Incidence and Risk Factors of Pneumonia in Hospitalized Patients with Seasonal Influenza A or B

Seongjun Chu, M.D.1,*, Sang Joon Park, M.D.1,*, So My Koo, M.D.1, Yang Ki Kim, M.D., Ph.D.1, Ki Up Kim, M.D., Ph.D.1, Soo-Taek Uh, M.D., Ph.D.1, Tae Hyung Kim, M.D., Ph.D.2 and Suyeon Park, Ph.D.3

Divisions of 1Pulmonary and Allergy Medicine and 3Infectious Disease, Department of Internal Medicine, 2Department of Biostatistics, Soonchunhyang University Hospital, Seoul, Korea

**Background:** Most patients with influenza recover spontaneously or following treatment with an anti-viral agent, but some patients experience pneumonia requiring hospitalization. We conducted a retrospective review to determine the incidence and risk factors of pneumonia in hospitalized patients with influenza A or B.

**Methods:** A total of 213 patients aged 18 years or older and hospitalized with influenza between January 2012 and January 2015 were included in this study. A reverse-transcriptase polymerase chain reaction assay was used to detect the influenza A or B virus in the patients’ sputum samples. We collected demographic and laboratory data, combined coexisting diseases, and radiologic findings.

**Results:** The incidence of pneumonia was higher in patients in the influenza A group compared to those in the influenza B group (68.6% vs. 56.9%), but this difference was not statistically significant. The presence of underlying respiratory disease was significantly associated with pneumonia in the influenza A group (adjusted odds ratio [OR], 3.975; 95% confidence interval [CI], 1.312–12.043; p=0.015). In the influenza B group, the white blood cell count (adjusted OR, 1.413; 95% CI, 1.053–1.896; p=0.021), platelet count (adjusted OR, 0.988; 95% CI, 0.978–0.999; p=0.027), and existence of an underlying medical disease (adjusted OR, 15.858; 95% CI, 1.757–143.088; p=0.014) were all significantly associated with pneumonia in multivariate analyses.

**Conclusion:** The incidence of pneumonia was 65.7% in hospitalized patients with influenza A or B. The risk factors of pneumonia differed in hospitalized patients with influenza A or B.

**Keywords:** Pneumonia; Influenza; Risk Factors; Comorbidity

**Introduction**

Influenza is a type of self-limiting disease characterized by acute onset of fever, sore throat, malaise, and respiratory symptoms. In healthy people, the disease resolves without any complications. However, considerable excess mortality is observed in elderly and comorbid patients. Although influenza combined with pneumonia can lead to death, mortality is often caused by the aggravation of a preexisting disease such as bronchial asthma, chronic obstructive airways disease, and cardiovascular diseases.

In the case of seasonal influenza, approximately 1% of hospitalized patients with combined influenza and pneumonia died between 2005 and 2008. From the 1976–1977 to the 2002–2003 seasons, 9.9 deaths per 100,000 attributed to...
infection confirmed by a reverse-transcriptase polymerase chain reaction (RT-PCR) assay from nasopharyngeal aspirates or sputum. Pneumonia was defined radiographically by the modified World Health Organization criteria as the presence of a consolidation, infiltrate, or opacity that could be described as alveolar, interstitial, or lobar.

2. Data

Patients’ demographic data, vital signs, clinical manifestations, coexisting conditions, and laboratory and radiographic findings were collated from medical records. Body mass index (BMI; weight in kilograms divided by the square of the height in meters) was calculated to determine whether the patient was overweight or obese, defined as a BMI ≥25 or ≥35, respectively. We analyzed the CURB-65 and CRB-65 scores to determine the severity of pneumonia. The CURB-65 parameter consists of five risk factors, as follows: confusion of new onset, blood urea nitrogen (BUN) greater than 7 mmol/L (19 mg/dL), respiratory rate of 30 breaths per minute or greater, blood pressure less than 90 mm Hg systolic or a diastolic blood pressure 60 mm Hg or less, and an age of 65 years or older. The CRB-65 parameter is as described above but omits the BUN score.

