

Original Article

Prevalence and Risk Factors of Anemia among Patients Hospitalized with Community-Acquired Pneumonia

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Abstract

Anemia is a dangerous association in patients with community-acquired pneumonia (CAP). However, rigorous studies that identify the exact prevalence and risk factors of anemia in individuals with CAP are currently lacking. This descriptive cross-sectional study was conducted among 150 CAP patients admitted to the Department of Respiratory Medicine at Aichi Medical College Hospital, Demra, Dhaka, from May to November 2024. This study aimed to determine the prevalence and associated risk factors of anemia among patients hospitalized with CAP. In addition, the study sought to compare demographic characteristics and clinical manifestations between anemic and non-anemic patients with CAP. The majority of the patients were in the 41 - 50 years age group, with female predominance (56.0%), and male to female ratio was about 1:1.27. Analysis of hemoglobin concentration showed that 62.0% of patients had hemoglobin levels between 12.1-13.0+ g/dL, 27.3% had 11.1-12.0 g/dL, and 10.7% had ≤ 10.0 -11.0 g/dL, indicating varying degrees of anemia severity among hospitalized CAP patients. Using a threshold of ≤ 12.0 g/dL to define anemia, 38% of the study population were anemic. The mean age of anemic patients was 46.5 ± 10.41 years, whereas the mean age of non-anemic patients was 44.12 ± 11.21 years, and the difference was not statistically significant ($t = 1.32$, $p = 0.19$). Females represented 56.0% of the study population; however, the association between sex and anemia status was not statistically

significant (χ^2 test, $p > 0.05$). Regarding clinical features, the symptoms most frequently noted in both groups were fever (94.7% in anemic versus 97.8% in non-anemic patients) and cough (91.2% versus 90.3%), with no significant statistical differences between the groups. Additionally, pleuritic chest pain was reported in 47.4% versus 36.6%; hemoptysis was observed in 8.8% versus 6.5%; and weight loss was noted in 15.8% of anemic versus 7.5% of non-anemic patients, all without significant statistical differences. Expectoration and breathlessness were significantly more frequent among anemic compared with non-anemic patients. Expectoration was present in 84.2% of anemic versus 53.8% of non-anemic patients ($p < 0.001$), while breathlessness was observed in 78.9% versus 52.7% ($p = 0.002$), indicating a higher burden of respiratory symptoms among anemic individuals. In a comparative analysis of anemic versus non-anemic patients, it was found that the prevalence of smoking as a behavioral risk factor was higher in anemic (42.1%) than in non-anemic patients (15.1%). Odds ratio analysis suggests a significantly increased risk of developing anemia among smokers (OR 4.10; 95% CI: 1.94–8.67; $p < 0.001$). Comorbid conditions, diabetes mellitus (DM) was more than twice (22.8%) as common among anemic compared to non-anemic patients (10.8%). The significant p -value and OR suggest that DM is a meaningful risk factor for anemia in CAP patients (OR = 2.45; 95% CI: 1.00–6.01; $p = 0.037$). Similarly, immunosuppression was nearly three times (19.3%) more frequent among anemic than in non-anemic patients (7.5%). The significant association indicates that impaired immune function may predispose CAP patients to anemia (OR = 2.94; 95% CI: 1.06–8.17; $p = 0.045$). Other factors, such as prior Upper Respiratory Tract Infections (URTI), Congestive Heart Failure (CHF), and Gastroesophageal Reflux Disease (GERD), did not show significant differences between the two groups ($p > 0.05$). This finding demonstrates that anemia is a frequent comorbidity among hospitalized CAP patients. Comparison of risk factors between anemic and non-anemic patients with CAP shows that diabetes mellitus, smoking, and immunosuppression were significantly more prevalent among anemic patients. Considerable attention should be paid to the prevalence of anaemia in CAP patients.

