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# Factors Related to the Severity of COVID-19 Pneumonia Among Thai Patients in Community Hospitals of Nakhon Si Thammarat Province

**Thittita Chooprasoot[1], Naiyana Noonil[2,*], Rachadaporn Jantasuwan[2] and Thanawan Songprasert[2]**

*[1]Master of Nursing Science Program in Community Nurse Practitioner, School of Nursing, Walailak University, Nakhon Si Thammarat 80160, Thailand*
*[2]School of Nursing, The Excellence Center of Community Health Promotion, Walailak University, Nakhon Si Thammarat 80160, Thailand*

**([*]Corresponding author's e-mail: nnaiyana@mail.wu.ac.th)**

## Abstract

Coronavirus Disease 2019 (COVID-19) pneumonia remains a significant cause of morbidity in hospitalized patients, particularly among vulnerable populations. This study aimed to determine the prevalence of respiratory failure and to identify factors associated with the severity of COVID-19 pneumonia among patients admitted to community hospitals in Nakhon Si Thammarat Province, Thailand. A retrospective cross-sectional study was conducted among 356 patients diagnosed with COVID-19-related pneumonia and admitted to Thung Song and Tha Sala Hospitals between July 1, 2022, and June 30, 2024. Participants were selected based on specific inclusion criteria. Data were collected using structured forms that captured demographic information, comorbidities, and clinical records. Descriptive statistics, the Chi-square test, and Fisher's exact test were used for data analysis. The prevalence of respiratory failure among hospitalized COVID-19 pneumonia patients was 29 %. Most patients were female (66.3 %) and aged ≥ 60 years (65.7 %). A total of 28.9 % of patients were classified as overweight or obese (BMI ≥ 25 kg/m²). The most common comorbidities included hypertension (44.9 %), diabetes mellitus (14.9 %), and chronic respiratory disease (4.2%). Factors significantly associated with severe COVID-19 pneumonia included advanced age, alcohol consumption, and length of hospital stay ($p < 0.05$). Therefore, older adults, individuals with chronic conditions (e.g., hypertension, diabetes, chronic respiratory diseases), and those who consume alcohol are at elevated risk for severe COVID-19 pneumonia. Targeted surveillance and clinical management strategies should prioritize these high-risk groups to reduce adverse outcomes.

**Keywords:** COVID-19 pneumonia, Associated factors, Respiratory failure, Hospitalization, Community hospitals, Risk groups

## Introduction

Coronavirus Disease 2019 (COVID-19) is a respiratory infection caused by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), a novel coronavirus that first emerged in Wuhan, China, in December 2019. The disease rapidly spread worldwide, prompting the World Health Organization (WHO) to declare it a global pandemic on March 11, 2020 (World Health Organization, 2022). Since then, COVID-19 has imposed substantial burdens on healthcare systems and economies, resulting in widespread morbidity and mortality (Iamworakit, 2022). As of early 2024, more than 774 million confirmed cases and 7 million deaths have been reported globally. In Thailand, over 23,000 new cases and 137 deaths were recorded during the same period, with 663 cases diagnosed as pneumonia (Department of Disease Control, 2022). In Nakhon Si Thammarat Province, a total of 475 cases were confirmed, with no reported deaths (Nakhon Si Thammarat Public Health Office, 2024).

Among the serious complications of COVID-19, pneumonia is particularly critical. In Thailand, the prevalence of severe COVID-19 pneumonia has been reported at 42.7 % (Pongpirul et al., 2020). The pathophysiology of this condition involves an excessive immune response to viral infection, particularly the overproduction of pro-inflammatory cytokines such as interleukin-6 (IL-6), leading to what is known as a cytokine storm (Aziz et al., 2020). This hyperinflammatory state causes widespread tissue damage, disrupted coagulation, pulmonary edema, and impaired gas exchange, ultimately resulting in respiratory distress or failure and increasing the risk of mortality (Jantakam et al., 2022).

