



Controlling Nutritional Status score: A novel prognostic marker for patients with community-acquired pneumonia

Hong Kong Journal of Emergency Medicine
1–6

© The Author(s) 2020

Article reuse guidelines:

sagepub.com/journals-permissions

DOI: 10.1177/1024907920923919

journals.sagepub.com/home/hkj

Birdal Yıldırım¹ , Funda Sungur Biteker²,
Ethem Acar¹ and Ahmet Demir¹

Abstract

Objective: We aimed to investigate the prevalence and prognostic value of malnutrition assessed by Controlling Nutritional Status score in community-acquired pneumonia patients.

Methods: All adult patients admitted to our emergency department and hospitalized for community-acquired pneumonia were prospectively followed-up until hospital discharge or death. Nutritional status was assessed with the Controlling Nutritional Status score, which is based on serum albumin levels, total cholesterol levels, and lymphocyte counts. The primary study endpoint was complicated hospital course defined as need for mechanical ventilation, mortality, or intensive care unit admission.

Results: Three hundred and five patients (mean age 68.6 ± 11.2 years and 51.8% female) were enrolled, and 40 patients (13.1%) had complicated hospitalizations. Older patients, patients with more comorbidities, and patients with higher Controlling Nutritional Status scores on admission were tended to have a higher rate of complications during their hospitalization. Multivariate analysis showed that older age (odds ratio 2.55, 95% confidence interval 1.41–4.64, $p < 0.001$), presence of diabetes (odds ratio 1.54; 95% confidence interval 1.09–3.65; $p = 0.004$), pneumonia severity index ≥ 3 (odds ratio 1.27, 95% confidence interval 0.524–3.725, $p = 0.035$), and Controlling Nutritional Status score > 4 (odds ratio 2.23, 95% confidence interval 1.129–3.657, $p = 0.001$) were independent predictors of complicated hospitalizations.

Conclusion: Malnutrition determined by Controlling Nutritional Status score predicts complications in hospitalized patients with community-acquired pneumonia.

Keywords

Pulmonary infection, respiratory disease, Controlling Nutritional Status

Introduction

Community-acquired pneumonia (CAP) is an important cause of hospitalization, and healthcare expenditure worldwide.¹ Several risk factors such as older age, male gender, and higher burden of comorbid diseases are known to be associated with complications and mortality in CAP patients.^{1–3} It is also known that the complication and mortality rates are low in CAP patients treated as outpatients, but are higher among patients hospitalized for CAP.^{1–3} Numerous scoring systems

have been developed to predict adverse events in CAP patients.^{4,5} However, most of these scores have some

¹Department of Emergency Medicine, Faculty of Medicine, Muğla Sıtkı Koçman University, Muğla, Turkey

²Department of Infectious Diseases and Clinical Microbiology, Yatağan State Hospital, Muğla, Turkey

Corresponding author:

Birdal Yıldırım, Muğla Sıtkı Koçman Üniversitesi Tıp Fakültesi, Orhaniye Mah. Zihniderin Cad., 48000 Muğla, Turkey.
Email: birdalgul@gmail.com



limitations and therefore new prognostic markers are needed.

Nutritional condition, which reflects patients' health status, has emerged as a prognostic factor in patients with various diseases like heart failure,⁶ diabetes mellitus,⁷ and malignant tumors.⁸ However, only a few studies have evaluated the significance of malnutrition in patients with CAP.^{9,10} While several tools for assessing nutritional status have been evaluated in different conditions, most of these tools are difficult to use in daily practice due to their complexity. However, the Controlling Nutritional Status (CONUT) score can be easily calculated with parameters (serum albumin, total cholesterol concentrations, and total lymphocyte count) which may routinely be evaluated in laboratory tests during emergency department (ED) evaluation.¹¹ The CONUT score was first examined for the detection of hospital malnutrition in 2005.¹¹ Following its first definition, the utility of the CONUT score in predicting prognosis has been generally reported in specific types of surgeries and only in a variety of specific surgical populations such as patients with gastric cancer,¹² lung adenocarcinoma,¹³ or urinary tract cancer.¹⁴ Although the prognostic value of CONUT score has been investigated in patients other than the surgical populations such as acute ischemic stroke¹⁵ and heart failure¹⁶ in recent studies, there has been no study evaluating the significance of CONUT score in predicting outcomes in patients with CAP. Hence, we aimed to investigate the significance of admission nutritional status evaluated by CONUT score in patients with CAP.

