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# Prevalence of Malnutrition in Hospitalized Patients: a Multicenter Cross-sectional Study

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The authors have no potential conflicts of interest to disclose.

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## ABSTRACT

**Background:** Malnutrition is associated with many adverse clinical outcomes. The present study aimed to identify the prevalence of malnutrition in hospitalized patients in Korea, evaluate the association between malnutrition and clinical outcomes, and ascertain the risk factors of malnutrition.

**Methods:** A multicenter cross-sectional study was performed with 300 patients recruited from among the patients admitted in 25 hospitals on January 6, 2014. Nutritional status was assessed by using the Subjective Global Assessment (SGA). Demographic characteristics and underlying diseases were compared according to nutritional status. Logistic regression analysis was performed to identify the risk factors of malnutrition. Clinical outcomes such as rate of admission in intensive care units, length of hospital stay, and survival rate were evaluated.

**Results:** The prevalence of malnutrition in the hospitalized patients was 22.0%. Old age ( $\geq 70$  years), admission for medical treatment or diagnostic work-up, and underlying pulmonary or oncological disease were associated with malnutrition. Old age and admission for medical treatment or diagnostic work-up were identified to be risk factors of malnutrition in the multivariate analysis. Patients with malnutrition had longer hospital stay (SGA A =  $7.63 \pm 6.03$  days, B =  $9.02 \pm 9.96$  days, and C =  $12.18 \pm 7.24$  days,  $P = 0.018$ ) and lower 90-day survival rate (SGA A = 97.9%, B = 90.7%, and C = 58.3%,  $P < 0.001$ ).

**Conclusion:** Malnutrition was common in hospitalized patients, and resulted in longer hospitalization and associated lower survival rate. The rate of malnutrition tended to be higher when the patient was older than 70 years old or hospitalized for medical treatment or diagnostic work-up compared to elective surgery.

**Keywords:** Malnutrition; Nutrition Assessment; Hospitalization; Prevalence; Subjective Global Assessment

## INTRODUCTION

Malnutrition is associated with many adverse clinical outcomes, including longer length of stay, increased morbidity and mortality, and increased hospital costs.<sup>1-5</sup> Although measurement of malnutrition varied depending on the hospital setting and method of nutritional assessment, its prevalence in hospitals was reported to range from 20% to 50%.<sup>1,4-8</sup> Therefore, the recognition of malnutrition and early nutritional therapy in hospitalized patients is important along with the treatment of underlying diseases. However, although malnutrition among hospitalized patients is not rare, it is occasionally overlooked<sup>1,4,8,9</sup> either because medical resources, such as the availability of nutritional specialists or hospital systematic and financial support, are insufficient, or because clinicians do not consider malnutrition to be a vital issue.

The nationwide prevalence of malnutrition in hospitalized patients is not well studied in Korea, and nutritional therapy planning for patients with malnutrition is difficult without information regarding the present situation. This nationwide multicenter cross-sectional study was conducted to determine the prevalence of malnutrition and associated clinical factors, and to evaluate the association with clinical outcomes in Korea.

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## METHODS

### Participants

Clinical research groups of the Korean Society for Parenteral and Enteral Nutrition (KSPEN) recruited a total of 25 hospitals (19 tertiary hospitals and 6 secondary hospitals). The size of the participating hospitals ranged from 400 to 2,700 beds. All hospitals had their own nutritional support team. The study participants were recruited from among the patients hospitalized on January 6, 2014, regardless of the departments of admission. The exclusion criteria were as follows: patients who were pregnant, aged < 18 years, and planned to be discharged within 72 hours. The number of recruiting participants from each hospital was determined by considering the average number of admitting patients for 1 day. Based on the sample size calculation, we planned to enroll 337 patients. The included participants were investigated for the following characteristics: age, sex, height, weight, department of admission, major diagnosis at the time of admission, and underlying diseases. All the participating hospitals acquired approval from the Institutional Review Board, and informed consent was obtained from all the patients.