Several factors have been identified as contributing to the severity of COVID-19 pneumonia. First, advanced age is a well-established risk factor. The incidence of pneumonia increases with age, peaking at 52.2 % among individuals aged 50 - 59 years, and remaining high in those aged 60 years and older (44.4 %) (Intarapradit, 2021). Second, a body mass index (BMI) $\geq$ 25 kg/m$^2$ has been associated with greater disease severity. Obesity leads to metabolic dysfunction and increased expression of angiotensin-converting enzyme 2 (ACE2) receptors in adipose tissue, which facilitates viral entry. It also promotes chronic inflammation and immune dysregulation, predisposing individuals to cytokine storms and pulmonary complications (Chiyangkabut et al., 2023). Third, pre-existing comorbidities such as hypertension (34.01 %), hyperlipidemia (30.61 %), and diabetes mellitus (22.44 %) further elevate the risk of severe pneumonia. Conditions such as heart failure and malignancies also contribute significantly to poor outcomes by compromising immune responses and lung function (Chiyangkabut et al., 2023; Srichomphu, 2023). Fourth, vaccination status plays a crucial role in disease mitigation. Vaccinated individuals show significantly lower rates of pneumonia, with a reported incidence of 41.0 % compared to 71.5 - 78.0 % among unvaccinated patients (Schiebler et al., 2022; Murillo-Zamora et al., 2022). Vaccination enhances immune preparedness and reduces the risk of severe complications, even in cases of reinfection (Brogna et al., 2021).

Although numerous studies have examined COVID-19 mortality risk factors, limited research has focused specifically on the clinical determinants of pneumonia severity, particularly at the

community hospital level. Understanding these factors is crucial for improving case management, allocating resources effectively, and developing targeted interventions. This study aims to investigate the factors associated with the severity of COVID-19 pneumonia among patients admitted to community hospitals in Nakhon Si Thammarat Province, Thailand. Findings from this research will inform evidence-based strategies for surveillance, prevention, and treatment, ultimately supporting improved patient outcomes in COVID-19 care.

## Methodology

### Research design

This study employed an analytical retrospective cross-sectional design to investigate the prevalence and associated factors of COVID-19 pneumonia severity among hospitalized patients in community hospitals in Nakhon Si Thammarat Province, Thailand. This design enabled the analysis of pre-existing medical records to identify clinical and demographic factors influencing disease severity.

### Population and samples

The study population consisted of 938 patients diagnosed with COVID-19 pneumonia and admitted to Thung Song Hospital and Tha Sala Hospital, which were purposively selected due to their high volume of COVID-19 pneumonia cases. Inclusion criteria were as follows: 1) Patients diagnosed with COVID-19 pneumonia and admitted to either hospital, with laboratory confirmation via RT-PCR or Antigen Test Kit (ATK), and 2) Radiographic evidence of pneumonia based on abnormal chest X-ray findings consistent with the disease. The sample size was calculated using Krejcie and Morgan's formula (1970), assuming a 95 % confidence level, a margin of error of 5%, and a proportion of 0.5. With a population of 938 patients, the required sample size was determined to be 356 participants. A two-step sampling method was employed: Hospital selection involved purposively selecting Thung Song and Tha Sala Hospitals. A simple random sampling technique without replacement was used to select 356 participants from the hospital databases, ensuring representativeness.

### Data collection

Data were extracted using a structured data recording form developed through a comprehensive literature review and comprised two main sections: 1) General Patient Information (10 items), including: demographics (age, gender), anthropometrics (weight, height, BMI), behavioral factors (smoking, alcohol consumption), comorbidities and regular medication use, COVID-19 vaccination status, and History of prior COVID-19 infection; and 2**)** Hospital Treatment History, including: date and type of initial hospital visit (OPD/IPD), presenting symptoms and initial diagnosis, outpatient treatment details, laboratory investigations and inflammatory markers, radiological findings (chest X-ray at admission and during hospitalization), date and department of hospital admission, inpatient treatment and complications, and treatment outcomes and discharge medications. Data were

retrieved solely from electronic medical records (EMRs) to ensure completeness, accuracy, and consistency. The form included both closed- and open-ended fields to capture comprehensive data. To establish content validity, the data collection instrument was evaluated by a panel of five experts in infectious diseases and clinical epidemiology. The resulting Content Validity Index (CVI) was 1.00, indicating excellent content appropriateness and relevance.