Methods

Study design and patients

In this prospective and single-center study, all consecutive CAP patients requiring hospitalization who were aged 18 years or older, and admitted to ED were included between March 2016 and March 2017 at Muğla University Hospital (Muğla, Turkey). All patients were diagnosed and treated according to the current guidelines for the management of CAP in adults,^{17,18} and they were followed up during hospitalization or until death. Patients younger than 18 years, patients with healthcare-associated pneumonia, patients with incomplete laboratory or follow-up data, and patients who were not hospitalized were excluded. Patients who have potential factors that affect inflammation-based and nutritional markers such as active tuberculosis, patients undergoing chronic dialysis, pregnant women, and immunocompromised patients were also excluded.

The CAP is defined as pneumonia acquired outside of a healthcare setting. This study was approved by the Muğla University Ethics Committee, and all patients or their relatives gave informed written consent.

Table 1. Scoring system for the Controlling Nutritional Status.

Variables				
Serum albumin (g/mL)	≥3.5	3.0–3.49	2.5–2.99	<2.5
Score	0	2	4	6
Total cholesterol (mg/dL)	≥180	140–179	100–139	<100
Score	0	1	2	3
Lymphocytes (count/mL)	≥1600	1200–1599	800–1199	<800
Score	0	1	2	3

Measurements

Patients' demographic and clinical characteristics, vital signs, laboratory data, and radiological findings at the presentation to the ED were collected. Complete blood count and routine biochemical analyses including cholesterol levels were measured within the first 24 h of admission. Severity of pneumonia was assessed by the pneumonia severity index (PSI) and CURB-65 score as previously described.^{4,5}

The CONUT score was calculated by serum albumin level, total cholesterol level, and lymphocyte counts (Table 1). Patients were classified according to the CONUT score as normal nutritional status (CONUT 0–1 points), mild malnutrition (CONUT score 2–4 points), and moderate-to-severe malnutrition (CONUT score ≥ 5 points).

Study endpoints

The primary outcome of the study was complicated hospitalization: mortality during hospitalization, need for mechanical ventilation, or need for intensive care unit admission. The secondary outcome of interest was the length of stay in hospital.

Statistical analysis

Data were analyzed using SPSS for Windows (version 24; SPSS Inc., Chicago, IL, USA). Comparison of patients characteristics in two groups (patients with and without complicated hospitalization) was done by chi-square test. Distribution of the analyzed continuous variables for normality was tested with the Kolmogorov–Smirnov test. Univariable and multivariable analyses with Cox proportional hazard regression were used to determine significant predictors of complicated hospitalizations. The variables listed in Table 2 are included in the Cox models except for albumin, cholesterol, and lymphocyte counts, which are included in the CONUT score. The receiver operating characteristic (ROC) curve was used to identify the optimal cut-off point of the CONUT score for the outcome.

The sample size was estimated at 200 patients, with a power of 80%, and a two-tailed alpha error of 0.05. For all tests, a *p*-value < 0.05 was considered statistically significant.

Table 2. Comparison of patients with and without complicated hospitalizations.

	Uncomplicated hospitalizations (n=265)	Complicated hospitalizations (n=40)	p-value
Male	145 (54.7)	23 (57.5)	0.165
Age (years)	64.6 ± 10.4	75.2 ± 8.6	<0.001
Medical history			
Atrial fibrillation	12 (4.5)	6 (15.0)	0.086
Smoking	60 (22.6)	8 (10.0)	0.413
Diabetes mellitus	44 (16.6)	20 (50.0)	<0.001
Hypertension	135 (50.9)	24 (60.0)	0.326
Hyperlipidemia	68 (25.7)	10 (25.0)	0.456
Coronary artery disease	55 (20.7)	18 (45.0)	0.015
Cerebrovascular disease	20 (7.5)	7 (17.5)	0.069
Heart failure	16 (6.1)	8 (20.0)	0.032
Chronic obstructive pulmonary disease	28 (10.6)	15 (37.5)	0.012
Malignancy	30 (11.3)	7 (17.5)	0.189
Laboratory results			
White blood count (×10 ³ cells/mL)	9.8 ± 4.5	9.4 ± 5.3	0.136
Hemoglobin (g/dL)	12.5 ± 1.7	12.1 ± 1.6	0.324
Albumin (g/dL)	3.9 ± 0.6	3.50 ± 0.4	0.023
Creatinine, median (mg/dL)	1.0 (0.6–1.2)	1.0 (0.7–1.3)	0.256
Lymphocytes (cell/mm ³)	1824 ± 585	1489 ± 1056	<0.001
Total cholesterol (mg/dL)	185 ± 32	179 ± 30	0.065
Nutritional status (CONUT score)			
Normal (0–1)	100 (37.7)	17 (42.5)	
Mild malnutrition (2–4)	145 (54.7)	15 (37.5)	<0.001
Moderate-to-severe malnutrition (≥5)	20 (7.6)	8 (20)	
CONUT score	3.16 ± 1.88	5.03 ± 2.24	0.001
Pneumonia severity index (median)	3.0 (1.0–5.0)	5.0 (3.0–5.0)	<0.001
CURB-65 (median)	2.0 (0–2.0)	3.0 (2.0–4.0)	<0.001
Length of stay (median) (days)	4.0 (3.0–9.0)	11.0 (8.0–23.0)	<0.001