### Nutritional status and clinical outcome assessment

The nutritional support team of each hospital investigated the demographic characteristics and evaluated the nutritional status of the study subjects using the Subjective Global Assessment (SGA) on the day of admission and categorized them into SGA A, B, or C (Appendix 1).<sup>10,11</sup> The worst two groups in terms of nutrition, SGA B and C, were defined as patients with malnutrition. Subsequently, clinical outcomes, such as length of stay, intensive care unit admission rate, survival rate, and type of discharge were evaluated after 90 days.

### Statistical analysis

In the preliminary study conducted with 99 patients from six hospitals in Korea 2013,<sup>12</sup> the malnutrition rate in the hospitalized patients was 20.2% (20/99). By using this rate, we initially calculated the sample size to be 218 patients, with an  $\alpha$  of 0.05 and a statistical power of 0.8. The refusal rate of the enrolled study subjects from our preliminary study was 0%–35%; therefore, we applied the highest rate in a conservative manner. Thus, the total number of participants was calculated to be 335 ( $218 \times \frac{100}{100 - 35}$ ).

In addition, we classified the 25 participating hospitals into five groups according to rank for the number of admitting patients a day (range: 20–350). The hospitals in the same group were allocated with the same number of study subjects. We allotted the required number of study participants to each group in proportion to the average number of admitted patients. As a result, each hospital in the five groups was allotted 6, 11, 12, 15, and 25 patients, respectively. Finally, the total number of participants was determined to be 337.

Categorical variables were compared by using the  $\chi^2$  or Fisher exact test; and continuous variables, by using the Student t-test or one-way analysis of variance (ANOVA). To determine the risk factors of malnutrition in hospitalized patients, we used logistic regression models in the univariate and multivariate analyses with the backward method. A two-sided significance level of 0.05 was used for all statistical analyses. Statistical analyses were performed by using the Statistical Package for Social Sciences version 22.0 software (SPSS Inc., Chicago, IL, USA).

### Ethics statement

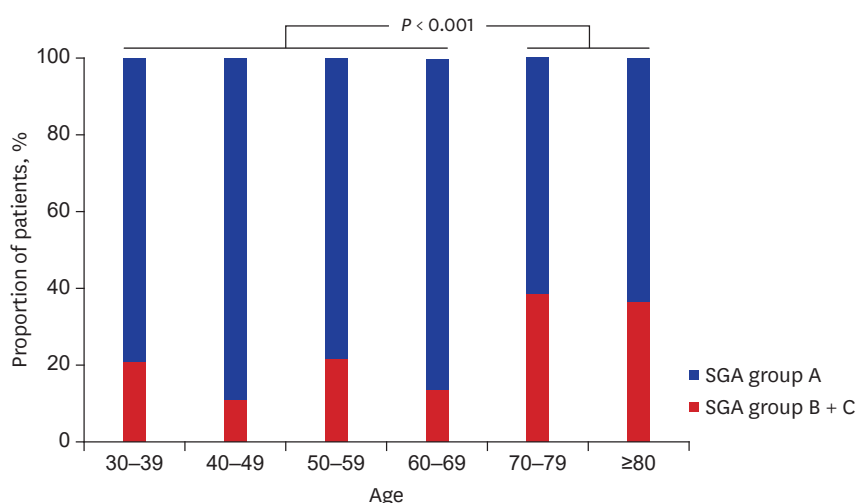
The Institutional Review Board of Asan Medical Center approved this study (approval number: 2013-1120) and informed consent was obtained from all patients.