### Ethical considerations

This study was approved by the Human Research Ethics Committee of Walailak University (Approval No. WUEC-24-316-01) on September 11, 2024. Ethical conduct was maintained according to the following principles: 1) Respect for Persons - ensured through protection of participant rights and autonomy, 2) Beneficence - all efforts were made to minimize risk and maximize benefit, and 3) Justice - fair and unbiased data collection procedures ensured equitable representation. To protect patient confidentiality, no personally identifiable information (e.g., name, address) was collected. All data were anonymized using coded identifiers and securely stored on a password-protected system with restricted access. Data will be retained for three years and then permanently deleted to prevent unauthorized access.

### Data analysis

Data were analyzed using SPSS software version 22. Statistical procedures included: 1) Descriptive statistics (frequency, percentage, mean, and standard deviation) to summarize demographic and clinical characteristics, and 2) Inferential statistics: Chi-square tests or Fisher's exact tests were used to assess the associations between patient characteristics and the severity of COVID-19 pneumonia. A $p$-value < 0.05 was considered statistically significant.

## Results

### General characteristics of participants

A total of 356 patients diagnosed with COVID-19 were included in this study, of whom 37.95 % developed COVID-19-related pneumonia. The majority of participants were female (66.3 %), with a mean age of 64.89 years (SD = 20.22, range: 1 - 99). Approximately 65.7 % of participants were aged 60 years or older. The average BMI was 23.29 kg/m² (SD = 6.89), with 28.9 % of participants classified as overweight or obese (BMI ≥ 25 kg/m²). Only 0.8 % of participants were smokers, and 1.4 % reported alcohol consumption. A significant proportion (70.2 %) had at least one underlying chronic condition. The most common comorbidities were hypertension (44.9 %), diabetes mellitus (14.9 %), and chronic respiratory disease (4.2 %). Most participants had a single comorbidity (59.8%), while 10.4% had multiple comorbidities. Regarding vaccination status, 41.6 % of participants were unvaccinated, 39.6 % had received 1 - 2 vaccine doses, and only 18.8 % had received three or more doses. The mean number of vaccine doses was 1.34 (SD = 1.27, range: 0 - 4). Full details are presented in **Table 1**.

**Table 1** General characteristics of participants.

| Variables | Frequency (%) |
|---|---|
| **Age (years)** Mean 64.89±20.22, Min - Max = 1 - 99 | |
| ≥ 60 | 234 (65.7) |
| < 60 | 122 (34.3) |
| **Sex** | |
| Man | 120 (33.7) |
| Female | 236 (66.3) |
| **Body mass index (kg/m$^2$)** Mean 23.29±6.89, Min - Max = 11.72 - 44.80 | |
| < 25 | 253 (71.1) |
| ≥ 25 | 103 (28.9) |
| **Smoking (people)** | |
| No smoking | 353 (99.2) |
| Smoking | 3 (0.8) |
| **Drinking alcohol (people)** | |
| Not drink alcohol | 351 (98.6) |
| Drink alcohol | 5 (1.4) |
| **Types of chronic diseases** | |
| Hypertension | 160 (44.9) |
| Diabetes | 53 (14.9) |
| Chronic respiratory disease | 15 (4.2) |
| Stroke | 15 (4.2) |
| Chronic kidney disease | 6 (1.7) |
| Cardiovascular disease | 1 (0.3) |
| No underlying diseases | 106 (29.8) |
| **Number of chronic diseases (diseases)** Mean 0.67±0.67, Min - Max = 0 - 3 | |
| 1 | 213 (59.8) |
| ≥ 2 | 37 (10.4) |
| **Number of vaccinations (doses)** Mean 1.34±1.27, Min - Max = 0 - 4 | |
| Not vaccinated | 148 (41.6) |
| 1-2 | 141 (39.6) |
| ≥3 | 67 (18.8) |