3. Underlying medical conditions

Data were collected on the following underlying medical conditions: gastrointestinal disease including liver cirrhosis, chronic hepatitis, and inflammatory bowel disease; cardiologic disease including heart failure and coronary artery disease; respiratory disease including asthma, COPD, and idiopathic pulmonary fibrosis (IPF); renal disease including chronic kidney disease and end-stage renal disease with dialysis; neurological disease including cerebral infarction, cerebellar infarction, and intracranial hemorrhage; malignancy; and history of transplantation. Hypertension was excluded a cardiologic disease.

4. AdvanSure RV real-time RT-PCR

Nucleic acids (RNA and DNA) were extracted from 200 µL nasopharyngeal samples using a fully automated magnetic bead operating platform, the Smart LabAssist-32 with the TANBead Viral Auto Plate (96-well plate) (Taiwan Advanced Nanotech Inc., Taoyuan City, Taiwan). AdvanSure RV real-time kits (LG Life Sciences, Seoul, Korea) were used to detect 12 types of RNA virus and two types of DNA virus according to the manufacturer’s instructions. Briefly, 5 µL extracted nucleic acids was added to an AdvanSure RV real-time RT-PCR reaction tube containing 5 µL primer probe mixture and 10 µL 1-step premix to perform DNA synthesis and real-time RT-PCR. For the reverse transcription step, this mixture was incubated at 50°C for 10 minutes. Denaturation followed at

Materials and Methods

1. Inclusion criteria and definitions

This retrospective observational study was performed according to the guidelines of the Declaration of Helsinki and was approved by the local ethics committees (SCHUH-2016-10-010). Patients admitted between January 2012 and June 2015 who met the following criteria were included: age over 18 years old; chest radiographs obtained within 24 hours of hospital admission; and influenza A or B infection confirmed by a reverse-transcriptase polymerase
95°C for 30 seconds, then 10 cycles of polymerase chain reaction (PCR) (15 seconds at 95°C, 30 seconds at 53°C, and 30 seconds at 60°C), followed by 30 additional cycles of PCR to detect fluorescence signals (15 seconds at 95°C, 30 seconds at 53°C, and 30 seconds at 60°C). The AdvanSure RV real-time RT-PCR performed both the reverse-transcription reaction with the extracted RNA and the multiplex PCR reaction simultaneously in a single tube and used endogenous RNase P as an internal control to provide information on the validity of the RNA extraction procedure and to prevent inaccuracies arising from sampling errors and RT-PCR reaction errors.

5. Statistical analysis

Continuous variables are presented as mean±standard deviation, or as medians with ranges. Categorical variables are presented as numbers and percentages. Multivariate analyses was performed to compare the clinical characteristics of patients with seasonal influenza and co-infected pneumonia. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated, p-values were calculated using the chi-square test or Fisher exact test for categorical variables, as appropriate, and by the Student’s t test or Mann-Whitney U test for continuous variables. The clinical findings, laboratory findings, and underlying medical conditions were analyzed as variables for independent risk factors of the incidence of pneumonia in each group. Variables for which the p-value was <0.2 in univariate analyses were included in a logistic regression model for multivariate analyses. Variable selection was performed by backward method. All tests were two-tailed, and a p-value of <0.05 was considered to indicate significance in the multivariate analyses. All tests were performed with SPSS version 15.0 (SPSS Inc., Chicago, IL, USA).

Results

1. Baseline characteristics

Data from 216 patients infected with the influenza A or B virus were available for analysis. Three patients were excluded due to being positive for both viruses. A total of 210 patients were subsequently evaluated and the clinical characteristics of 159 patients with influenza A (74.6%) and 51 patients with influenza B (25.4%) are presented in Table 1. The patients’ clinical characteristics, including underlying medical conditions, did not differ between the two groups. Diabetes mellitus was the most common comorbidity in both groups (Table 1).

