Ten-year all-cause mortality in hospitalized non-surgical patients based on nutritional status screening

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Abstract
Objective: Malnutrition is common in patients admitted to hospital due to acute illness and contributes to negative patient outcomes. In Slovakia there is a lack of relevant data on malnutrition in hospitalized patients, particularly based on chronic co-morbidity and survival. The aim of the present study was to explore the prevalence of malnutrition in hospitalized chronic patients, its relationship to co-morbidity and its impact on 10-year survival.

Design: Retrospective cohort study.

Setting: Nutritional status was estimated by Subjective Global Assessment (SGA), BMI and serum albumin level. Survival was assessed from the National Insurance Registry over a 10-year period. The association between nutritional status measured by SGA and 10-year survival controlling for age, gender, BMI and serum albumin was analysed using Cox regression.

Subjects: Data were taken from the medical records of 202 consecutively admitted chronic patients.

Results: Median age was 63.5 years; 55.4% were males; median BMI was 25.9 kg/m²; median serum albumin level was 39.0 g/l. Based on SGA evaluation, 38.1% did not have sufficient nutritional status (SGA classification B and C). Malnutrition was more common in patients who were older (P=0.023), with lower BMI (P<0.001), who had gastrointestinal (P=0.049) and oncologic co-morbidity (P=0.021) and lower albumin level (P=0.049). In-hospital mortality was 3%, but during the following 10 years 52% died. Cox regression analysis controlling for age, gender, BMI and serum albumin showed that SGA was an independent predictor of death (hazard ratio = 1.55; 95% CI 1.04, 2.32; P=0.031).

Conclusions: SGA is a simple screening tool that can be routinely used in hospitalized Slovak medical patients to predict the risk of death. Improving patient nutrition could thus reduce mortality.

Keywords
Nutritional status
Subjective Global Assessment (SGA)
Co-morbidity
Survival
All-cause mortality

Malnutrition in the form of unintentional weight loss of more than 10% of body weight is common among acutely and chronically ill medical patients in hospitals[1,2]. The presence of malnutrition adversely affects clinical outcomes and indicates a need to target this population[3].

Many factors alter nutritional status[4]; therefore, it is difficult to estimate the optimal approach to nutritional assessment. However, serum albumin level can be influenced by body fluid distribution, post-operative state and renal and hepatic function[5]. BMI, a simple anthropometric measure, is the most frequently used parameter of nutritional status and is associated with all-cause mortality risk in older people, mostly driven by an increased risk of cardiovascular mortality[6].

On the other hand, Detsky et al.[7] introduced the Subjective Global Assessment (SGA), which provides an integration of historical (weight loss, dietary intake) and physical (loss of subcutaneous muscle mass or fat mass) data. The application of SGA in nutritional risk screening enhances the ability to predict poor clinical outcomes[8]. Thus far, SGA as a malnutrition screening tool has been a good predictor of health-related quality of life in chronic kidney disease as well[9]. BMI and SGA have been used in many studies as predictors of malnutrition prevalence, clinical outcomes and mortality in different periods of follow-up[8,10].

Data from European countries on the prevalence of malnutrition in different clinical settings[11-13] are well known;
Participants and methods

This was a prospective observational cohort study. All patients hospitalized at the Internal Clinic of the Nitra Teaching Hospital from April 2003 until June 2003 were consecutively included (243 patients). Out of these patients, twenty-two did not agree to participate or could not provide informed consent and nineteen were excluded due to multi-organ failure, resulting in 202 patients included in the study.

Patient nutritional status at admission (up to 12 h) was evaluated by a trained physician using the SGA protocol. SGA is an appropriate tool for assessing malnutrition\(^8,11\). With regard to SGA we classified patients into two groups: (i) normal nutrition (good nutritional status), SGA classification A; and (ii) malnutrition (moderate or severe), SGA classification B and C.