Keywords: Community-acquired pneumonia; hospital prevalence; risk factors; anemia; non-anemic

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INTRODUCTION

Despite improvements in antibiotic therapy, microbiological diagnostic testing, and preventive measures, pneumonia remains the leading cause of morbidity and mortality associated with infectious diseases.¹ A common and sometimes fatal illness is community-acquired pneumonia (CAP). Acute anemia is a prevalent condition that includes numerous instances in patients with community-acquired pneumonia.²

Patients with underlying cardiovascular diseases, respiratory disorders, or prior hospitalization for pneumonia are more likely to develop severe community-acquired pneumonia (CAP), and their general health deteriorates more when they become anemic.³

Antimicrobial guidance is guided by the microbiological diagnosis of CAP, which makes it significant. However, less than 50% of cases of pneumonia can be diagnosed by microbiological means, and antimicrobial medication is usually administered empirically to prevent delays in the start of management. (H. Ticona et al., 2020) pathophysiology, risk factors, symptoms, diagnosis, presentations, risk-stratification, markers, and management of CAP in the United States (US Notably, bacteria are typically shown to be the more common cause of CAP, in comparison with viruses or fungi. (H. Ticona et al., 2020) pathophysiology, risk factors, symptoms, diagnosis, presentations, risk-stratification, markers, and management of CAP in the United States (US Streptococcus pneumoniae, which has historically been the most frequent cause of CAP, manifests as fevers, rust-colored sputum, and acute lower respiratory tract infection symptoms.³

Reduced red cell mass in vitro lowers cell-mediated immunity and is linked to compromised phagocytic function. Low hemoglobin levels have been found in 30% of individuals with pneumococcal pneumonia or community-acquired pneumonia (CAP). (Kumar et al., 1970) Severe anemia promotes the development of ischemic syndrome by delaying the maturation of red blood cells in the bone marrow and increasing hypercapnia.⁶ Anemia might enhance vulnerability to infection and may be a sign of possible comorbidities, according to prior research findings.⁷

The association between anemia and chronic obstructive pulmonary disease (COPD) has been the subject of much research. According to studies, up to 33% of patients with COPD exhibit anemia.⁸ Additionally, because of several physiological symptoms, people with COPD are more

likely to get pneumonia. These patients frequently have continuous mucus production along with chronic bronchitis. The situation is made worse by the existence of potentially harmful bacteria in the respiratory system, which could raise the prevalence of pneumonia in the general population. The coronavirus illness (COVID-19) that emerged in 2019 increased the burden of pneumonia on the healthcare system. The current study aims to ascertain the prevalence of anemia and its potential function as a risk factor among hospitalized pneumonia patients.

METHODS AND MATERIALS

Study Design and Setting

This hospital-based cross-sectional study was conducted in the Department of Respiratory Medicine at Aichi Medical College Hospital, Demra, Dhaka, over six months from 1 May 2024 to 30 November 2024. A total of 150 adult patients diagnosed with community-acquired pneumonia (CAP) and admitted to the hospital during the study period were included using purposive sampling. Patients were included if they were aged ≥ 18 years, had a clinical diagnosis of community-acquired pneumonia, supported by: compatible symptoms such as cough, fever (>37.5 °C), or dyspnea, and radiological evidence of dense, patchy, or lobar consolidation on chest X-ray. Finally, patients who provided written informed consent to participate in the study. Patients were excluded if they had: cystic fibrosis or bronchiectasis, pulmonary tuberculosis, co-existing malignancy, chronic liver disease or chronic renal failure, bleeding disorders, current iron supplementation, or known hematological disorders affecting hemoglobin levels. The patients were either selected based on inclusion criteria or rejected based on the exclusion criteria. Concerns pertaining to anonymity and confidentiality were assured for every patient. At the time of admission, a pre-prepared proforma is used to gather information and obtain a thorough history.