## RESULTS

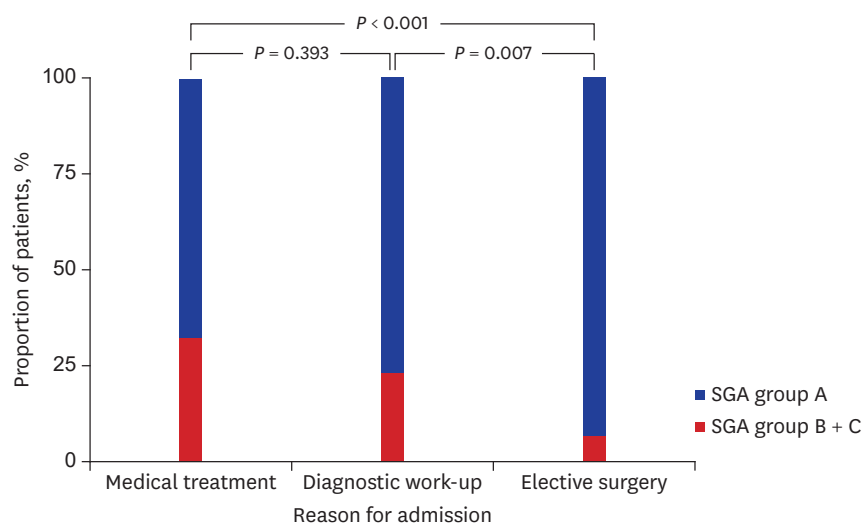
Among the 337 planned participants, 300 (79.0%) were finally recruited. No significant differences in enrollment rate were found between the five groups of hospitals ( $P = 0.701$ ). The most common reason for admission was medical treatment (50.7%), followed by elective surgery (38.7%) and diagnostic work-up (10.6%).

The malnutrition rate in the hospitalized patients was found to be 22.0% (66/300). Among the patients with malnutrition (SGA B + C), 81.8% ( $n = 54$ ) had moderate malnutrition (SGA B) and 18.2% ( $n = 12$ ) had severe malnutrition (SGA C). The malnutrition rate was not different according to the size (number of admitting patients a day, divided into five groups) or the referral level (secondary or tertiary) of the participating hospital ( $P = 0.851$  and  $P = 0.769$ ). A difference in malnutrition rate was found between the different age groups, and the elderly (aged  $\geq 70$  years) had a significantly higher malnutrition rate than the younger age group (38.2% vs. 17.2%,  $P < 0.001$ ; **Fig. 1**). A significant difference in malnutrition rate was observed among the reasons for admission. The malnutrition rate was highest in the patients admitted for medical treatment (32.5%), followed by those admitted for diagnostic work-up (23.3%) and elective surgery (7.0%; **Fig. 2**).

The demographic characteristics of the enrolled patients according to nutritional status are presented in **Table 1**. The patients with malnutrition had significantly lower body mass index ( $24.2 \pm 3.3$  kg/m<sup>2</sup> vs.  $21.9 \pm 3.9$  kg/m<sup>2</sup>,  $P < 0.001$ ), and more patients were admitted for medical treatment in the malnourished group (41.6% vs. 69.7%,  $P < 0.001$ ). In terms of underlying disease, more patients had underlying pulmonary and oncological diseases in the malnourished group, with a statistically significant difference (4.3% vs. 12.1%,  $P = 0.034$ ; 15.0% vs. 25.8%,  $P = 0.041$ ). The prevalence rates of renal, gastrointestinal, and



**Fig. 1.** Patients aged  $\geq 70$  years exhibited higher malnutrition rates than the younger patients. SGA = Subjective Global Assessment.



**Fig. 2.** Malnutrition rates according to the reason for admission.  
SGA = Subjective Global Assessment.

psychological diseases were also elevated in this group (6.8% vs. 13.6%, 5.6% vs. 12.1%, and 1.7% vs. 6.1%), but these were not statistically significant (**Table 1**).

