SCREENING FOR MALNUTRITION IN NURSING HOME RESIDENTS:
COMPARISON OF DIFFERENT RISK MARKERS AND THEIR ASSOCIATION
TO FUNCTIONAL IMPAIRMENT

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Abstract: Objectives: To identify nursing home residents with malnutrition or at risk of malnutrition by using different markers, determine if the Mini Nutritional Assessment (MNA®) is able to identify all residents at risk according to single risk markers and explore the relation between risk markers and functional impairment. Design: Cross-sectional study. Setting: Six German nursing homes. Participants: 286 residents (86±7y, 89% female). Measurements: Screening for malnutrition or its risk included low BMI (≤22 kg/m²), recent weight loss (WL), low food intake (LI) as single risk markers and MNA (<24 points, p.) as composite marker. Prevalence of single nutritional risk markers in different MNA categories was compared by cross-tables. Mental (cognition, mood) and physical function (mobility) were assessed by interviewing nursing staff and association of impaired status to nutritional risk markers determined by Chi² test. Results: 32.9% of residents had a low BMI, 11.9% WL and 21.3% LI. 60.2% were categorized malnourished (18.2%) or at risk of malnutrition (42.0%) by MNA. 64% presented at least one of these nutritional risk markers. Of those classified malnourished by MNA, 96.2% also showed low BMI, WL or LI. In contrast, eleven residents (9.6%) considered well-nourished by MNA presented single risk markers (9 low BMI, 2 WL). Cognitive impairment, depressive symptoms and immobility was present in 59.0%, 20.8% and 25.5%, respectively. Functional impairment, and in particular severe impairment, was to a higher proportion present in residents at nutritional risk independent of the chosen marker (MNA<24 p., low BMI, WL, LI). Conclusion: The high prevalence of nutritional risk highlights the importance of regular screening of nursing home residents. The MNA identified nearly all residents with low BMI, WL and LI. The close association between nutritional risk and functional impairment requires increased awareness for nutritional problems especially in functionally impaired residents, to early initiate nutritional measures and thus, prevent further nutritional and functional deterioration.

Key words: Screening, malnutrition, nursing home, functionality, nutritional risk, MNA.

Introduction

Screening for malnutrition in nursing homes is a crucial first step to early identify affected residents and those at risk that should be followed by nutritional assessment and initiation of appropriate nutritional treatment (1-3). Despite the detrimental effects of malnutrition (4, 5), guidelines (6-8) and proven efficacy of oral nutritional supplements (ONS) (9), this is, however, not always common practice. Consequences of malnutrition include adverse health effects like infections, complications, prolonged hospital stays and mortality, but also loss of independency and quality of life (1, 10, 11). Besides, the costs resulting from malnutrition (12) may lead to considerable economic burden for nursing homes, enhanced by the rising number of older people. It evaluates nutritional markers and general health status to nutritional risk markers determined by Chi² test. Results: 32.9% of residents had a low BMI, 11.9% WL and 21.3% LI. 60.2% were categorized malnourished (18.2%) or at risk of malnutrition (42.0%) by MNA. 64% presented at least one of these nutritional risk markers. Of those classified malnourished by MNA, 96.2% also showed low BMI, WL or LI. In contrast, eleven residents (9.6%) considered well-nourished by MNA presented single risk markers (9 low BMI, 2 WL). Cognitive impairment, depressive symptoms and immobility was present in 59.0%, 20.8% and 25.5%, respectively. Functional impairment, and in particular severe impairment, was to a higher proportion present in residents at nutritional risk independent of the chosen marker (MNA<24 p., low BMI, WL, LI). Conclusion: The high prevalence of nutritional risk highlights the importance of regular screening of nursing home residents. The MNA identified nearly all residents with low BMI, WL and LI. The close association between nutritional risk and functional impairment requires increased awareness for nutritional problems especially in functionally impaired residents, to early initiate nutritional measures and thus, prevent further nutritional and functional deterioration.

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improvement is commonly regarded an exclusion criterion.
Thus, the objectives of the study were (i) to identify nursing home residents with malnutrition or at risk of malnutrition using different markers, (ii) to determine if the MNA is able to identify all residents at risk according to other markers and (iii) to explore the relation between risk markers and functional impairment.

Methods

Study design

This cross-sectional study forms part of an intervention trial investigating the effects of oral nutritional supplements (ONS) on nutritional and functional status in nursing home residents with malnutrition or at risk of malnutrition.

