Applied nutritional investigation

The relationship between malnutrition parameters and pressure ulcers in hospitals and nursing homes


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**Objective:** Pressure ulcers (PU) remain a major health care problem throughout the world. Although malnutrition is considered to be one of the intrinsic risk factors for PU, more evidence is needed to identify the exact relation between PU and malnutrition. This study aims to identify whether there exists a relationship between PU and malnutrition in hospitals and nursing homes.

**Methods:** A cross-sectional study was performed in April 2007 in hospitals and nursing homes in Germany. PU were assessed using the Braden scale. Malnutrition was assessed by low body mass index (BMI), undesired weight loss, and insufficient nutritional intake.

**Results:** Two thousand three hundred ninety-three patients from 29 nursing homes and 4067 patients from 22 hospitals participated in the study. PU in both hospital and nursing home patients were significantly related to undesired weight loss (5%–10%). Moreover low nutritional intake and low BMI (<18.5) were also significantly related to PU in hospitals and nursing homes.

**Conclusion:** There is a significant relationship between malnutrition parameters like undesired weight loss, BMI < 18.5, and low nutritional intake and PU.

**Introduction**

Pressure ulcers (PU) have been described as one of the most costly and physically debilitating complications in the 20th century [1]. PU cause a great deal of discomfort for patients and increase the workload in all health care sectors; PU slow the rehabilitation process, delay hospital discharge, and furthermore increase costs considerably [2,3]. PU is an area of localized damage to the skin and underlying tissue caused by pressure or shear and/or a combination of these [4,5]. Whether a patient develops PU depends on both extrinsic and intrinsic factors. Important extrinsic factors (from outside the patient) that play a role in causing pressure sores are pressure, friction, and shear forces. These factors lead to mechanical loading at the skin level and secondary to skin damage and soft-tissue breakdown [6]. Intrinsic (patient-bound) factors affect tissue viability in the patient and by this the pathophysiologic response to mechanical loading. Several studies using logistic regression analysis indicate that the following intrinsic factors are significantly associated with the presence of PU: age, sex, limitation in activity, the need for assistance with the activities of daily living, bowel and/or bladder incontinence, total Braden Scale score, anemia, infection, and nutritional status [7–10]. Nutritional status is one of the intrinsic factors that can be readily influenced. Both poor nutritional intake and poor nutritional status have been shown
to correlate with the development of PU as well as with pro-
tracted healing of wounds [11,12]. Notwithstanding methodo-
logic shortcomings, cross-sectional and prospective studies also
suggest that there is a fairly strong correlation between
malnutrition (low body weight, poor oral food intake, and
undesired weight loss) and the development of PU [10,11,13–20].
Malnutrition is a status of nutrition in which a deficiency
(which is also called undernourishment) or excess, or imbalance
of energy, protein, and other nutrients causes measurable adverse
effects on tissue, body structure, body function, and clinical outcome. In this article we mean by malnutrition a status of undernutrition.

A 2003 Cochrane review indicated that there is no strong
scientific evidence for a direct relationship between poor nutrition
and PU development and healing, although the methodo-
logic quality of the studies that were included was weak [21].
Nevertheless, individual studies have demonstrated that an
adequate nutritional intake may help to protect against PU
development and improve the rate of PU healing [22–30].
A meta–analysis by Stratton et al. pointed out that, in four
randomized controlled trials (RCTs), oral nutritional supple-
ments (250–500 Kcal for 2 to 26 wk) were associated with
a significantly lower incidence (25%) of PU development in “at-
risk” patients compared with routine care. Furthermore, some
studies showed a trend toward improved healing with high
protein nutritional supplements when compared with studies
using standard formulae. However, Stratton et al. indicated that
more robust RCT studies are needed to scientifically confirm the
latter finding [31].

The exact causal relationship between PU and (mal)nutrition
still remains unclear. Uncertainty also surrounds the precise role
of various macronutrients and micronutrients in the prevention
and healing of PU [17,18]. Because more evidence is needed as to
whether there exists a relationship between PU and malnutri-
tion, this study aims to investigate the relationship between
malnutrition parameters and PU in patients admitted to German
hospitals and nursing homes on a large scale.