In the univariate analysis, malnourishment was the dependent variable, and age  $\geq 70$  years (odds ratio [OR], 2.97; 95% confidence interval [CI], 1.64–5.39), underlying pulmonary and oncological diseases (OR, 3.09; 95% CI, 1.17–8.18 and OR, 1.97; 95% CI, 1.02–3.81, respectively), and admission for medical treatment or diagnostic work-up (OR, 6.11; 95% CI, 2.79–13.36) were associated with a significantly higher rate of malnutrition (**Table 2**). Factors that were statistically significant in the univariate analysis ( $P < 0.100$ ) and sex were included in the multivariate analysis. The patients aged  $\geq 70$  years were found to have 2.4 times higher risk of malnutrition (95% CI, 1.01–4.56;  $P = 0.005$ ). The patients admitted for medical treatment or diagnostic work-up had an increased risk of malnutrition (OR, 5.48; 95% CI, 2.47–12.14,  $P < 0.001$ ; **Table 2**).

**Table 1.** Demographic characteristics of the hospitalized patients (n = 300) according to SGA rank

Items of demography or clinical condition	SGA A (n = 234)	SGA B (n = 54) and C (n = 12) (n = 66)	P value
Sex (male)	125 (53.4)	37 (56.1)	0.704
Age, yr	54.5 $\pm$ 15.6	59.6 $\pm$ 16.9	0.024
BMI, kg/m <sup>2</sup>	24.2 $\pm$ 3.3	21.9 $\pm$ 3.9	< 0.001
Admission for medical treatment or diagnostic work-up	126 (53.8)	58 (87.9)	< 0.001
Underlying diseases (yes)			
Cardiological disease	20 (8.5)	6 (9.0)	0.897
Vascular disease	73 (31.1)	23 (34.8)	0.574
Pulmonary disease	10 (4.3)	8 (12.1)	0.034
Neurological disease	4 (1.7)	2 (3.0)	0.616
Endocrine disease	49 (20.9)	19 (28.8)	0.179
Renal disease	16 (6.8)	9 (13.6)	0.078
Gastrointestinal disease	13 (5.6)	8 (12.1)	0.065
Oncological disease	35 (15.0)	17 (25.8)	0.041
Psychological disease	4 (1.7)	4 (6.1)	0.074
Musculoskeletal disease	12 (5.1)	3 (4.5)	> 0.999
Others <sup>a</sup>	8 (3.4)	4 (6.1)	0.306

Data are shown as number (%) or mean  $\pm$  standard deviation.

SGA = Subjective Global Assessment, BMI = body mass index.

<sup>a</sup>For example, benign prostatic hypertrophy and cataract.

**Table 2.** Logistic binary regression with malnutrition (SGA B + C) as a dependent variable

Variables	Univariate analysis <sup>a</sup>			Multivariate analysis <sup>b</sup>		
	OR	95% CI	P value	OR	95% CI	P value
Male	1.113	0.642–1.928	0.704			
Age ≥ 70 yr	2.971	1.637–5.393	< 0.001	2.439	1.307–4.553	0.005
Admission for medical treatment or diagnostic work-up	6.108	2.793–13.360	< 0.001	5.479	2.473–12.140	< 0.001
Pulmonary disease	3.090	1.167–8.179	0.023			
Renal disease	2.151	0.904–5.120	0.083			
Gastrointestinal disease	2.345	0.928–5.925	0.072			
Oncological disease	1.973	1.021–3.810	0.043			
Psychological disease	3.710	0.902–15.250	0.069			

SGA = Subjective Global Assessment, OR = odds ratio, CI = confidence interval.

<sup>a</sup>Only underlying diseases with a *P* value of < 0.100 are listed; <sup>b</sup>All the listed variables are adjusted in the multivariate analysis.

**Table 3.** Clinical outcomes of the hospitalized patients according to SGA rank

Outcomes	SGA A (n = 234)	SGA B (n = 54)	SGA C (n = 12)	P value
ICU admission	9 (3.8)	1 (1.9)	1 (8.3)	0.531
Length of hospital stay <sup>a</sup>	7.63 ± 6.03	9.02 ± 9.96	12.18 ± 7.24	0.018
Survival rate <sup>b</sup>	229 (97.9)	49 (90.7)	7 (58.3)	< 0.001

Data are shown as number (%) or mean ± standard deviation.