2. Incidence of pneumonia

The incidence of pneumonia in the influenza A group was higher compared to the influenza B group (68.6% vs. 56.9%) but the difference was not statistically significant (p=0.126), with both groups together having an incidence of 65.7% (Table 1).

3. Laboratory and clinical findings

Among the patients hospitalized with the influenza A virus, female patients were more predominant in the pneumonia group (56.9%) compared to the non-pneumonia group (38.0%) (p<0.05). Respiratory diseases were more common in the pneumonia group (25.7%) than in the non-pneumonia group (8.0%) (p=0.01). Laboratory findings, other clinical findings, and underlying medical diseases did not differ between the groups except for the CRB-65 score (Table 2).

Table 1. Baseline characteristics of patients with influenza A or B

| Characteristic                  | Influenza A virus (n=159) | Influenza B virus (n=51) | Total (n=210) |
|--------------------------------|---------------------------|--------------------------|---------------|
| Male sex                       | 81 (50.9)                 | 23 (45.1)                | 104 (49.5)    |
| Age, yr                        | 68 (19–95)                | 69 (24–91)               | 138 (65.7)    |
| Pneumonia                      | 109 (68.5)                | 29 (56.9)                | 138 (65.7)    |
| Underlying medical conditions  |                           |                          |               |
| Gastrointestinal diseases       | 23 (14.5)                 | 5 (9.8)                  | 28 (13.3)     |
| Cardiologic diseases           | 33 (22.0)                 | 10 (19.6)                | 43 (21.4)     |
| Respiratory diseases           | 32 (20.1)                 | 15 (29.4)                | 47 (22.4)     |
| Diabetes mellitus              | 49 (30.8)                 | 18 (35.3)                | 67 (31.9)     |
| Malignancies                   | 38 (23.9)                 | 11 (21.6)                | 49 (23.3)     |
| Renal diseases                 | 20 (12.6)                 | 12 (23.5)                | 32 (15.2)     |
| Transplantation                | 1 (0.6)                   | 1 (2.0)                  | 2 (1.0)       |
| Neurological diseases          | 14 (8.8)                  | 8 (15.7)                 | 22 (10.5)     |