**Initial clinical and laboratory findings**

At admission, chest x-ray imaging revealed reticular infiltrates in 54.9 % and patchy infiltrates in 45.1 % of pneumonia cases. Oxygen saturation levels were below 95 % in 43.2 % of patients, with a mean $SpO_2$ of 96.8 % (SD = 4.8, range: 91 - 98 %). All patients were diagnosed with COVID-19 pneumonia; 6.5 % presented with concurrent COPD exacerbations. Laboratory testing revealed a mean hemoglobin level of 13.4 g/dL (SD = 3.3), with 43.3 % of patients showing subnormal levels. The mean lymphocyte count was 42.8 % (SD = 2.1), and 60.7 % of patients had lymphocyte percentages that were elevated beyond the normal range (11 - 49 %). The mean platelet count was 236 × $10^3$/uL (SD = 176), with 30.3 % of patients presenting with thrombocytopenia. The mean creatinine level was 1.64 g/dL (SD = 2.8), and 37.4 % of patients had levels above the normal range (0.51 - 1.77 g/dL), suggesting possible renal impairment. In terms of treatment, 65.3 % received molnupiravir, while 34.7 % received favipiravir. The mean length of hospital stay was 2.74 days (SD = 2.54, range: 1 - 33), with 95.8 % of patients discharged within 5 days. These findings are detailed in **Table 2**.

**Table 2** Initial clinical and laboratory at hospital admission.

| Variables | Frequency (%) |
|---|---|
| **Chest X-ray results** | |
| reticular infiltration | 203 (54.9) |
| patchy infiltration | 153 (45.1) |
| **Oxygen saturation (%)** Mean = 96.8±4.8, Min - Max = 91 - 98 % | |
| < 95 | 166 (43.2) |
| ≥ 95 | 190 (56.8) |
| **Diagnosis** | |
| Covid-19 with Pneumonia | 333 (93.5) |
| Covid-19 with Pneumonia with COPD | 23 (6.5) |
| **Laboratory blood test results** | |
| **Hemoglobin (gm%)** Mean = 13.4±3.3, Min - Max = 10.6 - 14 gm% | |
| Normal (12 - 18 gm%) | 202 (56.7) |
| < Normal | 154 (43.3) |
| **Lymphocyte count (%)** Mean = 42.8±2.1, Min - Max = 34.6 - 52.3 % | |
| Normal (11 - 49 %) | 140 (39.3) |
| > Normal | 216 (60.7) |
| **Platelet level ($10^3$ u/L)** Mean = 236x$10^3$±176, Min-Max = 96×$10^3$- 444×$10^3$ | |
| Normal (140 - 400 $10^3$ u/L) | 248 (69.7) |
| < normal | 108 (30.3) |

| Variables | Frequency (%) |
|---|---|
| **Creatinine (g/dL)** Mean = 1.64±2.8, Min-Max = 0.69 - 1.8 g/dL | |
| Normal (0.51 - 1.77 g/dL) | 223 (62.6) |
| > Normal | 133 (37.4) |
| **Received antiviral medication for COVID-19 (people)** | |
| Favipiravir | 104 (34.7) |
| Molnupiravir | 252 (65.3) |
| **Number of days in hospital (days)** Mean = 2.74±2.54**,** Min - Max = 1 - 33 days | |
| < 5 days | 341 (95.8) |
| ≥ 5 days | 15 (4.2) |

**Factors associated with the severity of COVID-19 pneumonia**

An analysis of potential risk factors revealed that the severity of COVID-19 pneumonia was significantly associated with the following variables: age ≥ 60 years was significantly linked to a greater likelihood of requiring ventilatory support ($p$ = 0.028). Alcohol consumption was significantly associated with more severe pneumonia outcomes ($p$ = 0.025). Hospitalization lasting 5 days or more was strongly associated with severe disease presentation ($p < 0.001$). In contrast, no statistically significant associations were found between pneumonia severity and gender, BMI, vaccination status, number of underlying conditions, or smoking status ($p > 0.05$ for all). These associations are summarized in **Table 3**.

## Discussion

This study found a substantial burden of COVID-19 pneumonia among hospitalized patients in community hospitals, with older adults (≥ 60 years) accounting for 65.7 % of cases. This finding is consistent with previous studies that highlight aging as a key risk factor for severe COVID-19 outcomes, due to age-related physiological changes such as reduced immune competence, diminished pulmonary function, and impaired mobility (Chiyangkabut et al., 2023). These age-related factors contribute to delayed viral clearance and increased susceptibility to respiratory complications. Among the sample, 28.9 % of patients were classified as overweight or obese (BMI ≥ 25 kg/m²). Obesity is a known risk factor for severe COVID-19 due to chronic systemic inflammation, mechanical restriction of the lungs, and impaired immune responses. A rise of just one unit in BMI has been associated with a 1.08-fold increase in the risk of severe pneumonia (Wanaborworn, 2023). Adipose tissue not only promotes excessive cytokine production but also expresses higher levels of angiotensin-converting enzyme 2 (ACE2) receptors, facilitating viral entry and amplification of inflammatory cascades (Intarapradit, 2021).