Data Collection

Data were collected using a pre-structured questionnaire that had been formally approved by the 'Institutional Ethical Review Committee' and that comprised demographic characteristics, clinical features, and comorbid conditions. After getting permission from the patient, the 3 ml samples of venous blood were collected from each patient at admission and analyzed for hemoglobin concentration in the hospital laboratory to check the hemoglobin levels and diagnose anemia within

24 hours. Anemia was defined as hemoglobin levels below 12 g/dL in premenopausal women and below 13 g/dL in both postmenopausal women and men of all ages (Garcia-Casal et al., 2019).

Statistical Analysis

Collected data were compiled, then entered and analyzed using the Statistical Package for Social Sciences (SPSS). Continuous variables were expressed as mean ± standard deviation (SD). Categorical variables were presented as frequency and percentage. The independent sample t-test was used to compare the mean age. The chi-square test was applied to compare categorical variables between anemic and non-anemic groups. Odds ratios (ORs) were calculated to evaluate associations between selected risk factors and anemia. A p-value <0.05 was considered statistically significant.

RESULTS

Table I displays the age distribution of male and female patients diagnosed with community-acquired pneumonia (CAP). The majority of patients in both sexes were in the 41–50 years age group, accounting for 51.5% of males and 45.2% of females. Overall, females constituted a slightly higher proportion of the study population (56.0%) compared with males (44.0%).

Table I: Age distribution of patients with CAP according to sex (n = 150)

Age group (years)	Male n (%)	Female n (%)	Total n (%)
<21	2 (3.0)	4 (4.8)	6 (4.0)
21–30	5 (7.6)	8 (9.5)	13(8.7)
31–40	13 (19.7)	15 (17.9)	28(18.7)
41–50	34 (51.5)	38 (45.2)	72 (48.0)
51–60	6 (9.1)	7 (8.3)	13 (8.7)
61–70	4 (6.1)	8 (9.5)	12 (8.0)
>70	2 (3.0)	4 (4.8)	6 (4.0)
Total	66 (44.0)	84 (56.0)	150 (100)

Values expressed as frequency and percentage.

Table II presents the distribution of hemoglobin concentration range categories among hospitalized CAP patients. The largest proportion of patients (45.3%) had hemoglobin levels between 12.1–13.0 g/dL, followed by 27.3% with levels between 11.1–12.0 g/dL. Only 2.7% of

patients had severe anemia with hemoglobin levels ≤10 g/dL.

Table II: Distribution of hemoglobin concentration range categories among patients with CAP (n = 150)

Hemoglobin concentration (g/dL) Category	Frequency	Percentage
≤10.0	4	2.7%
10.1–11.0	12	8.0%
11.1–12.0	41	27.3%
12.1–13.0	68	45.3%
13.0+	25	16.7%

Figure 1 illustrates the distribution of anemia status among patients hospitalized with community-acquired pneumonia. Out of the 150 patients included in the study, 57 (38.0%) were identified as anemic, whereas 93 patients (62.0%) had normal hemoglobin levels at the time of admission according to the diagnostic criteria used in the study.

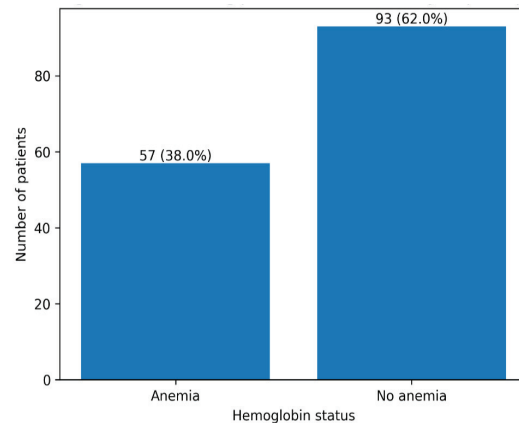


Figure 1: Distribution of anemia status among hospitalized patients with community-acquired pneumonia (n = 150)

Table III compares the demographic characteristics of anemic and non-anemic patients with CAP. The mean age of anemic patients was 46.5 ± 10.41 years, while the mean age of non-anemic patients was 44.12 ± 11.21 years, with no statistically significant difference between the two groups (t = 1.32, p = 0.19). Similarly, the sex distribution did not differ significantly between anemic and non-anemic patients (χ = 2.79, p = 0.095).