### Materials and methods

#### Design

A cross-sectional multicenter prevalence study was conducted in hospitals and
nursing homes throughout Germany in April 2007.

#### Instrument

A standardized protocol (including a questionnaire +
standardized measurements) was used with questions regarding patient demographics, PU
characteristics (site, grade, duration), and malnutrition parameters measure-
ments. Malnutrition parameters were assessed according the European Society
for Clinical Nutrition and Metabolism (ESPEN) guidelines, by measuring the
following: percentage undesired weight loss (5% during the last month or more
than 10% during the last 6 mo), body mass index (BMI) with a value of <18.5 kg/
m² for patients between 18 and 64, or a BMI of less than 20 kg/m² for patients 
>65 y [32,33]. In addition the parameter nutritional intake was measured using
an item of the Braden scale, a validated scale to measure the risk of developing
a PU. This item includes the four following levels; “poor,” “probably inadequate,”
“adequate,” and “excellent” nutritional intake [34].

#### Data collection

A coordinator was responsible for the measurement within each institution.
Researchers trained the coordinators in all participating hospitals and nursing
homes. Secondarily each coordinator trained the teams of ward nurses in gath-
ering the data and assessing the four PU grades [5]. The trained ward nurses
examined all patients in the participating nursing homes and hospitals. To
achieve an objective judgment of every patient, two healthcare professionals
assessed each patient together, with one professional working on the ward of the
patient, and one independent professional working within the same organiza-
tion. The patients were weighed with light clothes and without shoes. The
patients’ height was taken in centimeters. BMI (kg/m²) was calculated by the
research group. The item undesired weight loss was assessed from earlier
recorded weights in the charts, or, if missing, from recalled weight. Nutritional
intake (item from the Braden Scale) was assessed using earlier recorded
nutritional intake and, if missing, recalled intake was used [34].

#### Sample

A total of 8934 patients (6117 from hospitals and 2817 from nursing homes)
from all over Germany were invited by leaflets to participate voluntarily in the
study. Patients included in the study were 18 y and older.

### Table 1

Difference between patients with and without pressure ulcers concerning nutritional parameters in hospitals (N = 4067, univariate analysis)

<table>
<thead>
<tr>
<th>Variables</th>
<th>PU+(N = 290)</th>
<th>PU−(N = 3777)</th>
<th>P value</th>
<th>OR</th>
<th>CI 95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undesired weight loss &lt; 5%</td>
<td>15.9%</td>
<td>9.4%</td>
<td>&lt;0.001</td>
<td>1.797</td>
<td>1.253–2.577</td>
</tr>
<tr>
<td>5%–10%</td>
<td>14.0%</td>
<td>6.6%</td>
<td>&lt;0.001</td>
<td>2.294</td>
<td>1.557–3.378</td>
</tr>
<tr>
<td>&gt; 10%</td>
<td>3.7%</td>
<td>3.1%</td>
<td>0.029</td>
<td>1.198</td>
<td>0.575–2.495</td>
</tr>
<tr>
<td>BMI cutoff &lt; 18.5 kg/m²</td>
<td>16.0%</td>
<td>5.4%</td>
<td>&lt;0.001</td>
<td>3.325</td>
<td>1.514–7.306</td>
</tr>
<tr>
<td>BMI cutoff &lt; 20 kg/m²</td>
<td>12.7%</td>
<td>8.0%</td>
<td>0.018</td>
<td>1.683</td>
<td>1.090–2.600</td>
</tr>
<tr>
<td>Poor nutritional intake</td>
<td>10.5%</td>
<td>2.5%</td>
<td>&lt;0.001</td>
<td>4.617</td>
<td>2.998–7.108</td>
</tr>
<tr>
<td>Probably inadequate nutritional intake</td>
<td>25.1%</td>
<td>12.0%</td>
<td>&lt;0.001</td>
<td>2.455</td>
<td>1.846–3.263</td>
</tr>
</tbody>
</table>

PU+, with pressure ulcers; PU−, without pressure ulcers
* Odds ratio.
† Confidence interval, 95%.

