more self-feeding support from nurses than those more impaired. Authors encourage future extension of this research to confirm whether this outcome is culture specific or more universal. Nurses and nursing home managers should be aware that a caring bias towards residents with more cognitive impairment may exist. Such attitudes need to be corrected to prevent nursing staff unintentionally increase malnutrition.

4.1 | Limitations

Authors acknowledge that gender distribution of this sample was skewed towards females. Sample was selected from a tighter geographical location thus not representing all nursing homes in the country. Additional research questions developed by authors assumed expert validity, however, no validity testing for these items was performed. Responses of more cognitively impaired subjects may have influenced results. International generalizability of results may be subject to replication.

5 | CONCLUSIONS

High malnutrition risk was prevalent for nursing home residents. Forty-seven per cent of those with severe cognitive impairment was classified being at such risk. Malnutrition risk was strongest correlated with cognitive impairment followed by independence of self-feeding. Nurse support and cognitive status acted as mediators for nutritional risk. General self-care capacity and appetite the week before were key predictors of malnutrition risk, therefore, improving overall self-care capacity should decrease malnutrition risk. The relationship between nurse support and cognitive impairment indicated negative care bias towards more cognitively impaired residents and increased the likelihood of nurse induced malnutrition risk. Authors argue that to significantly reduce malnutrition risk in nursing home residents advanced collaboration between geriatric nurses and dietitians is vital. Authors recommend more in-depth research to clarify the mediating role of nurse support and cognitive status in relation to nutritional risk.

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