Table III
Comparison of demographic characteristics between anemic and non-anemic patients with CAP (n=150).

Variable	Anemia (n=57)	No anemia (n=93)	Test statistic	p-value
Age (Mean ± SD)	46.5 ± 10.41	44.12 ± 11.21	t = 1.32	0.19
Sex			$\chi^2 = 2.79$	0.095
Male	30 (52.6%)	36 (38.7%)		
Female	27 (47.4%)	57 (61.3%)		

Continuous variables expressed as mean ± SD. An independent sample t-test was used for age comparison; a chi-square test was used for categorical variables. $p < 0.05$ is considered statistically significant.

Table IV compares the clinical manifestations between anemic and non-anemic patients with CAP. Fever and cough were highly prevalent in both groups, occurring in 94.7% and 91.2% of anemic patients, and 97.8% and 90.3% of non-anemic patients, respectively. Expectoration and breathlessness were significantly more frequent among anemic patients, reported in 84.2% and 78.9%, compared with 53.8% and 52.7% among non-anemic patients ($p < 0.001$ and $p = 0.002$, respectively). Other clinical symptoms, including pleuritic chest pain, hemoptysis, and weight loss, were observed in both groups but did not show statistically significant differences ($p > 0.05$).

Table IV: Comparison of clinical features between anemic and non-anemic patients with CAP (n=150)

Clinical feature	Anemia n (%)	No anemia n (%)	p-value
Fever	54 (94.7)	91 (97.8)	0.303
Cough	52 (91.2)	84 (90.3)	0.853
Expectoration	48 (84.2)	50 (53.8)	<0.001*
Breathlessness	45 (78.9)	49 (52.7)	0.002*
Pleuritic chest pain	27 (47.4)	34 (36.6)	0.204
Hemoptysis	5 (8.8)	6 (6.5)	0.640
Weight loss	9 (15.8)	7 (7.5)	0.129

Multiple response. Data expressed as a number and a percentage. Chi-square test applied for comparison. *Statistically significant ($p < 0.05$).

Table V provides a comparative overview of risk factors between anemic and non-anemic patients with CAP. It indicates that diabetes mellitus, smoking, and immunosuppression were significantly more frequent among anemic patients, with p-values of 0.037, $p < 0.001$,

and $p = 0.045$, respectively. Smoking was notably higher in the anemic group at 42.1% versus 15.1% in the non-anemic group. Other factors, such as prior Upper Respiratory Tract Infections (URTI), Congestive Heart Failure (CHF), and Gastroesophageal Reflux Disease (GERD), did not show significant differences between the two groups ($p > 0.05$).

Table V: Comparison of risk factors between anemic and non-anemic patients with CAP (n=150).

Risk factor	Anemia n (%)	No anemia n (%)	p-value
Upper respiratory tract infections (URTI)	14 (24.6)	19 (20.4)	0.553
Diabetes mellitus (DM)	13 (22.8)	10 (10.8)	0.037*
Congestive heart failure (CHF)	4 (7.0)	2 (2.2)	0.207
Smoking	24 (42.1)	14 (15.1)	<0.001*
Immunosuppression	11 (19.3)	7 (7.5)	0.045*
Gastroesophageal reflux disease (GERD)	6 (10.5)	10 (10.8)	0.960

URTI: Upper respiratory tract infection; GERD: Gastroesophageal reflux disease. Chi-square test used for analysis. *Statistically significant ($p < 0.05$).

Figure 2 displays the odds ratios analysis for selected risk factors among patients with CAP. Smoking demonstrated the strongest association with anemia (OR 4.10, 95% CI 1.94–8.67, $p < 0.001$). Immunosuppression (OR 2.94, 95% CI 1.06–8.17, $p = 0.045$) and diabetes mellitus (OR 2.45, 95% CI 1.00–6.01, $p = 0.037$) were also significantly associated with anemia among CAP patients.

