



## The Association between Nutritional Parameters and the Prognosis of Community Acquired Pneumonia

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### Authors' contributions

This work was carried out in collaboration among all authors. Author HM designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Authors MH and YZ managed the analyses of the study. Author AA managed the literature searches. All authors read and approved the final manuscript.

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### ABSTRACT

**Background:** Community-acquired pneumonia (CAP) is the most common potentially fatal infectious disease in adults worldwide. Prognosis depends on many factors including nutritional status. (P.S this research began before COVID19 pandemic arrivals to our country).

**Objective:** The present study aims to assess the association between markers of nutritional status and severity of CAP.

**Materials and Methods:** This is observational descriptive study conducted in the Department of Pulmonology in Tishreen University Hospital –Lattakia- Syria from November 2019 to November 2020. Adult patients with the diagnosis of CAP were enrolled in the study.

**Results:** A total of 70 patients were included, Median age was 65 years, 40 (57.10%) were male. Serum albumin and cholesterol levels were lower in patients older than 65 years; ( $3.07 \pm 0.4$  vs  $3.5 \pm 0.5$ ,  $p:0.001$ ) and ( $135.2 \pm 33.2$  vs  $154.8 \pm 31.7$ ,  $p: 0.01$ ), respectively. Levels of albumin and cholesterol were significantly higher in survivors group; ( $3.6 \pm 0.4$  vs.  $2.7 \pm 0.3$ ,  $p:0.001$ ) and ( $158.3 \pm 23.9$  vs.  $120.3 \pm 35.08$ ,  $p: 0.0001$ ).

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Pearson's correlation analysis revealed negative correlation between pneumonia severity index (PSI) and: serum albumin ( $r = -0.61$ ,  $p:0.0001$ ), cholesterol( $r = -0.45$ ,  $p:0.0001$ ) and BMI ( $r = -0.16$ ,  $p: 0.1$ ). The CRP showed negative correlation with serum albumin ( $r = -0.55$ ,  $p:0.0001$ ), cholesterol ( $r = -0.51$ ,  $p:0.0001$ ) and BMI ( $r = -0.09$ ,  $p: 0.4$ ).

**Conclusion:** Serum albumin and cholesterol values were found to be related to the severity of CAP and initial levels may be a useful biomarkers to predict the outcome of patients.

*Keywords: Community –acquired pneumonia; prognosis; outcome; albumin.*

## 1. INTRODUCTION

Community –acquired pneumonia (CAP) remains as serious illness with a significant impact not only at an individual level, but also on society as a whole [1,2]. It refers to an acute infection of the pulmonary parenchyma acquired outside of the hospital [3]. Streptococcus pneumonia (pneumococcus) is the most common cause of CAP, and the mortality rate of pneumococcal pneumonia is approximately 12% and has not dramatically changed in the past 50 years despite medical advances [4]. The clinical presentation of CAP varies, ranging from mild pneumonia characterized by fever and productive cough to severe pneumonia characterized by respiratory distress and sepsis [5]. The potential severity of pneumonia and its economic impact have led to the development of a number of predictive score systems designed to optimize the treatment of CAP. The most widely used predictive score system for CAP was pneumonia severity index (PSI) [6]. Given the limitations of existing CAP severity scores, there has been considerable interest in the development of rapidly available biomarkers that might confer additional and reliable prognostic information.

Nutritional status has emerged as a prognostic factor in patients with various diseases [7]. However, only a few studies have evaluated the significance of malnutrition in patients with CAP. Hence we aimed to investigate the significance of admission nutritional status evaluated by Body Mass Index(BMI), albumin, and total cholesterol in patients with CAP and correlation with outcome.

## 2. MATERIALS AND METHODS

### 2.1 Study Design and Data Collection

We studied adult patients admitted to the department of Pulmonology in Tishreen University Hospital –Lattakia- Syria( this hospital

is related to medicine collage inpatients usually enroll in research which it does not happen in community hospitals) from November 2019 to November 2020 with a diagnosis of CAP. Demographic data including age, sex were recorded. Biochemical analyses including serum albumin and cholesterol levels were measured on admission. Severity of pneumonia was assessed by the PSI, and BMI was calculated.

Exclusion criteria were patients with one of the following: pulmonary edema, severe pleural effusion, liver failure and lung cancer.

### 2.2 Definitions

**Pneumonia severity index (PSI):** A validated risk stratification tool for patients with CAP. Risk classification is based on demographic factors, coexisting illnesses, physical examination findings, laboratory and radiographic findings. Risk class I has an PSI score  $<51$ , class II has a PSI score of 51 to 70. Both risk class I and II are classified as low risk pneumonia. Class III are those with a PSI score of 71 to 90 and the patient is classified as having intermediate risk pneumonia. Risk class IV are those patients with a PSI score of 91 to 130, and Risk class V are those whose PSI score are above 130. Both class IV and V are classified as having high risk pneumonia [8].