All residents from six nursing homes in Nuremberg and Fuert, Germany, meeting the following inclusion criteria, or their legal proxies, were asked for written informed consent: age >65 years, long-term care, no end-stage disease, no hospital stay, no tube-feeding, no dialysis or intolerance to ONS. Ethical approval was obtained from the ethics committee of the Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany. Between March and December 2009 trained research staff assessed residents’ characteristics, nutritional and functional status in cooperation with the responsible qualified nurses.

Residents’ characteristics

Information on gender, age, care level according to the German nursing insurance system (0 = <45, 1 = 45-<120, 2 = 120-<240, 3 = ≥240 min need of basic care/day), eating dependency during meal times (independent, partly dependent, completely dependent) and current provision of nutritional support, either ONS or home-made snacks, were collected from residents’ files.

Nutritional risk

Screening for malnutrition included the following nutritional risk markers:

- Body mass index (BMI) was calculated as weight (kg)/height² (m²) using height and current weight from residents’ files, with BMI ≤22 kg/m² defined as low.
- Weight loss (WL) was considered if it was unintended and amounting >5% in the last 3 or >10% in the last 6 months, calculated from weight history of routine documentation.
- Low intake (LI) was reported by nursing staff, if food intake was involuntarily remarkable low during the last week.
- MNA® (Mini Nutritional Assessment) was completed in personal interviews with nurses. Weighted answers of this standardized 18-item-questionnaire covering anthropometry, global assessment, dietary patterns and subjective assessment sum up to a maximum score of 30 points (p.). A total score ≥24 p. indicates normal nutritional status, 17-23.5 p. risk of malnutrition and <17 p. malnutrition.

Nutritional risk was defined as presence of at least one of these 4 nutritional risk markers.

Functional status

Cognitive impairment and depressive mood (mental function) were assessed in standardized interviews with the responsible nurses who subjectively classified into no, moderate or severe impairment.

Mobility impairment (physical function) was regarded absent if residents were able to move independently ≥3m with or without walking aid (including wheelchair), moderate if independent movement was not possible (immobile sitting) and severe if bedridden.

Data analysis and statistics

The statistical analysis was performed using SPSS (19.0). Categorical variables are presented as absolute numbers and percentages, continuous variables as mean and standard deviation (SD). Cross-tables are used to compare prevalence of low BMI, WL and LI in different MNA categories. Chi-square tests were performed to identify differences in the distribution of residents’ characteristics between residents with and without nutritional risk and to investigate associations between nutritional and functional status. P-values <0.05 were considered statistically significant.

Results

Residents’ characteristics

From a total of 565 nursing home residents, 31 did not meet inclusion criteria. Informed consent was obtained for 286 residents (participation rate 53.6%). Mean age of participants was 86±6.8 years, 88.8% were female. Eighty percent required ≥45 minutes basic care daily and 49.3% were eating-dependent. Mean BMI was 24.8±4.6 kg/m². General characteristics, stratified for presence of nutritional risk, are summarized in table 1. Residents at risk were more often female (p<0.05), in higher need of care (p<0.001) and more dependent during meal times (p<0.001). Twenty-five residents (13.7%) at nutritional risk received oral nutritional support.

Nutritional risk

One third (32.9%) of the participants had a low BMI, LI was reported in 21.3% and WL was present in 11.9%. In 9.1% WL information was missing. MNA classified 18.2% subjects malnourished and 42.0% at risk of malnutrition. Consideration of MNA and single markers amounted to 64.0% of residents at nutritional risk received oral nutritional support.

Comparison of MNA and single nutritional risk markers

Almost all (96.2%) residents classified malnourished by MNA also showed at least one single risk marker; 84.6% BMI ≤22 kg/m² and 73.1% LI. This correspondence was less pronounced in the group at risk of malnutrition (MNA 17-23.5 p.), with low BMI, LI or WL present in 51.7%. Eleven (9.6%) residents classified well-nourished by MNA yet showed a
single marker of nutritional risk: nine a low BMI and two WL (tab.2).