Body weight and height were measured by an electronic scale with a separate stadiometer. BMI was calculated for every patient (weight and height in the patient’s admission protocol sheet) within the first 12 h of the hospital stay. BMI evaluation was based on the WHO 1998 criteria with the following cut-off points: obesity, BMI \(\geq 30\, \text{kg/m}^2\); overweight, BMI = 25–29.9 \(\text{kg/m}^2\); normal weight, BMI 18.5–24.9 \(\text{kg/m}^2\); and underweight, BMI <18.5 \(\text{kg/m}^2\).\(^14\)

Nevertheless, the use of BMI to assess nutritional status in elderly patients over 65 years old is widely debated due to body composition alterations\(^15\). Blood samples were drawn from the venous line for determination of serum albumin level. Albumin was assessed by colorimetric assay with the bromocresol green method in a local laboratory as a standard part of diagnostic procedures, with references values between 39 and 42 g/l.

Co-morbidity data were extracted from medical and nursing investigation records. The following diseases were recorded: CVD (angina pectoris, myocardial infarction, positive coronaryography, congestive heart disease (New York Heart Association Functional Classification, class III and IV), history of stroke); respiratory diseases (bronchial asthma, chronic obstructive pulmonary disorder (Global initiative for chronic Obstructive Lung Disease, since stage III), restrictive pulmonary disorders); neurological diseases (multiple sclerosis, myasthenia gravis, stroke within 3 months, polyradiculoneuritis, dementia); endocrine diseases (thyroid disorders, diabetes mellitus); nephrologic diseases (chronic kidney disease); liver diseases (cirrhosis scoring, Child/Pugh since B/B); gastrointestinal diseases (inflammatory bowel disease based on histology, acute and chronic pancreatitis, coeliac disease); systemic diseases (systemic collagen and vascular diseases such as vasculitis, rheumatoid arthritis); oncolgic diseases (active disease with ongoing treatment by chemotherapy or radiotherapy, except skin malignancies); and others (intoxication, psychotic disorders).

Information about patient survival was collected from the registry of the Healthcare Surveillance Authority until June 2012. The local ethics committee of the Nitra Teaching Hospital in Slovakia agreed the research proposal.

Statistics

Descriptive statistics (frequencies, medians and inter-quartile ranges (IQR)) were used for the sample description. Associations between SGA and the categorical variables were evaluated using the \(\chi^2\) test; between SGA and continuous variables using the Mann–Whitney \(U\) test. Cox regression was used to explore the association between mortality and a model made up of the following variables: age, gender, BMI, albumin serum level and SGA evaluation. In the second model co-morbidity was also added (only variables significant in bivariate analysis). Kaplan–Meier curves were plotted for survival of patients with normal nutrition and malnutrition. The statistical software package IBM SPSS Statistics version 20 was used for statistical analyses.

Results

No significant differences were found between participants and non-participants regarding age and gender. The median age of patients was 65.5 (IQR 51.0–74.0) years; 112 of them were males (55.4%); median BMI was 25.9 (IQR 22.1–29.0) \(\text{kg/m}^2\); and median serum albumin level was 39.0 (IQR 34.3–43.0) g/l. Based on SGA evaluation, sixty-eight patients were malnourished (SGA classification B) and nine patients were severely malnourished (SGA classification C); due to the small number in the SGA C group we merged these two categories. Detailed information on the sample divided into normal nutrition (SGA classification A) and malnutrition (SGA classification B and C) is given in Table 1; the major reasons for hospitalization are described in Table 2.

Malnutrition was more common in older patients (\(P=0.023\)), patients with lower BMI (\(P<0.001\)), with gastrointestinal co-morbidity (\(\chi^2=10.7\), \(P=0.001\)), oncolgic co-morbidity (\(\chi^2=5.35\), \(P=0.021\)) and those with lower serum albumin (\(P=0.049\)).