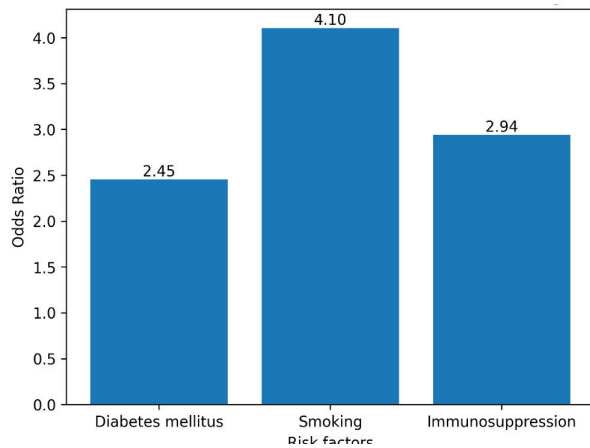


Figure 2: Odds ratio analysis of selected risk factors associated with anemia among patients with CAP

Chi-square test was used for comparison previously. Odds ratios with 95% confidence intervals were calculated to assess the strength of association between risk factors and anemia. A statistically significant p-value was considered <0.05.

DISCUSSION

The present study evaluated the prevalence and risk factors of anemia among patients hospitalized with community-acquired pneumonia (CAP) and demonstrated that 38.0% of patients were anemic at the time of admission.³ reported that anemia was prevalent among hospitalized CAP patients and was associated with adverse outcomes, including increased mortality. Similarly, Doshi et al.¹⁰ found that anemia was present in a substantial proportion of patients with pneumococcal pneumonia, supporting the current findings. This finding highlights that anemia is a frequent comorbidity among hospitalized CAP patients.

This study demonstrated that nearly half (48.0%) of the CAP patients belonged to the 41–50 years age group, with a mean age of 45.02 ± 10.89 years (the mean age of anemic versus non-anemic patients was 46.5 ± 10.41 versus 44.12 ± 11.21 years), and a female predominance (56.0%). However, neither age group nor sex showed a statistically significant association with anemia ($p > 0.05$), suggesting that anemia in CAP is not strongly influenced by demographic characteristics in this study. These findings are comparable with previous studies. Reade et al.³ reported a slightly higher mean age among hospitalized CAP patients, reflecting the tendency of CAP to affect older populations in developed countries. Similarly, Watts et al.¹⁸ observed that patients admitted to intensive care units were generally older, which may explain the lower

hemoglobin levels reported in their cohort. In contrast, the relatively younger mean age in this study may reflect regional demographic differences and earlier exposure to risk factors, such as smoking and infectious diseases, in developing countries. The female predominance differs from several studies that reported a higher prevalence of CAP among males^{11,12}. However, similar female predominance has been reported in certain hospital-based studies, particularly in South Asian populations.

Analysis of hemoglobin distribution revealed that 27.3% of patients had mild anemia (11.1–12.0 g/dL) and 10.7% had moderate-to-severe anemia (≤ 11.0 g/dL), suggesting a substantial burden of reduced hemoglobin levels among hospitalized patients. The mean hemoglobin level observed in this study (approximately 12.13 g/dL) is slightly higher than that reported in critically ill populations, such as the study by Watts et al.¹⁸, where lower hemoglobin levels were noted at ICU admission.