Table 1
Characteristics of residents with (n=183) and without (n=103)
nutritional risk

<table>
<thead>
<tr>
<th>nutritional risk</th>
<th>no nutritional risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>15</td>
</tr>
<tr>
<td>female</td>
<td>168</td>
</tr>
<tr>
<td>Age</td>
<td></td>
</tr>
<tr>
<td>65 - 74 (years)</td>
<td>14</td>
</tr>
<tr>
<td>75 - 84</td>
<td>46</td>
</tr>
<tr>
<td>85 - 94</td>
<td>104</td>
</tr>
<tr>
<td>95+</td>
<td>19</td>
</tr>
<tr>
<td>Level of care</td>
<td></td>
</tr>
<tr>
<td>0 (&lt;45 min basic care)</td>
<td>24</td>
</tr>
<tr>
<td>1 (45-&lt;60 min)</td>
<td>41</td>
</tr>
<tr>
<td>2 (60-&lt;90 min)</td>
<td>66</td>
</tr>
<tr>
<td>3 (≥90 min)</td>
<td>52</td>
</tr>
<tr>
<td>Eating dependency</td>
<td></td>
</tr>
<tr>
<td>independent</td>
<td>56</td>
</tr>
<tr>
<td>partly dependent</td>
<td>68</td>
</tr>
<tr>
<td>completely dependent</td>
<td>59</td>
</tr>
<tr>
<td>Oral nutritional support</td>
<td></td>
</tr>
<tr>
<td>no</td>
<td>158</td>
</tr>
<tr>
<td>oral nutritional supplements</td>
<td>18</td>
</tr>
<tr>
<td>home-made snacks</td>
<td>7</td>
</tr>
</tbody>
</table>

Chi-square test *p<0.05, *** p<0.001; MNA: Mini Nutritional Assessment; 1. nutritional risk defined as presence of MNA≤23.5 p., BMI ≤22 kg/m², weight loss (>5%/10% in last 3/6 months) or low food intake

Table 2
Prevalence of low BMI, weight loss and low intake in MNA categories

<table>
<thead>
<tr>
<th>Single markers of nutritional risk</th>
<th>MNA nutritional Assessment</th>
<th>Risk of undernutrition</th>
<th>Well-nourished</th>
<th>N = 286</th>
</tr>
</thead>
<tbody>
<tr>
<td>(&lt;17 p)</td>
<td>(17-23.5 p)</td>
<td>(≥23.5 p)</td>
<td>N=114</td>
<td>N=172</td>
</tr>
<tr>
<td>low BMI</td>
<td>44</td>
<td>84.6</td>
<td>41</td>
<td>34.1</td>
</tr>
<tr>
<td>- weight loss</td>
<td>11</td>
<td>21.2</td>
<td>21</td>
<td>17.5</td>
</tr>
<tr>
<td>low food intake</td>
<td>38</td>
<td>73.1</td>
<td>23</td>
<td>19.2</td>
</tr>
<tr>
<td>≥ 1 marker*</td>
<td>50</td>
<td>96.2</td>
<td>62</td>
<td>51.7</td>
</tr>
<tr>
<td>no marker*</td>
<td>2</td>
<td>3.8</td>
<td>58</td>
<td>48.3</td>
</tr>
</tbody>
</table>

1. BMI ≤22 kg/m²; 2. Weight loss >5% in last 3/10% in last 6 months; *either low BMI, weight loss or low intake.

Functional status
In seven and 27 cases nursing staff could not judge cognitive status and depressive mood, respectively. Of those remaining, 59.0% showed moderate (36.9%) or severe (22.1%) cognitive impairment, 20.8% were rated moderately (16.2%) or severely (4.6%) depressed. One quarter of the participants (25.5%) was mobility-restricted, mostly moderate (20.6%) and to a lower extent severe (4.9%).

Discussion
The present results highlight that malnutrition and its risk are still widely present and that these problems are yet unsolved in German nursing homes. The MNA identified nearly all residents showing important single markers of nutritional risk. Functional impairment was common and not only associated with low MNA scores but also with low BMI, WL and LI, that are risk factors negatively impacting health, cognition and life expectancy in the aged population (4, 5).

The alarming proportion of residents (64%) identified at nutritional risk during screening in this study indicates that the efforts undertaken in practice to reduce prevalence and unfavorable outcome, e.g. by implementing initiatives (21, 22) or guidelines (3, 6, 7, 23), seems insufficient or without success. Uncertainty on the most practicable way to identify and treat elderly at risk persists, possibly intensified by the lack of a gold standard on the definition of malnutrition (15).