The median follow-up period was 8.5 (IQR 3–8.5) years. The median period of follow-up for patients with
Ten-year mortality based on nutritional screening

Table 1: Baseline characteristics according to nutritional status among hospitalized non-surgical patients (n=202; median age 63.5 years) admitted to Nitra Teaching Hospital, Slovak Republic, April–June 2003

<table>
<thead>
<tr>
<th></th>
<th>Normal nutrition (n = 125)</th>
<th>Malnutrition (n = 77)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean, n or median</td>
<td>sd, % or IQR</td>
</tr>
<tr>
<td>Age (years), mean and sd</td>
<td>59.4</td>
<td>15.8</td>
</tr>
<tr>
<td>Gender, n and %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>72</td>
<td>57.6</td>
</tr>
<tr>
<td>Female</td>
<td>53</td>
<td>42.4</td>
</tr>
<tr>
<td>BMI (kg/m²), median and IQR</td>
<td>27.5</td>
<td>245–30.5</td>
</tr>
<tr>
<td>BMI&lt;18.5 kg/m², n and %</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>BMI≥30.0 kg/m², n and %</td>
<td>91</td>
<td>72.8</td>
</tr>
<tr>
<td>Albumin (g/l), median and IQR</td>
<td>39.6</td>
<td>35.2–43.0</td>
</tr>
<tr>
<td>Albumin&lt;32 g/l, n and %</td>
<td>19</td>
<td>15.2</td>
</tr>
</tbody>
</table>

Normal nutrition, SGA classification A; malnutrition, SGA classification B and C; IQR, interquartile range; SGA, Subjective Global Assessment.

*Significant predictor.

Table 2: Co-morbidity according to nutritional status among hospitalized non-surgical patients (n=202; median age 63.5 years) admitted to Nitra Teaching Hospital, Slovak Republic, April–June 2003

<table>
<thead>
<tr>
<th>Co-morbidity</th>
<th>Normal nutrition (n = 125)</th>
<th>Malnutrition (n = 77)</th>
<th>P value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>CVD</td>
<td>60</td>
<td>48</td>
<td>36</td>
</tr>
<tr>
<td>Respiratory diseases</td>
<td>19</td>
<td>15</td>
<td>14</td>
</tr>
<tr>
<td>Neurological diseases</td>
<td>18</td>
<td>14</td>
<td>5</td>
</tr>
<tr>
<td>Endocrine diseases</td>
<td>30</td>
<td>24</td>
<td>18</td>
</tr>
<tr>
<td>Nephrological diseases</td>
<td>7</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Liver diseases</td>
<td>13</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>Gastrointestinal diseases</td>
<td>10</td>
<td>8</td>
<td>19</td>
</tr>
<tr>
<td>Oncologic diseases</td>
<td>31</td>
<td>25</td>
<td>31</td>
</tr>
<tr>
<td>Systemic diseases</td>
<td>5</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Other diseases</td>
<td>14</td>
<td>11</td>
<td>6</td>
</tr>
</tbody>
</table>

Normal nutrition, SGA classification A; malnutrition, SGA classification B and C; SGA, Subjective Global Assessment.

*P value for the difference between SGA classification A and SGA classification B and C.

Table 3: Results of Cox regression models of 10-year survival among hospitalized non-surgical patients (n=202; median age 63.5 years) admitted to Nitra Teaching Hospital, Slovak Republic, April–June 2003

<table>
<thead>
<tr>
<th></th>
<th>Model 1 without co-morbidity</th>
<th>Model 2 with co-morbidity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>β</td>
<td>HR</td>
</tr>
<tr>
<td>Age</td>
<td>0.002</td>
<td>1.00</td>
</tr>
<tr>
<td>Male gender (ref. = female)</td>
<td>0.374</td>
<td>1.45</td>
</tr>
<tr>
<td>BMI</td>
<td>0.000</td>
<td>1.00</td>
</tr>
<tr>
<td>Albumin</td>
<td>-0.035</td>
<td>0.97</td>
</tr>
<tr>
<td>Malnutrition (ref. = normal nutrition)</td>
<td>-0.440</td>
<td>1.55</td>
</tr>
</tbody>
</table>

Model 1 without co-morbidity

Model 2 with co-morbidity

β, beta coefficient; HR, hazard ratio; ref., referent category; malnutrition, SGA classification B and C; normal nutrition, SGA classification A; SGA, Subjective Global Assessment.