**Body Mass Index (BMI):** It used as an indicator for appropriateness of weight for height; calculated by dividing the weight in kg by the height in  $m^2$  ( $kg/ m^2$ ). It is classified as underweight for  $BMI < 18.5$ , normal weight (18.5 to 24.9), overweight (25-29.9), obesity (30-39.9) and extreme obesity ( $>40$ ) [9].

**Albumin:** Albumin composes 50-60% of blood plasma proteins, and the normal range is 3.5 to 5.5 g/dL [10].

**Total cholesterol:** The normal range is less than 200 mg/dL[11].

### 2.3 Statistical Analysis

Statistical analysis was performed by using IBM SPSS version 20. Basic Descriptive statistics included means, standard deviations(SD), Frequency and percentages.

Comparisons of the admission data between two groups were performed using independent t test. Pearson's correlation coefficient is used to measure the association between quantitative variables. Statistical significance was accepted at a P value of <0.05.

### 3. RESULTS

The baseline demographics of the 70 participants for this study is shown in Table 1. Patients included were of age 28 to 91 years, 57.10%

were males, and the mean of BMI was 24.86±4.08.

The nutritional markers of the patients in the two age groups are shown in Table 2. The older group had significantly lower levels of albumin and cholesterol (p<0.05). There were no significant differences in BMI between two groups (p: 0.4). Levels of albumin and cholesterol were significantly lower in non-survivors group (p:0.0001).

The PSI showed negative correlation with serum albumin (r = -0.61, p:0.0001), cholesterol (r = -0.45, p:0.0001) and BMI (r = -0.16 , p: 0.1), Table 3.

The CRP showed negative correlation with serum albumin (r = -0.55, p:0.0001), cholesterol(r = -0.51, p:0.0001) and BMI (r = -0.09 , p: 0.4).

**Table 1. Demographic characteristics of the study population**

Variable	Result
<b>Age( years)</b>	65[28-91]
<b>age group(years)</b>	
< 65	32(45.7%)
>65	38(54.3%)
<b>Sex</b>	
Male	40(57.10%)
Female	30(42.90%)
BMI	24.86±4.08[18-35]
<b>Laboratory findings</b>	
Albumin	3.28±0.5 [2.20-5.10]
Cholesterol(TC)	144.18±33.8 [78-260]
C-reactive protein(CRP)	83.7±36.6 [8-194]

**Table 2. Nutritional markers according to age groups and outcomes**

Variable	Age group (years)		p-value	Outcome		p-value
	< 65	≥ 65		Recovery	Mortality	
Serum albumin	3.5±0.5	3.07±0.4	0.001	3.6±0.4	2.7±0.3	0.0001
Total cholesterol(TC)	154.8±31.7	135.2±33.2	0.01	158.3±23.9	120.3±35.08	0.0001
BMI	25.2±4.01	24.5±4.1	0.4	25.7±3.3	23.3±4.8	0.4

**Table 3. Correlation between PSI and nutritional parameters**

Variable	r	p-value
Albumin	-0.61	0.0001
Cholesterol(TC)	-0.45	0.0001
BMI	-0.16	0.1

**Table 4. Correlation between CRP and nutritional parameters**

Variable	r	p-value
Albumin	-0.55	0.0001
Cholesterol(TC)	-0.51	0.0001
BMI	-0.09	0.4

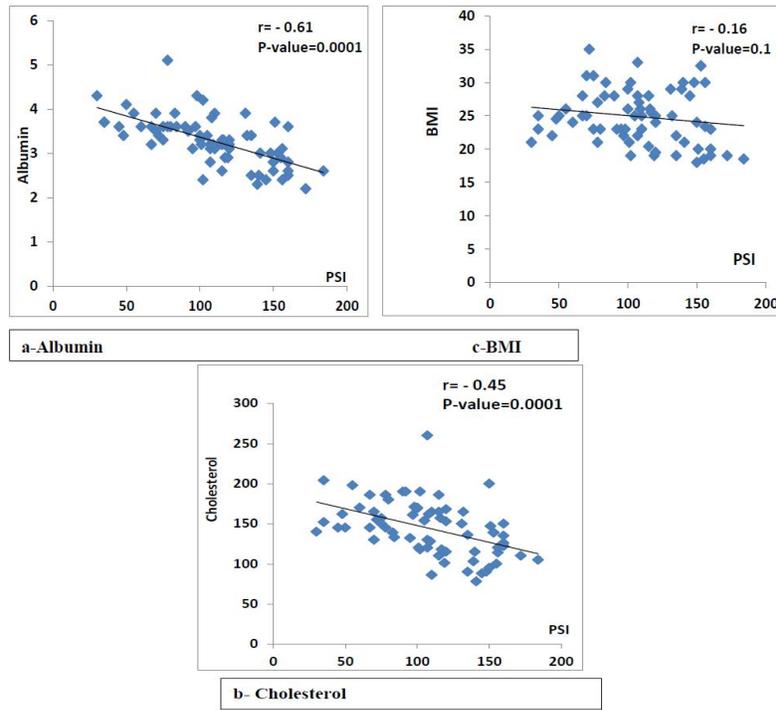


Fig. 1. Correlation of PSI with Albumin (a) Cholesterol (b) and BMI (c)