In this study we applied the MNA as well as low BMI, WL and LI as additional, separate markers for nutritional risk to investigate whether MNA covers all residents with these important single risk markers possibly requiring special attention. Even though BMI as sole marker of nutritional risk can be misleading in persons with high BMI losing weight or in persons that always had low BMI values at younger age, it represents one of the few markers that are routinely documented in nursing homes and may be an indicator of undernutrition if low (3, 24).

MNA was assessed by interviewing nursing staff to limit interference with resident’s cognitive or linguistic deficits (25) and obtain complete information, which is a strength of the study. However, nursing staff experienced the MNA as very time-consuming. This reflects one main barrier for regular use in practice (4) which could now be overcome with the recently developed 6-question short-form (MNA-SF) for improved practicability. Validation proved high sensitivity and specificity with the full version (26), making it a useful alternative for screening in nursing homes.

Compared to MNA, that identified 60.2% being malnourished or at risk, prevalence of single nutritional risk markers was lower – 32.9% low BMI, 21.3% LI and 11.9% WL. This highlights the wider approach of the MNA, also
covering acute illness, psychological disorders and immobility, which contributes to its preventive nature and enables early nutritional measures (19). Besides, it clearly shows that sole screening for single markers would certainly have neglected subjects with less obvious but also relevant risk factors for malnutrition in older people. A relevant percentage of nursing home residents are at risk of malnutrition as a consequence of functional disabilities, which may not be improved over time. This group may persistently stay at risk even after provision of nutritional support.

Therefore, in practice, further assessment of the root causes of the observed risk of malnutrition is important to find out if nutritional intervention is the appropriate sole measure to improve the situation, or if other measures including close monitoring of these residents are indicated to avoid further deterioration due to unresolved persisting causes, e.g. chewing or swallowing problems, that put them at risk of malnutrition.

An important finding is that all but 11 subjects (91.1%) with low BMI, WL or LI were identified by MNA, underscoring the broad identification of residents at nutritional risk achieved by the tool (tab.2). Those classified malnourished (<17 p.) virtually always (96.2%) showed one of the single nutritional risk markers as a clear sign of compromised nutritional status. In comparison, this proportion was lower (51.7%) in residents identified at risk of malnutrition (17-23.5 p.), indicating that a considerable share of this group is affected by an aggregation of other factors that contribute to their risk for malnutrition.

To date, it is still not quite clear which BMI cut-off is most appropriate for an elderly population and especially nursing home residents. Due to the fact that we aimed at identifying also subjects at risk of malnutrition we decided to choose a cut-off for BMI of 22 kg/m$^2$ which represents a value that corresponds to the 10th percentile of data recently assessed in a population of healthy non-Hispanic white elderly (27). Furthermore, it was shown that a BMI of 22 already increased the risk of mortality and disability (28).

Interestingly, 16 out of 42 residents with high BMI (>30 kg/m$^2$) were also identified by MNA, confirming that BMI as sole marker for nutritional risk seems insufficient. For obese persons, provision of ONS may be questionable, but nevertheless they should receive attention regarding nutritional care, especially if concurrent WL and LI are observed. This was true for 2 and 3 cases in this population, respectively. Research is needed to define strategies on nutritional treatment of obese elderly showing indicators of nutritional risk, as they may require a different intervention than subjects with lower body weight.

As sole MNA use would have overlooked some cases classified well-nourished based on total score despite having low BMI (n=9) or WL (n=2) (tab.2), separately looking at each...
of these single markers would prevent missing subjects possible in need of nutritional support. Despite being part of the MNA (MNA-SF), BMI and WL are important single markers of malnutrition and therefore also deserve separate consideration requiring low additional effort. This might be particularly important for subjects who lost weight, since WL is an important marker of malnutrition. Comparing the new MNA-SF to the three single markers (data not shown) resulted in 9 subjects being potentially overlooked instead of 11 with the full MNA. Considering also the previously mentioned high consistency with the long version, we would recommend the MNA-SF to improve screening practicability.

Participants of the present study were at high age, mostly female, with high care needs and thereby representative for nursing home populations, although the high rate of non-participation (46.4%) poses a risk of selection bias. Despite the benefits possibly resulting from screening for malnutrition, a high share of residents (or their proxies) was not willing to participate, leading to the observed high rate of refusals. For reasons of data protection it was also not possible to collect general characteristics for non-participating residents which would have enabled a comparison with participants to further evaluate the representativeness of the sample. During mealtimes, 49% of the participants were partly or completely dependent on nursing aid. Similar to previous findings (29), need of both assistance during mealtimes and general care was significantly higher in subjects at nutritional risk compared to those without risk (tab.1). If appropriate support is lacking in daily routine, this enhances the risk of nutritional deficits and might partly explain the high prevalence of nutritional risk in our sample.