SGA = Subjective Global Assessment, ICU = intensive care unit, ANOVA = analysis of variance.

<sup>a</sup>Statistically significant only between SGA A and C by ANOVA with Bonferroni correction (*P* = 0.024); <sup>b</sup>SGA A and B, *P* = 0.030; B and C, *P* = 0.015; A and C, *P* < 0.001, using the  $\chi^2$  test with Bonferroni correction.

Malnutrition was closely related to the clinical outcomes (Table 3). As malnutrition worsen, the length of hospital stay was increased and the survival rate decreased, with statistically significant differences across the three SGA groups (7.63 ± 6.03 vs. 9.02 ± 9.96 vs. 12.18 ± 7.24 days, *P* = 0.018 and 97.9% vs. 90.7% vs. 58.3%, *P* < 0.001). In the post hoc study, length of hospital stay was significantly different between groups A and C only (*P* = 0.024 with Bonferroni correction), and survival rate was significantly different among all the groups (SGA A and B, *P* = 0.030; B and C, *P* = 0.015; A and C, *P* < 0.001, with Bonferroni correction).

## DISCUSSION

In this nationwide multicenter cross-sectional study in Korea, 22% of the hospitalized patients had malnutrition at the point of admission according to SGA rank. This rate corresponds with those in other studies that evaluated the hospital malnutrition rate according to SGA rank. An Australian study performed in 2008 by Gout et al.<sup>4</sup> reported a 23% malnutrition rate in tertiary hospitals using the SGA rank, and a German study performed by Pirlich et al.<sup>7</sup> reported a malnutrition rate of 27.4% in 13 hospitals. Like our study, these studies only evaluated nutritional status at the point of admission. If our study included already hospitalized patients, the malnutrition rate may have been higher. For instance, in the Brazilian National Survey on Hospital Nutritional Assessment survey conducted in Brazil, the malnutrition rate was determined to be 48.1% by using the SGA rank.<sup>8</sup> This relatively high rate may have resulted from including both newly admitted and already hospitalized patients.

Age was a major risk factor of malnutrition. Of the patients aged ≥ 70 years, 38.2% had a significantly higher malnutrition rate than the younger patients (17.2% vs. 38.2%, *P* < 0.001). The aforementioned German study<sup>7</sup> also reported a high prevalence of malnutrition in elderly patients (43%). Many physiological, social, and psychological changes ensue as patients get older, which makes the elderly particularly vulnerable to malnutrition.<sup>13,14</sup> Considering the high prevalence of malnutrition in this group, routine and periodic nutritional assessment



of hospitalized elderly patients is mandatory as an initiating step of appropriate nutritional therapy. The Mini Nutrition Assessment, which is encouraged for use in the elderly, can be applied for a more detailed evaluation.<sup>15-17</sup>

Having specific underlying comorbidities was associated with malnutrition, and this was especially apparent in the patients with pulmonary and oncological diseases in this study. Resting energy expenditure increased to as high as 15%–20% of the expected value among chronic obstructive pulmonary disease patients, which could have resulted from the increased energy of the respiratory muscles.<sup>18,19</sup> In addition, inflammation, hypoxia, hypercapnia, and various medications are known to cause malnutrition in patients with pulmonary disease. Weight loss is a common symptom in patients with oncological diseases, due to the tumor itself, the physiological reaction to the tumor, and treatment complications from treatment, all of which can promote malnutrition.<sup>20-22</sup> Oncological disease was also identified as an independent risk factor of malnutrition in other studies.<sup>7,23</sup>

The patients admitted for medical treatment or diagnostic work-up exhibited a higher malnutrition rate than those admitted for elective surgery. This may be explained by the fact that the latter group of patients were unlikely to have acute medical diseases at the time of admission. A relatively low malnutrition rate in patients admitted for elective surgical treatment was also observed in other studies.<sup>7,8</sup> The analysis was done only for the type of care, not departments such as general surgery or cardiovascular department, because each hospital has a unique structure of departments, even patients with the same condition can be admitted to different departments. In addition, since the purpose of hospitalization differs for each patient even within a single department, it is difficult to correlate the general health condition of a patient with the departments where the patient was hospitalized.