CONUT: Controlling Nutritional Status; CURB-65: confusion, urea, respiratory rate, arterial blood pressure and age score. Values are given as mean ± standard deviation or number (percentage) unless otherwise indicated.

Results

During the study period, a total of 720 adult patients admitted to our ED with a diagnosis of CAP. However, 30 patients were excluded because of incomplete data; 64 patients were excluded due to immunocompromised diseases, hospital-acquired pneumonia, or active tuberculosis; 26 patients were excluded due to chronic dialysis; and 295 patients were excluded due to ambulatory treatment (Figure 1). Therefore, a total of 305 patients (mean age 68.6 ± 11.2 years, and 51.8% female) were finally analyzed in the study.

Complicated hospitalizations

Forty patients (13.1%) experienced 61 episodes of complicated hospitalizations. Nine patients (2.9%) died, 20 patients (6.6%) required mechanical ventilation, and 32 patients (10.5%) treated in intensive care units during the study period.

Compared to patients without complications, patients with complicated hospital course were older, were more likely to have comorbid diseases, had significantly lower albumin levels, and lymphocyte counts on admission (Table 2).

Of the study population, 117 (38.3%) patients had normal nutritional status, 160 (52.5%) patients had mild malnutrition, and 28 (9.2%) patients had moderate/severe malnutrition according to their CONUT scores. Patients with complicated hospitalization had higher CONUT scores on admission than the patients without complications (5.03 ± 2.24 vs 3.16 ± 1.88, respectively; p=0.001).

Length of stay

Patients with complicated hospitalization had longer length of stay compared to uncomplicated patients (median values of 11 vs 4 days, respectively; p<0.001). Compared to patients with CONUT score ≤ 4, length of hospital stay was longer for patients who had CONUT score > 4 (median value of 6 vs 10 days, respectively; p=0.01).