*Significant predictor.

Our study estimated the prevalence of malnutrition as assessed by SGA at 38.1%. However, classification of malnutrition according to BMI was not sensitive enough; only the SGA A group had the same value of interpretation, as no patient with a BMI<18.5 kg/m² was classified as A according SGA assessment. On the other hand, only 13.0% of malnourished patients according SGA classification B and C were assessed as undernourished using BMI. BMI assessment also estimated obesity (BMI≥30.0 kg/m²) in four patients who were evaluated by SGA as undernourished. This is the reason why more sensitive and specific tools that
Serum albumin concentration does not often discriminate between well-nourished and malnourished patients\(^4\). In our cohort of patients hypoalbuminaemia was measured quite frequently in patients with good nutritional status (15·2%), as well as in undernourished patients (20·8%); the differences were not statistically significant. Therefore, in line with others, we consider serum albumin to be rather a marker of severity of concomitant illness rather than of nutritional status\(^{19}\). Therefore, it is also reasonable to estimate plasma levels of inflammatory markers such as C-reactive protein, together with the proteins of nutritional status, in order to distinguish the inflammatory response of the body to nutritional status and malnutrition per se. Unfortunately, as our study was started 10 years ago, the routine measurement of C-reactive protein for general screening purposes without the presence of acute concomitant illness was not assigned as mandatory by health-care authorities. Nevertheless, hypoalbuminaemia in our study was found to be associated with mortality as an independent predictor of death; each decrease in albumin by 1·0 g/l was associated with a 3% increase in mortality\(^{20}\). Similar data have been shown in studies of patients with end-stage renal disease\(^{21}\), after hip fracture\(^{22}\) or in frail elderly patients\(^{23}\).

Malnutrition is commonly associated with certain diseases\(^{24,25}\), so we explored the prevalence of malnutrition estimated by SGA among the co-morbidities. A statistically significant difference in the prevalence of malnutrition was clearly noted only in patients with gastrointestinal and oncologic diseases. Surprisingly, we failed to find a difference in the group of patients with liver diseases; this is probably due to low presence of end-stage liver disease in our sample. We have a similar explanation for the negative findings among patients with neurologic diseases, probably due to the short time since onset of neurologic disorders and the low number of patients with dementia in our cohort.

The impact of malnutrition on the higher need of hospitalization and increased in-hospital mortality was reported by Agarwal et al.\(^{20}\); weight loss of 15% or more of maximum body weight is also associated with increased risk of death\(^{27}\). Nutritional status also influences treatment tolerability in oncology patients\(^{28}\). Our study was underpowered to show any differences in short-term (in-hospital) mortality, as only six patients died, but we did find an association of malnutrition with long-term mortality at up to 10 years of follow-up. The impact of nutritional status on mortality was analysed using Cox regression models, controlled for age, gender, BMI and serum albumin level. Age and serum albumin level were independent predictors of survival, as expected. In addition, malnutrition as assessed by SGA was an independent predictor of death in a 10-year follow-up in the Slovakian health-care setting; the mortality of malnourished patients was 55% higher compared with patients with normal nutrition. Our findings are similar to results from studies in patients with various diseases\(^{29,30}\). However, when co-morbidity (oncologic and gastrointestinal) was added...
to our statistical analysis, nutritional status was no longer a significant predictor of survival; we expected a confounding effect from co-morbidity. The relatively small sample size might also have contributed to this result.

In summary, SGA is a simple screening tool of nutritional status and can be routinely used in Slovak hospitalized medical patients to indentify malnutrition, which predicts long-term risk of death. SGA may be used as a reliable and valid instrument for screening of malnutrition in patients who might benefit from some nutritional interventions; the effectiveness of such treatment should be prospectively evaluated.

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References

26. Agarwal E, Ferguson M, Banks M et al. (2013) Malnutrition and poor food intake are associated with prolonged hospital...