Values are presented as number (%) or median (range).
| Variable                     | Non-pneumonia (n=50) | Pneumonia (n=109) | p-value |
|------------------------------|----------------------|-------------------|---------|
| Demographics                 |                      |                   |         |
| Female sex                   | 19 (38.0)            | 62 (26.9)         | 0.028   |
| Age, yr                      | 63.5±18.1            | 66.0±16.5         | 0.193   |
| Laboratory finding           |                      |                   |         |
| WBC count, ×10^3/µL          | 7.61±4.49            | 8.36±5.55         | 0.204   |
| Hemoglobin, g/dL             | 10.9±1.97            | 10.79±1.94        | 0.329   |
| Hematocrit, %                | 32.88±5.85           | 32.73±5.75        | 0.448   |
| Platelet count, ×10^3/µL     | 201.48±103.12        | 188.48±91.40      | 0.410   |
| AST, U/L                     | 37.44±50.10          | 59.56±190.97      | 0.223   |
| ALT, U/L                     | 30.06±34.15          | 44.94±144.68      | 0.295   |
| BUN, mg/dL                   | 20.50±17.99          | 20.19±17.00       | 0.021   |
| Serum creatinine, mg/dL      | 1.89±2.65            | 1.45±2.02         | 0.137   |
| eGFR, mL/min                 | 71.65±37.05          | 73.78±32.48       | 0.476   |
| CRP, mg/dL                   | 6.23±7.91            | 8.43±8.52         | 0.124   |
| CURB-65 score                | 1.20±1.05            | 1.36±1.10         | 0.221   |
| CRB-65 score                 | 0.82±0.77            | 1.02±0.86         | 0.099   |
| Clinical finding             |                      |                   |         |
| Respiratory rate             | 19.22±4.16           | 19.58±3.60        | 0.311   |
| Systolic blood pressure, mm Hg| 121.76±22.38         | 118.46±19.04      | 0.171   |
| Diastolic blood pressure, mm Hg| 71.32±11.27         | 70.02±10.24       | 0.239   |
| Height, cm                   | 158.48±9.20          | 160.72±10.94      | 0.049   |
| Weight, kg                   | 60.88±12.70          | 60.01±11.82       | 0.336   |
| BMI                          | 24.13±4.04           | 23.25±4.17        | 0.310   |
| Body temperature, °C         | 36.84±0.68           | 36.86±0.68        | 0.438   |
| Pulse rate                   | 79.24±10.07          | 82.94±17.89       | 0.087   |
| Abnormal mental status       | 3 (6.0)              | 15 (13.8)         | 0.153   |
| Underlying medical conditions|                      |                   |         |
| Hypertension                 | 20 (40.0)            | 53 (48.6)         | 0.312   |
| Diabetes                     | 15 (30.0)            | 34 (31.2)         | 0.880   |
| Respiratory disease          | 4 (8.0)              | 28 (25.7)         | 0.010   |
| Gastrointestinal disease     | 6 (12.0)             | 17 (15.6)         | 0.551   |
| Cardiologic disease          | 12 (24.0)            | 23 (21.1)         | 0.683   |
| Malignancy                   | 9 (18.0)             | 29 (26.6)         | 0.221   |
| Renal disease                | 6 (12.0)             | 14 (12.8)         | 0.882   |
| Transplantation              | 1 (2.0)              | 0                  | 0.140   |
| Neurological disease         | 3 (6.0)              | 11 (10.1)         | 0.399   |
| No underlying disease        | 11 (22.0)            | 19 (17.4)         | 0.496   |

Values are presented as number (%) or median (range).

WBC: white blood cell count; AST: aspartate aminotransferase; ALT: alanine aminotransferase; BUN: blood urea nitrogen; eGFR: estimated glomerular filtration rate; CRP: C-reactive protein; BMI: body mass index.
### Table 3. Laboratory and clinical findings of patients with influenza B

| Variable                        | Non-pneumonia (n=22) | Pneumonia (n=29) | p-value |
|---------------------------------|-----------------------|-------------------|---------|
| **Demographics**                |                       |                   |         |
| Female sex                      | 12 (54.5)             | 16 (55.2)         | 0.965   |
| Age, yr                         | 61.9±17.0             | 69.0±12.8         | 0.048   |
| **Laboratory findings**         |                       |                   |         |
| WBC count, ×10^9/µL             | 5.95±3.17             | 7.48±3.32         | 0.049   |
| Hemoglobin, g/dL                | 11.85±2.09            | 11.31±1.93        | 0.174   |
| Hematocrit, %                   | 33.37±6.01            | 34.20±5.38        | 0.233   |
| Platelet count, ×10^3/µL        | 180.36±85.14          | 134.97±68.77      | 0.021   |
| AST, U/L                        | 29.68±22.07           | 26.72±17.01       | 0.303   |
| ALT, U/L                        | 26.73±21.56           | 24.24±23.50       | 0.351   |
| BUN, mg/dL                      | 14.46±14.34           | 17.44±8.91        | 0.192   |
| Serum creatinine, mg/dL         | 0.92±0.87             | 1.19±0.98         | 0.169   |
| eGFR, mL/min                    | 90.19±23.89           | 72.67±27.91       | 0.010   |
| CRP, mg/dL                      | 3.35±5.79             | 4.77±5.43         | 0.190   |
| CURB-65 score                   | 1.05±1.09             | 1.55±1.33         | 0.074   |
| CRB-65 score                    | 0.91±0.92             | 1.14±0.92         | 0.234   |
| **Clinical findings**           |                       |                   |         |
| Respiratory rate                | 19.73±2.16            | 20.31±2.92        | 0.236   |
| Systolic blood pressure, mm Hg  | 113.59±10.92          | 118.07±12.17      | 0.092   |
| Diastolic blood pressure, mm Hg | 68.77±9.06            | 70.21±8.65        | 0.289   |
| Height, cm                      | 163.00±11.17          | 160.20±8.81       | 0.161   |
| Weight, kg                      | 63.13±13.26           | 59.92±12.17       | 0.186   |
| BMI                             | 23.60±3.44            | 23.26±3.67        | 0.062   |
| Body temperature, °C            | 37.00±0.78            | 36.72±0.66        | 0.085   |
| Pulse rate                      | 85.59±14.04           | 81.93±9.86        | 0.151   |
| Abnormal mental status          | 1 (4.5)               | 6 (20.7)          | 0.100   |
| **Underlying medical conditions**|                       |                   |         |
| Hypertension                    | 10 (45.5)             | 18 (62.1)         | 0.242   |
| Diabetes                        | 8 (36.4)              | 10 (34.5)         | 0.890   |
| Respiratory disease             | 4 (18.2)              | 11 (37.9)         | 0.129   |
| Gastrointestinal disease        | 2 (9.1)               | 3 (10.3)          | 0.883   |
| Cardiologic disease             | 3 (13.6)              | 7 (24.1)          | 0.354   |
| Malignancy                      | 5 (22.7)              | 6 (20.7)          | 0.915   |
| Renal disease                   | 5 (22.7)              | 7 (24.1)          | 0.907   |
| Transplantation                 | 1 (4.5)               | 0                  | 0.251   |
| Neurological disease            | 2 (9.1)               | 6 (20.7)          | 0.264   |
| No underlying disease           | 7 (31.8)              | 2 (6.9)           | 0.022   |