Malnutrition is known to worsen many clinical outcomes.<sup>1-5</sup> In the present study, a poor nutritional status was associated with longer length of hospital stay and lower 90-day survival rate. Fortunately, several studies demonstrated that adequate nutritional therapy for patients with malnutrition reduces length of hospital stay, infectious or non-infectious complications, and mortality.<sup>24-28</sup> Considering 22% of malnutrition rate and its adverse effect on clinical outcomes, clinician should make effort to identify and manage malnutrition in hospitalized patients. Therefore, all hospitals should implement a nutritional screening program to identify patients with or at risk of malnutrition.<sup>29,30</sup> In addition, having a multidisciplinary nutritional support team that can assess high-risk patients and provide appropriate nutritional therapy is important.<sup>28</sup> Foremost, clinicians should recognize that malnutrition is not an inevitable result of the aging process or underlying diseases but should be considered as a specific disease entity that requires active management.

The present study has some limitations. First, nutritional status was only evaluated on the day of admission and patients who were already hospitalized were not included in this study; therefore, this study may have underestimated the malnutrition rate of all the hospitalized patients. Second, clinical outcomes according to the nutritional status were not adjusted for the severity of underlying diseases, which may have biased the results. Third, previous admission history within some period was not considered in the analysis of the comparison between SGA A or SGA B or the association with the likelihood of malnutrition (SGA B + C), which could have been an important factor. However, the sample size for each hospital was calculated from the number of admitted patients at each hospital to reduce the selection bias. To the best of our knowledge, this study is the first nationwide prospective study to identify

the malnutrition rate of hospital inpatients in Korea, and our findings will help promote the hospital nutritional support programs in Korea.

In conclusion, malnutrition was common in hospitalized patients, and the rate of malnutrition tended to be high when the patient was older than 70 years old or hospitalized for medical treatment or diagnostic work-up. Malnourished patients needed longer hospitalization and showed lower survival rate in the present study.

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**Appendix 1. SGA questionnaire**

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**A. History****1. Weight change**

Overall loss in past 6 months: amount = \_\_\_\_ kg; % loss = \_\_\_\_

Change in past 2 weeks: increase, no change, or decrease

**2. Dietary intake change (relative to normal)**

No change,

If changed, duration = \_\_\_\_ weeks

type: suboptimal liquid diet, full liquid diet, hypocaloric liquids, or starvation

**3. Gastrointestinal symptoms (that persisted for > 2 weeks)**

None, nausea, vomiting, diarrhea, or anorexia

**4. Functional capacity**

No dysfunction (e.g., full capacity),

If dysfunction present, duration = \_\_\_\_ weeks

type: working suboptimally, ambulatory, or bedridden

**5. Disease and its relation to nutritional requirements**

Primary diagnosis (specify): \_\_\_\_

Metabolic demand (stress): no stress, low stress, moderate stress, or high stress

**B. Physical (for each trait specify: 0 = normal, 1+ = mild, 2+ = moderate, 3+ = severe)**

\_\_\_\_ loss of subcutaneous fat (triceps, chest)

\_\_\_\_ muscle wasting (quadriceps, deltoids)

\_\_\_\_ ankle edema

\_\_\_\_ sacral edema

\_\_\_\_ ascites

**C. SGA rating**

A = well nourished

B = moderately (or suspected of being) malnourished

C = severely malnourished

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SGA = Subjective Global Assessment.