Comorbidities were highly prevalent, particularly hypertension (44.9 %) and diabetes mellitus (14.9 %). Hypertension may increase the risk of severe pneumonia through dysregulation of the renin–angiotensin–aldosterone system. Some evidence suggests that antihypertensive agents such as

ACE inhibitors and angiotensin receptor blockers may upregulate ACE2 receptors, potentially enhancing viral entry (Peng et al., 2021). These observations are consistent with prior research in Thailand and globally, which has shown a 2 to 3-fold increased risk of severe pneumonia in hypertensive patients (Pongpirul et al., 2020; Jantakam et al., 2022). Similarly, diabetes mellitus is strongly associated with severe COVID-19 pneumonia. Hyperglycemia impairs innate and adaptive immunity, increasing susceptibility to infections (Berbudi et al., 2020). Patients with diabetes are reported to have a 2 to 5-fold increased risk of developing severe pneumonia (Nuevo-Ortega et al., 2022; Jantakam et al., 2022). Additionally, vaccination coverage in this study was suboptimal, with 41.6 % of patients remaining unvaccinated. Vaccination has been shown to reduce the incidence of pneumonia by priming the immune system and promoting antibody production. Schiebler et al. (2022) reported pneumonia rates of 71.5 - 78 % in unvaccinated patients versus only 41 % in fully vaccinated individuals. Vaccination has also been shown to mitigate the risk of pneumonia in cases of reinfection (Murillo-Zamora et al., 2022).

**Table 3** Factors related to the severity of COVID-19 pneumonia.

| Factor | Total n(%) | Severity of pneumonia | | $X^2$ | *p*-value |
|---|---|---|---|---|---|
| | | Ventilator n = 105 | No ventilator n = 251 | | |
| **Sex** | | | | 1.283[a] | 0.257 |
| Female | 236 (66.3) | 65 (27.5) | 171 (72.5) | | |
| Man | 120 (33.7) | 40 (33.3) | 80 (66.7) | | |
| **Age** | | | | 4.839[a] | 0.028* |
| ≥ 60 years | 234 (65.7) | 78 (33.3) | 156 (66.7) | | |
| < 60 years | 122 (34.3) | 27 (22.1) | 95 (77.9) | | |
| **BMI (Kg/m$^2$)** | | | | 0.861[a] | 0.353 |
| < 25 Kg/m$^2$ | 253 (71.1) | 71 (28.1) | 182 (71.9) | | |
| ≥ 25 Kg/m$^2$ | 103 (28.9) | 34 (33.0) | 69 (67.0) | | |
| **Number of vaccinations (doses)** | | | | 1.652[b] | 0.443 |
| Not vaccinated | 148 (41.6) | 49 (33.1) | 99 (66.9) | | |
| 1 - 2 doses | 141 (39.6) | 39 (27.7) | 102 (72.3) | | |
| ≥ 3 doses | 67 (18.8) | 17 (25.4) | 50 (74.6) | | |
| **Number of chronic diseases** | | | | 0.288[b] | 0.876 |
| No underlying diseases | 106 (29.8) | 45 (28.7) | 61 (71.3) | | |
| 1 diseases | 213 (59.8) | 50 (30.9) | 163 (69.1) | | |

| Factor | Total n(%) | Severity of pneumonia | | $X^2$ | *p*-value |
|---|---|---|---|---|---|
| | | Ventilator n = 105 | No ventilator n = 251 | | |
| ≥ 2 diseases | 37 (10.4) | 10 (27.0) | 27 (73.0) | | |
| **Smoking** | | | | 2.010[b] | 0.209 |
| No smoking | 353 (99.2) | 103 (29.2) | 250 (70.8) | | |
| Smoking | 3 (0.8) | 2 (66.7) | 1 (33.3) | | |
| **Drinking alcohol** | | | | 5.763[b] | 0.025* |
| Not drink alcohol | 351 (98.6) | 98 (27.9) | 253 (72.1) | | |
| Drink alcohol | 5 (1.4) | 4 (80.0) | 1 (20.0) | | |
| **Number of days in hospital** | | | | 37.434[b] | 0.000** |
| < 5 days | 341 (95.8) | 90 (26.4) | 251 (73.6) | | |
| ≥ 5 days | 15 (4.2) | 15 (100.0) | 0(0.0) | | |