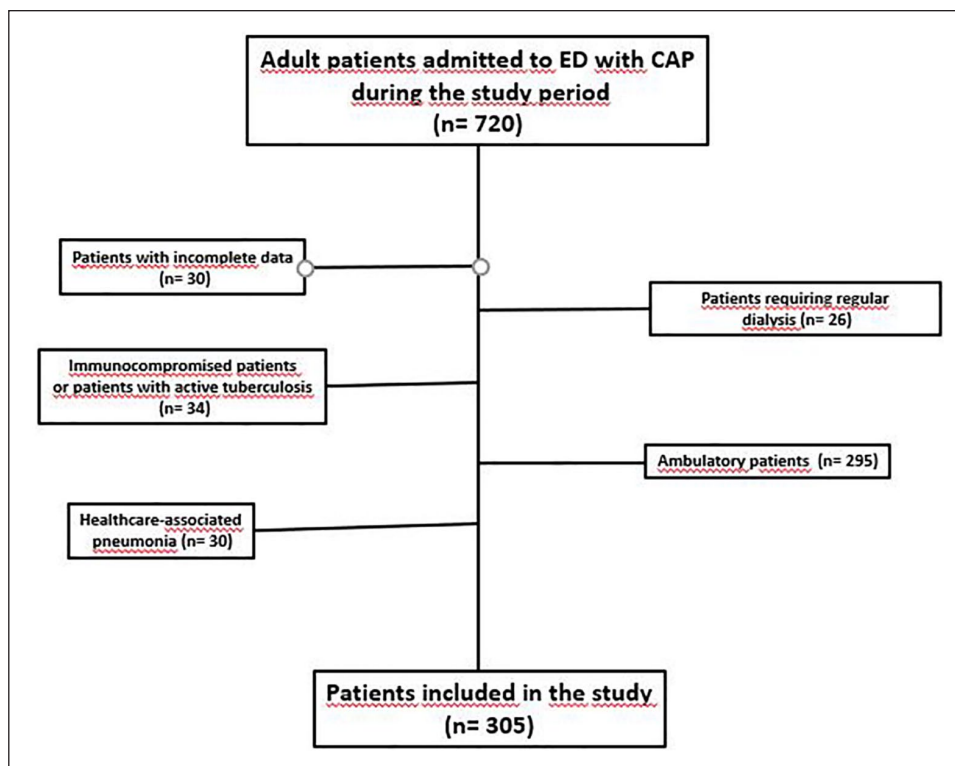


Figure 1. Flowchart of patients including exclusion criteria. ED: emergency department; CAP: community-acquired pneumonia.

Predictors of outcomes in CAP

Multivariate analysis showed that older age (odds ratio (OR) 2.55, 95% confidence interval (CI) 1.41–4.64, $p < 0.001$), presence of diabetes (OR 1.54; 95% CI 1.09–3.65; $p = 0.004$), PSI ≥ 3 (OR 1.27, 95% CI 0.524–3.725, $p = 0.035$), and CONUT score > 4 (OR 2.23, 95% CI 1.129–3.657, $p = 0.001$) were independent predictors of complicated hospitalizations (Table 3). In the ROC curve analysis, when complicated hospitalizations was used as an endpoint, the area under the curve of the CONUT score was 0.8476 (95% CI 0.725–0.912, $p < 0.001$) (Figure 2).

Discussion

In this study, 61.7% of the hospitalized adult patients with CAP were determined to have malnutrition (52.5% mild malnutrition, and 9.2% moderate-to-severe malnutrition) according to their CONUT scores. Our results also demonstrated that nutritional status assessed by CONUT score predicts complications in hospitalized CAP patients.

Malnutrition is frequently determined and is associated with adverse events and prolonged length of stay in hospitalized patients with various diseases.^{19,20} Malnutrition has been identified with several screening tools in the previous studies,^{20–22} but no nutritional screening tool has been validated in CAP patients. Therefore, the prevalence and importance of malnutrition are not clear for this population.

In a Korean study, Yeo et al.¹⁰ retrospectively examined 198 CAP patients aged ≥ 18 years. The prevalence of malnutrition was 39.4%, and the presence of malnutrition was associated with long-term mortality in patients with CAP.¹⁰ In another study, malnutrition was assessed by subjective global assessment tool and mini-nutritional screening score among elderly (aged ≥ 60 years) CAP patients.²³ This study showed that malnutrition was associated a higher risk for a more severe disease.²³ Akuzawa and Naito²⁴ enrolled 57 pneumococcal CAP patients in a retrospective study to investigate the association between markers of malnutrition and the severity of CAP. This study revealed a negative correlation between the serum albumin and cholinesterase levels and the length of stay.²⁴

Hypoalbuminemia has been used as a marker of malnutrition in CAP patients.²⁵ However, the evidence from previous studies is controversial, as some studies have suggested that malnutrition would be underdiagnosed when using hypoalbuminemia as the sole criterion.^{26,27} The CONUT score is a simple marker of malnutrition; however, it is not only a marker of nutritional status but also reflective of immunologic status as it contains lymphocyte and albumin levels in the same formula.

The CONUT score is a simple marker of malnutrition; however, it is not only a marker of nutritional status but also reflective of immunologic status as it contains lymphocyte and albumin levels in the same formula.

Table 3. Multivariate analysis for the prediction of complicated hospitalizations.

	OR	95% CI	P
Age (per 1 year)	2.554	1.412–4.645	<0.001
Diabetes mellitus (presence vs absence)	1.543	1.091–3.657	0.004
Coronary artery disease (presence vs absence)	1.045	0.670–1.752	0.456
COPD (presence vs absence)	1.058	0.978–1.143	0.365
Pneumonia severity index ≥ 3	1.275	0.524–3.725	0.035
CURB-65 ≥ 2	1.015	0.513–2.768	0.123
CONUT score > 4	2.234	1.129–3.657	0.001

OR: odds ratio; CI: confidence interval; COPD: chronic obstructive pulmonary disease; CONUT: Controlling Nutritional Status; CURB-65: confusion, urea, respiratory rate, arterial blood pressure and age score.