Values are presented as number (%) or median (range).

WBC: white blood cell count; AST: aspartate aminotransferase; ALT: alanine aminotransferase; BUN: blood urea nitrogen; eGFR: estimated glomerular filtration rate; CRP: C-reactive protein; BMI: body mass index.
Patients in the pneumonia group were older than those in the non-pneumonia group (69.0±12.8 years vs. 61.9±17.0 years, p<0.05). In contrast to the influenza A group, the incidence of underlying respiratory disease did not differ between the pneumonia and non-pneumonia groups. The pneumonia group had a higher white blood cell (WBC) count than the non-pneumonia group (5.950±3.170/µL vs. 7.480±3.320/µL, p=0.049) (Table 3).

4. Risk factors for pneumonia

To identify the factors associated with the incidence of pneumonia in hospitalized patients with influenza, each group was investigated using multivariate analyses. Sex, heart rate, abnormal mental status, C-reactive protein, underlying respiratory diseases, and the CRB-65 score were all associated with the incidence of pneumonia in the influenza A group. Among them, underlying respiratory diseases were significantly associated with pneumonia in multivariate analyses (adjusted OR, 3.975; 95% CI, 1.312–12.043; p=0.015) (Table 4).

With regard to the influenza B group (Table 5), an age over 65 years old, body temperature, systolic blood pressure, abnormal mental status, WBC count, platelet count, estimated glomerular filtration rate, the existence of an underlying medical condition, underlying respiratory diseases, and the CURB-65 score were all associated with the incidence of pneumonia. Among them, the WBC count (adjusted OR, 1.413; 95% CI, 1.053–1.896; p=0.021), platelet count (adjusted OR, 0.988; 95% CI, 0.978–0.999; p=0.027), and the existence of an underlying medical disease (adjusted OR, 15.858; 95% CI, 1.757–143.088; p=0.014) were significantly associated with pneumonia in multivariate analyses. In contrast to the influenza A group, underlying respiratory diseases were not significantly associated with pneumonia (Table 5).