### Table 2

Difference between patients with and without pressure ulcers concerning nutritional parameters in nursing homes (N = 2393 univariate analysis)

<table>
<thead>
<tr>
<th>Variables</th>
<th>PU+(N = 139)</th>
<th>PU−(N = 2254)</th>
<th>P value</th>
<th>OR</th>
<th>CI 95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undesired weight loss &lt; 5%</td>
<td>12.8%</td>
<td>5.2%</td>
<td>&lt;0.001</td>
<td>2.675</td>
<td>1.532–4.671</td>
</tr>
<tr>
<td>5%–10%</td>
<td>9.2%</td>
<td>1.5%</td>
<td>&lt;0.001</td>
<td>6.610</td>
<td>3.245–13.466</td>
</tr>
<tr>
<td>&gt; 10%</td>
<td>3.0%</td>
<td>0.5%</td>
<td>&lt;0.01</td>
<td>5.244</td>
<td>1.442–19.072</td>
</tr>
<tr>
<td>BMI cutoff &lt; 20 kg/m²</td>
<td>33.3%</td>
<td>15.5%</td>
<td>&lt;0.001</td>
<td>2.824</td>
<td>1.921–4.152</td>
</tr>
<tr>
<td>Poor nutritional intake</td>
<td>33.3%</td>
<td>15.0%</td>
<td>&lt;0.001</td>
<td>2.891</td>
<td>1.489–5.611</td>
</tr>
<tr>
<td>Probably inadequate nutritional intake</td>
<td>8.1%</td>
<td>3.0%</td>
<td>&lt;0.01</td>
<td>2.340</td>
<td>1.527–3.586</td>
</tr>
</tbody>
</table>

PU+, with pressure ulcers; PU−, without pressure ulcers
* Odds ratio.
† Confidence interval 95%.
Table 3
Multiple logistic regression model for malnutrition indicators associated (P < 0.05) with pressure ulcers in the hospital setting

<table>
<thead>
<tr>
<th>Indicator</th>
<th>B</th>
<th>S.E.</th>
<th>Sig.</th>
<th>OR</th>
<th>95.0% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undesired weight loss</td>
<td>1.205</td>
<td>0.489</td>
<td>0.014</td>
<td>3.336</td>
<td>1.279</td>
</tr>
<tr>
<td>BMI &lt; 18.5</td>
<td>1.383</td>
<td>0.472</td>
<td>0.003</td>
<td>3.982</td>
<td>1.579</td>
</tr>
<tr>
<td>Poor nutritional intake</td>
<td>1.393</td>
<td>0.574</td>
<td>0.015</td>
<td>4.028</td>
<td>1.308</td>
</tr>
<tr>
<td>Bedfast</td>
<td>3.134</td>
<td>0.415</td>
<td>0.001</td>
<td>22.961</td>
<td>10.180</td>
</tr>
</tbody>
</table>

B, regression coefficient; CI, confidence interval

Table 4
Multiple logistic regression model for malnutrition indicators associated (P < 0.05) with pressure ulcers in the nursing home

<table>
<thead>
<tr>
<th>Indicator</th>
<th>B</th>
<th>S.E.</th>
<th>Sig.</th>
<th>OR</th>
<th>95.0% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probably inadequate intake</td>
<td>0.349</td>
<td>0.127</td>
<td>0.006</td>
<td>1.418</td>
<td>1.106</td>
</tr>
<tr>
<td>Poor nutritional intake</td>
<td>0.929</td>
<td>0.428</td>
<td>0.030</td>
<td>2.532</td>
<td>1.094</td>
</tr>
<tr>
<td>BMI &lt; 18.5</td>
<td>0.929</td>
<td>0.267</td>
<td>0.001</td>
<td>2.540</td>
<td>1.504</td>
</tr>
<tr>
<td>Undesired weight loss</td>
<td>1.652</td>
<td>0.421</td>
<td>&lt;0.001</td>
<td>5.230</td>
<td>2.292</td>
</tr>
<tr>
<td>Undesired weight loss &lt; 10%</td>
<td>1.601</td>
<td>0.782</td>
<td>0.041</td>
<td>4.960</td>
<td>1.071</td>
</tr>
</tbody>
</table>

B, regression coefficient; CI, confidence interval

Ethical considerations

Permission to conduct the study in Germany was obtained from the Berlin medical ethics committee. Prior to the data collection, oral informed consent was obtained from the patients, either in person or from one of their legal representatives.