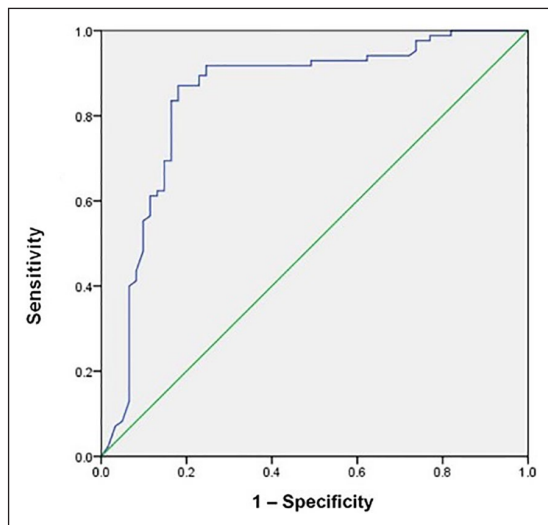


Figure 2. Receiver operating characteristic curve for CONUT score. The area under the receiver operating characteristic curve (AUC) was 0.8476.

Usage of the total lymphocyte count, serum albumin, and total cholesterol concentration enables CONUT score to evaluate the immunologic status, the protein reserves, and the calorie depletion, respectively. However, the prognostic impact of CONUT score has been evaluated mostly among surgical patients,^{12–14} and to our knowledge, its relation to adverse events have never been described in patients with CAP.

Our results suggest that the impaired immuno-nutritional status, determined by higher CONUT score, may result in prolonged length of stay and poorer prognosis in adult patients with CAP.

Study limitations

The follow-up studies were not performed after hospital discharge in our study. We also lack information about detailed dietary intake during hospitalization. We included only adult hospitalized patients in this single-center study.

Therefore, further studies are needed to elucidate the value of CONUT score in patients with CAP.

Conclusion

This is the first study examining the applicability of CONUT score in assessing malnutrition among CAP patients. Our results showed that 61.7% of the CAP patients had moderate-to-severe malnutrition on admission. We also showed that CAP patients with higher CONUT scores were more likely to exhibit higher rates of complications and more likely to have longer length of stay.

Authorship

Birdal Yıldırım, MD, Associate Professor, Faculty of Medicine, Department of Emergency Medicine, Muğla Sıtkı Koçman University.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

Availability of data and materials

305 cases, present.

Ethical approval

Ethical approval received.

Informed consent


Permission for informed consent was obtained from all cases.

Human rights

Respectful to human rights.