While various findings were associated with the incidence of pneumonia in the total group of patients, only underlying respiratory diseases had a significant association (adjusted OR, 3.155; 95% CI, 1.347–7.387; p=0.008) (Table 6).

| Variable | Univariate OR | 95% CI | p-value | Multivariate Adjusted OR | 95% CI | p-value |
|----------|--------------|--------|---------|--------------------------|--------|---------|
| Female sex | 0.465 | 0.234–0.922 | 0.028 | - | - | - |
| Heart rate | 1.016 | 0.992–1.041 | 0.180 | - | - | - |
| Abnormal mental status | 2.500 | 0.689–9.065 | 0.163 | - | - | - |
| CRP, mg/dL | 1.036 | 0.990–1.083 | 0.128 | - | - | - |
| Respiratory diseases | 3.975 | 1.312–12.043 | 0.015 | 3.975 | 1.312–12.043 | 0.015 |
| CACI | 1.142 | 0.980–1.330 | 0.088 | - | - | - |
| CRB-65 | 1.334 | 0.884–2.047 | 0.166 | - | - | - |

OR: odds ratio; CI: confidence interval; CRP: C-reactive protein; CACI: Charlson Age-Comorbidity Index.

| Variable | Univariate OR | 95% CI | p-value | Multivariate OR | 95% CI | p-value |
|----------|--------------|--------|---------|----------------|--------|---------|
| Age ≥65 yr | 1.034 | 0.994–1.077 | 0.100 | - | - | - |
| Body temperature | 0.567 | 0.249–1.289 | 0.175 | - | - | - |
| Systolic blood pressure, mm Hg | 1.035 | 0.984–1.088 | 0.180 | - | - | - |
| Abnormal mental status | 5.478 | 0.608–49.348 | 0.129 | - | - | - |
| WBC count, ×10⁹/µL | 1.173 | 0.964–1.426 | 0.111 | 1.143 | 1.053–1.896 | 0.021 |
| Platelet count, ×10⁹/µL | 0.992 | 0.984–1.000 | 0.047 | 0.980 | 0.978–0.999 | 0.027 |
| eGFR, mL/min | 0.971 | 0.945–0.998 | 0.035 | - | - | - |
| Existence of underlying condition | 6.300 | 1.158–34.262 | 0.033 | 15.858 | 1.757–143.088 | 0.014 |
| Respiratory diseases | 2.750 | 0.736–10.271 | 0.132 | - | - | - |
| CURB-65 score | 1.521 | 0.895–2.584 | 0.121 | - | - | - |

OR: odds ratio; CI: confidence interval; WBC: white blood cell count; eGFR: estimated glomerular filtration rate.
Discussion

Infection with the influenza virus can lead to various complications. However, among them, the occurrence of pneumonia has been considered a serious condition that should be treated properly because it can lead to death. Riquelme et al.\textsuperscript{18} demonstrated that more severe respiratory compromise was found in patients with pneumonia associated with pandemic influenza A (H1N1) compared to those with seasonal influenza. Another report showed that patients hospitalized with pandemic influenza A (H1N1) were more likely to have complications such as lower respiratory tract infections, shock or sepsis, and organ failure compared to those with seasonal influenza\textsuperscript{19}. However, nearly one-third of patients with seasonal influenza in the United States had pneumonia and this was associated with admission to an intensive care unit and death\textsuperscript{20}. For this reason, we speculated that seasonal influenza can cause severe respiratory complications and even death, although it has a much milder clinical course than pandemic influenza. We investigated the incidence and risk factors of pneumonia in hospitalized patients with seasonal influenza in Korea. The incidence was 68.6%, 56.9%, and 65.7% in influenza A, influenza B, and influenza A and B combined, respectively. In the United States, a recent epidemiologic study reported that 29% of patients had pneumonia among 4,765 patients hospitalized with influenza\textsuperscript{21}. However, a separate study showed that 48.5%–52% of patients hospitalized with influenza had pneumonia\textsuperscript{22}. This large difference may be related to the type of hospital and difficulty admitting patients. Because present study was performed at a tertiary hospital in Seoul, it was not easy to admit patients with mild symptoms. Furthermore, no epidemiologic studies to date have included admission criteria. This suggests that prospective studies are required to define the incidence of pneumonia in hospitalized patients with influenza.