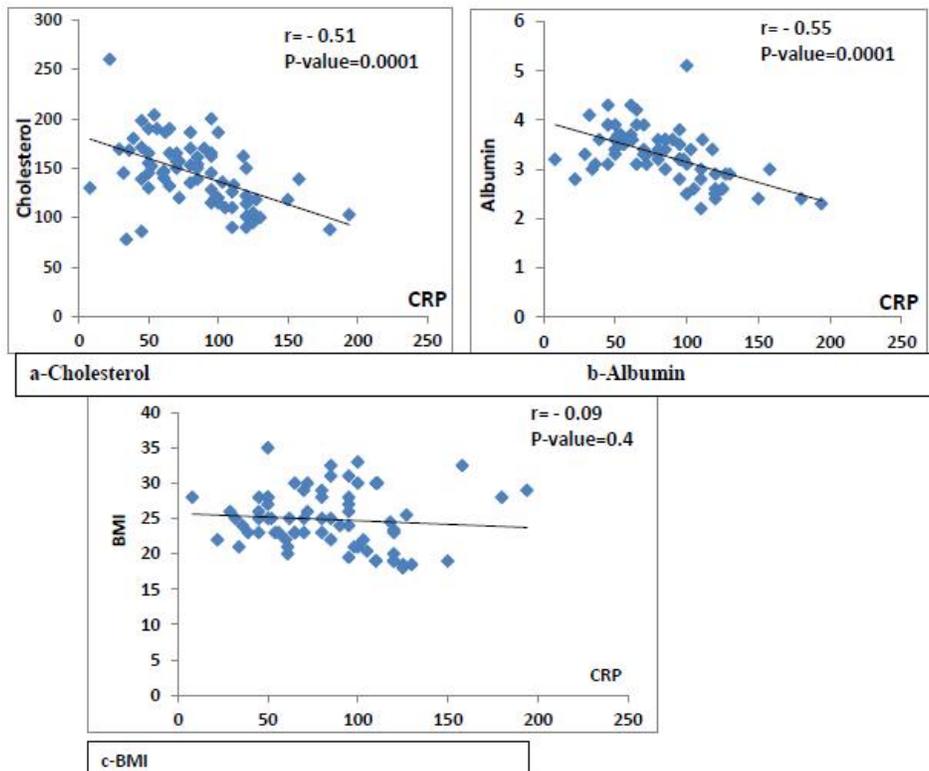


Fig. 2. Correlation of CRP with Cholesterol (a) Albumin (b) and BMI (c)

#### 4. DISCUSSION

In this study, by analysis of 70 CAP patients, we found that serum albumin and cholesterol levels were lower in older patients (> 65 years) and non- survivors. Increasing in PSI and CRP was correlated with significant reduction in serum albumin and cholesterol. The PSI and CRP showed negative correlation with BMI but without significant differences.

Albumin is synthesized in the liver. It plays an important role in the inflammatory response and oxidative stress. However, the exact mechanism responsible for hypoalbuminemia in CAP, correlation with clinical outcome is not fully understood, and there are many supposed mechanisms [12]. The reason for decreasing cholesterol in CAP patients might be due to an acute phase response during the inflammatory process which could be induced by the mediators of inflammation [13].

The results of our study are consistent with the results of a previous studies. Lee et al. (2011) demonstrated that albumin was associated with 28 day mortality in hospitalized patients with CAP, and these markers increased prognostic performance when combined with PSI scale [14].

Akuzawa et al. (2015) found that total cholesterol levels were associated with both the severity of pneumonia and length of stay in younger group (< 65 years) which may reflect a greater effects of cholesterol levels on immunity in younger patients [4].

Miyazaki et al. (2018) demonstrated that serum albumin is not less important than PSI score for predicting 30-day mortality in hospitalized patients with pneumonia occurring outside hospital [15].

Wang et al. (2019) found that there were no significant difference in mortality of obese patients with pneumonia compared to normal BMI patients with pneumonia [16].

Ko et al. (2020) showed that decreased level of total cholesterol was associated with increased short term mortality in elderly patients with CAP [17].

#### 5. CONCLUSION

Albumin and cholesterol measurements may provide important prognostic information for patients with CAP.

#### CONSENT AND ETHICAL APPROVAL

As per international standard or university standard guideline patients consent and ethical approval has been collected and preserved by the authors.

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#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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