ORCID iDs

Birdal Yıldırım  <https://orcid.org/0000-0002-6626-2180>

Ethem Acar  <https://orcid.org/0000-0003-2251-112X>

References

1. Wunderink RG and Waterer GW. Clinical practice: Community-acquired pneumonia. *N Engl J Med* 2014; 370(6): 543–551.
2. Musher DM and Thorner AR. Community-acquired pneumonia. *N Engl J Med* 2014; 371(17): 1619–1628.
3. Morley D, Torres A, Cillóniz C, et al. Predictors of treatment failure and clinical stability in patients with community acquired pneumonia. *Ann Transl Med* 2017; 5(22): 443.
4. Fine MJ, Auble TE, Yealy DM, et al. A prediction rule to identify low-risk patients with community-acquired pneumonia. *N Engl J Med* 1997; 336(4): 243–250.
5. Lim WS, van der Eerden MM, Laing R, et al. Defining community acquired pneumonia severity on presentation to hospital: an international derivation and validation study. *Thorax* 2003; 58(5): 377–382.
6. Wleklík MI, Uchmanowicz I, Jankowska-Polanska B, et al. The role of nutritional status in elderly patients with heart failure. *J Nutr Health Aging* 2018; 22(5): 581–588.
7. Gau BR, Chen HY, Hung SY, et al. The impact of nutritional status on treatment outcomes of patients with limb-threatening diabetic foot ulcers. *J Diabetes Complications* 2016; 30(1): 138–142.
8. Mantzourou M, Koutelidakis A, Theocharis S, et al. Clinical value of nutritional status in cancer: what is its impact and how it affects disease progression and prognosis? *Nutr Cancer*. 2017; 69(8): 1151–1176.
9. Riquelme OR, Riquelme OM, Rioseco ZML, et al. Community-acquired pneumonia in the elderly: clinical and nutritional aspects. *Rev Med Chil* 2008; 136: 587–593.
10. Yeo HJ, Byun KS, Han J, et al. Prognostic significance of malnutrition for long-term mortality in community-acquired pneumonia: a propensity score matched analysis. *Korean J Intern Med* 2019; 34(4): 841–849.
11. Ignacio de UJ, González-Madroño A, de Villar NG, et al. CONUT: a tool for controlling nutritional status. First validation in a hospital population. *Nutrición Hospitalaria* 2005; 20: 38–45.
12. Kuroda D, Sawayama H, Kurashige J, et al. Controlling Nutritional Status (CONUT) score is a prognostic marker for gastric cancer patients after curative resection. *Gastric Cancer* 2018; 21(2): 204–212.
13. Akamine T, Toyokawa G, Matsubara T, et al. Significance of the preoperative CONUT score in predicting postoperative disease-free and overall survival in patients with lung adenocarcinoma with obstructive lung disease. *Anticancer Res* 2017; 37(5): 2735–2742.
14. Ishihara H, Kondo T, Yoshida K, et al. Preoperative Controlling Nutritional Status (CONUT) score as a novel predictive biomarker of survival in patients with localized urothelial carcinoma of the upper urinary tract treated with radical nephroureterectomy. *Urol Oncol* 2017; 35(9): 539.e9–539.e16.
15. Lopez Espuela F, Roncero-Martin R, Zamorano JDP, et al. Controlling Nutritional Status (CONUT) score as a predictor of all-cause mortality at 3 months in stroke patients. *Biol Res Nurs* 2019; 21(5): 564–570.
16. Nishi I, Seo Y, Hamada-Harimura Y, et al. Nutritional screening based on the Controlling Nutritional Status (CONUT) score at the time of admission is useful for long-term prognostic prediction in patients with heart failure requiring hospitalization. *Heart Vessels* 2017; 32(11): 1337–1349.
17. Mandell LA, Wunderink RG, Anzueto A, et al. Infectious diseases society of America/American thoracic society consensus guidelines on the management of community-acquired pneumonia in adults. *Clin Infect Dis* 2007; 44(Suppl. 2): S27–S72.
18. Woodhead M, Blasi F, Ewig S, et al. Guidelines for the management of adult lower respiratory tract infections—full version. *Clin Microbiol Infect* 2011; 17(Suppl. 6): E1–E59.
19. Orlandoni P, Venturini C, Jukic Peladic N, et al. Malnutrition upon hospital admission in geriatric patients: why assess it. *Front Nutr* 2017; 4: 50.
20. Pirlich M, Schutz T, Norman K, et al. The German hospital malnutrition study. *Clin Nutr* 2006; 25(4): 563–572.
21. O’Shea E, Trawley S, Manning E, et al. Malnutrition in hospitalised older adults: a multicentre observational study of prevalence, associations and outcomes. *J Nutr Health Aging* 2017; 21(7): 830–836.
22. Álvarez-Hernández J, Planas Vila M, León-Sanz M, et al. Prevalence and costs of malnutrition in hospitalized patients; the PREDyCES Study. *Nutr Hosp* 2012; 27(4): 1049–1059.
23. Tongo MA and Sy RA. The relation of nutritional assessment and pneumonia severity index among elderly patients with community acquired pneumonia admitted at Cardinal Santos Medical Center. *J Nutr Diet Suppl* 2017; 1(1): 102.
24. Akuzawa N and Naito H. Nutritional parameters affecting severity of pneumonia and length of hospital stay in patients with pneumococcal pneumonia: a retrospective cross-sectional study. *BMC Pulm Med* 2015; 15: 149.
25. Viasus D, Garcia-Vidal C, Simonetti A, et al. Prognostic value of serum albumin levels in hospitalized adults with community-acquired pneumonia. *J Infect* 2013; 66(5): 415–423.
26. Hedlund JU, Hansson LO and Ortqvist AB. Hypoalbuminemia in hospitalized patients with community-acquired pneumonia. *Arch Intern Med* 1995; 155(13): 1438–1442.
27. Kuzuya M, Izawa S, Enoki H, et al. Is serum albumin a good marker for malnutrition in the physically impaired elderly. *Clin Nutr* 2007; 26(1): 84–90.