Data analysis

Data were analyzed using the statistical package for social science (SPSS, Chicago, IL, USA) version 15. Descriptive statistics were used to describe the patient’s characteristics. Chi-square, odds ratio, and t test were used to describe the differences regarding nutritional status between patients with PU and patients without PU. The same statistical procedures were used to describe the differences between hospital patients and nursing home patients regarding nutritional status. A multivariate (stepwise) logistic regression analysis was performed separately for hospitals and nursing homes organizations by using the enter method. This analysis was performed to describe the relationship between PU and BMI as well as amount of nutritional intake and undesired weight loss. Prior to analysis, data were assessed for congruence with regression assumption. Furthermore, the independent variables (age, gender, mobility [34], time since admission, neurologic diseases, cancer, dementia, infection, cerebrovascular accident [CVA], and chronic obstructive pulmonary disease) were checked for possible interaction, and confounding and multicollinearity. Because patients within the same hospital and nursing home could be clustered, this was corrected for by including indicator variables for the different hospitals of nursing homes within the logistic regression analysis. Variables that remained significant at the 0.05 level were presented.

Results

The overall response rate to participate in this study was 72.5% (6473). Concerning the nutritional indicators, missing data were found on BMI (3.2%) and undesired weight loss (14.2%). The multivariate logistic analysis shows a significant relationship between the presence of PU and undesired weight loss (Table 3). This is even more the case in nursing homes where the OR for getting PU was 5.230 for weight loss 5%–10% and 4.960 for weight loss <10% (Table 4). Furthermore, poor nutritional intake and low BMI are related to PU in both settings. Bedfast was found to be a confounder in the hospital setting.

Discussion

The main objective of this study was to find evidence of a relationship between PU and malnutrition parameters (undesired weight loss, low BMI, and low nutritional intake) in patients admitted to hospitals and nursing homes. This study was able to explore this on a large scale in two different settings. Based on the logistic regression analysis, there was a significant relationship between the presence of PU and undesired weight loss. Also in other studies it has been indicated that many acute and chronically ill as well as elderly patients, at risk of PU or with established PU, suffer from undesired weight loss [11,17–20].

Moreover, poor nutritional intake was strongly related to the presence of PU in hospitals and nursing homes. This is in agreement with other studies using multivariate analysis that have indicated that poor oral food intake is an independent risk factor for pressure sores [10,17,18]. The mobility item bedfast was indicated as a confounder because immobility is related to both PU as to weight loss and nutritional intake. Weight loss and nutritional intake are related to immobility because these malnutrition parameters influence the functional capacity of a patient [7–10,35–38].

A particular difficulty with cross-sectional studies focusing on correlations is the fact that the progression over time of certain disorders and their possible risk factors cannot be measured by a one-time measurement. As the dependent and independent variable are selected at one and the same time, causality cannot be assessed. For example, disease and malnutrition interact such that the disease may cause secondary malnutrition, or malnutrition may adversely influence underlying disease. It is important that the relationship between (mal)nutrition and PU is made more explicit, and strong scientific evidence from robust RCTs is therefore needed. This will help increase our understanding of the relationship between PU and (mal)nutrition and provide a stronger evidence base.

Furthermore, although this measurement was intended to measure the BMI and undesired weight loss of every patient, still missing data were found according to BMI and undesired weight loss. It is extremely difficult to measure these indicators in such a large group of hospital and nursing home patients. Other studies have indicated this as well in the past [30–31].
**Practical implications**

Nevertheless, the results of this article confirm the relationship between PU and malnutrition and therefore stress the importance of adequate nutritional care in PU (prone) patients. Because potential malnutrition is a reversible risk factor for wounds (PU), early identification and management of it are very important.

Therefore all PU (prone) patients should have a nutritional screening to determine whether the patient has any nutritional problems and if nutritional screening identifies patients to be malnourished or at nutritional risk; subsequently, this must lead to a more complete nutritional assessment by a registered dietitian or if needed by a multidisciplinary nutritional team. After the assessment, tailor-made nutritional support has to be provided to each nutritionally compromised individual. To support the implementation of adequate nutritional management in daily PU care, more detailed clinical guidelines on nutrition exist and should be available [38,39].

**Acknowledgments**

We would like to thank all the organizations that participated in the measurements.

**References**