Complicated influenza infections are associated with obesity, underlying pulmonary disease, cardiologic disease, and old age\textsuperscript{10,11,20}. Our findings are consistent with this, in that the main risk factors for pneumonia were respiratory disease and underlying medical conditions in patients with influenza A and B, respectively. Other factors such as the WBC and platelet counts were risk factors for pneumonia in patients with influenza B, which was not found in other pandemic studies. This difference may be explained by the different target populations: seasonal influenza in our study and pandemic influenza in other studies. Hong et al.\textsuperscript{21} showed that the main risk factor for complicated seasonal influenza was diabetes mellitus. In our study, although diabetes mellitus was the most common underlying medical condition, diabetes itself did not serve as a risk factor for pneumonia.

It is widely accepted that influenza B viruses are more likely to infect children and cause milder illness than influenza A viruses\textsuperscript{22}. Furthermore, influenza A and B affect different segments of the population. Older age is associated with increased influenza A detection\textsuperscript{23}. Thus, we compared the incidence and risk factors of pneumonia in both influenza A and B. The incidence of pneumonia was similar between the influenza A and B groups. We are unable to explain this difference. Future studies that include virology data are needed to clarify this difference.

The present study had several limitations. First, it was performed at a single center with a relatively small study population. Second, we did not analyze subtypes of the influenza virus. However, the subtypes of seasonal influenza do not alter treatment regimens or have clinical implications. Third, we were unable to differentiate the cause of pneumonia as either primary viral pneumonia or secondary bacterial pneumonia because, clinically, it is very difficult to isolate the infectious pathogen.

### Table 6. Risk factors of the incidence of pneumonia in hospitalized patients with both influenza A and B

| Variable                         | Univariate | Multivariate |
|----------------------------------|------------|--------------|
|                                  | OR         | 95% CI       | p-value | Adjusted OR | 95% CI       | p-value |
| Female sex                       | 0.567      | 0.318–1.010  | 0.054   | -           | -            | -       |
| Abnormal mental status           | 3.051      | 1.005–9.261  | 0.049   | -           | -            | -       |
| WBC count, $\times 10^3/\mu$L    | 1.051      | 0.985–1.122  | 0.133   | -           | -            | -       |
| Platelet count, $\times 10^3/\mu$L| 0.998     | 0.995–1.001  | 0.189   | -           | -            | -       |
| CRP, mg/dL                       | 1.042      | 1.000–1.086  | 0.048   | 1.047       | 1.005–1.091  | 0.028   |
| Type of virus                    | 0.605      | 0.316–1.155  | 0.128   | -           | -            | -       |
| Respiratory diseases             | 3.152      | 1.384–7.178  | 0.006   | 3.399       | 1.483–7.793  | 0.004   |
| CURB-65                          | 1.235      | 0.944–1.617  | 0.124   | -           | -            | -       |
| CRB-65                           | 1.321      | 0.934–1.868  | 0.116   | -           | -            | -       |
| CACI                             | 1.137      | 1.000–1.293  | 0.050   | -           | -            | -       |

OR: odds ratio; CI: confidence interval; WBC: white blood cell count; CRP: C-reactive protein; CACI: Charlson Age-Comorbidity Index.
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agents. Fourth, we did not define indications of hospitalization. However, most previous epidemiologic studies also did not do this due to their retrospective design.

In conclusion, the incidence of pneumonia was 65.7% in patients hospitalized with influenza, and underlying respiratory disease (e.g., asthma, COPD, and IPF) was a strong risk factor for the incidence of pneumonia in hospitalized patients with influenza A. Otherwise, the existence of an underlying disease along with laboratory findings such as elevated WBC and platelet counts are significantly associated with pneumonia in patients with influenza B.

Conflicts of Interest

No potential conflict of interest relevant to this article was reported.

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