Oral nutritional support was at the time of the screening only allocated to residents identified at nutritional risk, but a considerable share (86.4%) did not receive ONS or snacks (tab.1). In agreement with studies where nutritional treatment was initiated in less than half of subjects at risk (2, 29, 30), it underlines the lasting discrepancy between need for nutritional support, its recognition and implementation. Lack of time, knowledge and effort of physicians or nursing staff are regarded contributing factors (5, 31) which should also be addressed in initiatives aiming at improved nutritional care.

The high prevalence rates of cognitive deficits (59%), depressive symptoms (20%) and immobility (25%) underline the relevance of these conditions in this setting. All three functional parameters were rated based on nursing staff perception, which is affected by subjectivity and thus, might be regarded inaccurate. Due to the screening nature of the study and the large number of residents included, it was unfortunately not possible to use standardized assessment tools for cognition, depression and mobility like Mini Mental State Examination (MMSE), Geriatric Depression Score (GDS) or gait speed, which might have been more accurate. However, it was the aim to get a rough classification, and besides this approach offered the advantage of a reduced number of missing values. By asking the responsible qualified nursing personnel who were closest to residents’ everyday life and very familiar with their impairments and abilities, we feel confident that we obtained a reliable estimate. Compared to data collection from medical records, this proceeding avoided the risk of missing diagnosis by physicians’ underestimation that is particularly disadvantageous in the context of malnutrition where milder forms are also relevant (32).

Similarly, low intake was assessed subjectively by asking the nursing staff, if food intake of the residents was involuntarily remarkable low during the last week. This definition was explained to the interviewed nursing staff responsible for the wards, who were therefore able to rate it in a standardized and comparable way. Again, the screening nature of the present study did not allow for a more precise and standardized assessment using plate diagrams or dietary records.

Our results clearly show that functional impairment was significantly more prevalent in residents with malnutrition at risk (fig.1a-d). The observed relationship between nutritional risk markers and deteriorated function was especially pronounced for low MNA scores that were significantly associated with cognitive impairment, depressive mood and impaired mobility (fig.1a). This was in part expected since the MNA also includes functional aspects, but it also highlights the strength of the MNA to translate different functional impairments into an estimation of malnutrition risk. Other studies using the MNA in context with functional parameters showed an association between malnutrition according to MNA and depression (33-35), and accelerated cognitive decline over a one-year follow-up in Alzheimer patients with initial low MNA score (<23.5 p.) (36).

Remarkably, the association to functional impairment was also consistently found for every single nutritional risk marker (fig.1b-d). The relation of low BMI to functional impairment was less pronounced though and limited to a significant association to immobility. Likewise, in another nursing home sample BMI <21 kg/m² was strongly associated with sarcopenia (37), underscoring the presumed role of good nutritional status in preventing its onset and consequent mobility loss (38, 39). With regard to mental impairment, BMI ≤22 kg/m² was only by tendency related to cognitive impairment in our study (fig.1b). This might be explained by the higher cut-off chosen for low BMI, as in a previous study with a lower cut-off <20 kg/m², BMI was significantly associated with reduced cognitive status (40).

Low food intake is described as a multi-factorial problem (41) and in our study the only single marker that was significantly associated with all functional impairments (fig.1c). Both depression, dementia and physical impairment are regarded contributing factors to LI, and in accordance with our findings a previous study showed that low energy and nutrient intakes in an elderly community population were also related to frailty (42). In daily routine, LI is the easiest marker to observe and close monitoring could enable early counteraction trying to
screening for malnutrition which is not mandatory yet. The MNA enabled broad identification of nutritional risk, capturing almost all residents with low BMI, weight loss or low intake. To avoid missing residents not covered by MNA (MNA-SF) who possibly benefit from nutritional intervention, we recommend also looking at BMI, weight loss and food intake separately which requires no additional effort, since these aspects are part of the MNA. The strong relationship between nutritional risk and functional impairment highlights the need to sensitize nursing personnel for nutritional problems, especially in functionally impaired residents, to initiate early intervention and thus, avoid further nutritional and functional deterioration.

References

21. Ljungqvist O, van Gossum A, Sanz ML, de Mun F. The European fight against