Fever was the most common complaint (96.7%) of CAP patients, followed by cough (90.7%), expectoration (65.3%), breathlessness (62.7%), pleuritic chest pain (40.7%), and haemoptysis (7.3%). These symptoms were also mentioned by Amer & van Bree, 2022dyspnoea, pleuritic chest pain, sputum with mucopurulent components, to systemic features such as myalgia, and fever. Patients in their older years are more likely to present with confusion or worsening pre-existing conditions and may lack fever. Severe CAP is a pneumonia that requires supportive therapy within intensive care settings, and is still associated with a high mortality and significantly morbidity, specifically amongst the elderly population with multiple comorbidities. Despite the improvement in supportive care by new modalities, such as high-flow nasal oxygen therapy, severe CAP remains one of the most common reasons for admission to a critical care facility. Correct diagnosis, risk stratification and early initiation of antibiotic treatment are key factors determining outcomes of patients with severe CAP. Future developments are likely to concentrate on diagnostics such as point of care microbiological tests and adjuvant non-antibiotic immunomodulating treatment strategies. Further research is warranted to elucidate the role of treatment with corticosteroids in severe CAP. Neither coronavirus disease (COVID-19, and similar findings were also stated in another study by Fally et al., 2025evidence on CAP management is often of variable quality. This may be reinforced by the lack of a systematic and homogeneous way of defining the disease in randomized controlled trials

(RCTs^{13, 14}. Clinically, expectoration (84.2% vs 53.8%, $p < 0.001$) and breathlessness (78.9% vs 52.7%, $p = 0.002$) were significantly more frequent among anemic patients, indicating a higher severity of respiratory symptoms that may reflect the combined impact of pneumonia-induced lung pathology and reduced oxygen-carrying capacity. Kumar et al.⁵ and Hamad et al.⁶ have demonstrated that reduced hemoglobin levels impair oxygen delivery and may exacerbate hypoxia, thereby increasing respiratory distress. In contrast, symptoms such as fever, cough, pleuritic chest pain, hemoptysis, and weight loss did not differ significantly between groups ($p > 0.05$).

Importantly, behavioral and clinical risk factors showed strong associations with anemia. Over a quarter (25.3%) of the CAP patients were smokers. Smoking was significantly more prevalent among anemic patients (42.1% vs 15.1%), with a markedly increased risk (OR 4.10; 95% CI: 1.94–8.67; $p < 0.001$). The strong association between smoking and anemia in this study is supported by prior evidence. Almirall et al.¹¹ and Baskaran et al.¹² demonstrated that smoking significantly increases the risk of CAP.

Comorbidity-wise, 22% had URTI, 15.3% had diabetes, and 4% had CHF, while immunosuppression and GERD affected 12.0% and 10.67% of CAP patients. These findings were similar to a study done by Cheng and colleagues¹⁵. Diabetes mellitus (22.8% vs 10.8%; OR 2.45; $p = 0.037$) and immunosuppression (19.3% vs 7.5%; OR 2.94; $p = 0.045$) were significantly associated with anemia, highlighting the multifactorial nature of anemia in CAP. This aligns with previous studies indicating that chronic diseases and impaired immune function can predispose individuals to both infection and hematological abnormalities. Cheng et al.¹⁵ reported that comorbidities such as diabetes significantly influence the clinical outcomes of CAP, while Xu et al.⁷ highlighted the relationship between hemoglobin levels and mortality risk.

CONCLUSION

This study highlights the importance of early detection and management of anemia in patients with CAP, as well as the need to address modifiable risk factors such as smoking and chronic comorbidities. These findings demonstrate that anemia is highly prevalent (38.0%) among patients hospitalized with CAP and is significantly associated with increased respiratory symptom burden, particularly expectoration and breathlessness. Behavioral and clinical factors, including smoking (OR 4.10), diabetes mellitus

(OR 2.45), and immunosuppression (OR 2.94), were identified as significant risk factors for anemia in this population. Incorporating anemia assessment into routine clinical evaluation may improve risk stratification and patient outcomes. Further multicenter and longitudinal studies are recommended to better understand the causal relationship between anemia and CAP outcomes and to evaluate the impact of targeted interventions on clinical prognosis.

LIMITATIONS

As a cross-sectional study, causal relationships cannot be established. The study was conducted in a single tertiary care center, which may limit the generalizability of the findings. Additionally, biochemical parameters related to iron status and inflammatory markers were not extensively evaluated, which could have provided deeper insights into the underlying mechanisms of anemia.

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