[a]: Chi-square, [b]: Fisher exact, *p*-value: < 0.05*, < 0.00**

The presence of hypoxia on admission, with oxygen saturation < 95 % in 43.2 % of patients, suggests late-stage presentation and more severe pulmonary involvement. Delayed treatment-seeking behavior, possibly due to initially mild or atypical symptoms, may have contributed to this trend (Oran et al., 2020). These findings support earlier reports that low initial oxygen saturation is a key indicator of severe COVID-19 pneumonia (Pongpirul et al., 2020; Jantakam et al., 2022). Approximately 6.5 % of patients had coexisting chronic obstructive pulmonary disease (COPD), which likely exacerbated disease severity. SARS-CoV-2 is known to induce a potent inflammatory response, activating complement pathways (C3a and C5a), as well as neutrophils and macrophages, which ultimately leads to alveolar damage and acute lung injury (Risitano et al., 2020). Laboratory findings showed elevated lymphocyte percentages in many patients. While lymphopenia has been identified as a marker of severe disease, lymphocytosis in this context may reflect a reactive immune response or lab variation (Lee et al., 2021). Platelet and creatinine levels further provided insights into disease burden and the presence of systemic inflammation or organ dysfunction.

Three variables were found to be significantly associated with the severity of COVID-19 pneumonia: advanced age, alcohol consumption, and prolonged hospitalization. First, age 60 years or older was significantly associated with severe disease ($p$ = 0.028). This association has been repeatedly confirmed in previous studies. For example, individuals aged ≥ 60 are twice as likely to experience severe pneumonia (Vanichaniramol et al., 2022), with some estimates suggesting a 5.1-fold increase in critical illness risk (Gao et al., 2021). Each additional decade of life may double the risk of mortality (Patiphanwat, 2022). Second, alcohol consumption was significantly associated with severe pneumonia ($p$ = 0.025). Chronic alcohol use weakens host defense mechanisms,

reduces neutrophil function, and impairs mucociliary clearance (Kalayasiri, 2020). Studies have shown that alcohol dependence increases pneumonia risk by 2.9 times and accounts for a significant proportion of pneumonia-related mortality. Third, hospital stays of 5 days or longer were significantly associated with greater disease severity ($p < 0.001$). This likely reflects the complexity of managing patients with severe pneumonia and comorbidities such as diabetes and hypertension, which can prolong recovery and increase the need for supportive care.

These findings emphasize the importance of targeted surveillance and early intervention for high-risk groups, particularly older adults, individuals with chronic conditions, and those who consume alcohol. Vaccination campaigns should continue to focus on vulnerable populations to reduce severe outcomes. Early identification and timely treatment may reduce progression to critical illness and the burden on healthcare resources. However, this study has limitations, such as the retrospective cross-sectional design, which precludes causal inferences between identified factors and the severity of COVID-19 pneumonia. Data collection was limited to Nakhon Si Thammarat Province, which may not reflect the epidemiological patterns or healthcare practices in other regions. Additionally, vaccination data lacked details on vaccine types, timing, and booster doses, which could influence disease severity but were not examined. Thus, future research include the use of prospective cohort designs to better establish causal relationships. Expanding the study population to include multiple provinces or healthcare levels (e.g., tertiary hospitals) would enhance generalizability. Moreover, detailed assessment of vaccination history and viral strain data should be incorporated to understand their influence on disease progression.

## Conclusions

Older age, alcohol use, and prolonged hospitalization were significantly associated with the severity of COVID-19 pneumonia in community hospital settings. Clinical strategies should prioritize early screening, vaccination, and integrated care for high-risk groups to prevent complications and reduce hospital burden. These findings can inform resource allocation and patient management protocols in future public health emergencies.

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