

Characteristics of the severe acute respiratory syndrome coronavirus 2 omicron BA.2 subvariant in Jilin, China from March to May 2022

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ABSTRACT

Background and Objectives: In the midst of the pandemic, new coronavirus mutants continue to emerge; the most relevant variant worldwide is omicron. Here, patients who recovered from the disease living in Jilin Province were analyzed to identify factors affecting the severity of omicron infection and to provide insights into its spread and early indication. **Methods:** In this study, 311 cases of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) were divided into two groups. Data on the patients' demographic characteristics and laboratory tests, including platelet count (PLT), neutrophil count (NE), C-reactive protein (CRP), serum creatinine (SCR), and neutrophil-to-lymphocyte ratio (NLR), were collected. The biomarkers for moderate and severe coronavirus disease 2019 (COVID-19) and factors affecting the incubation period and time to subsequent negative nucleic acid amplification test (NAAT) were also investigated. **Results:** Age, gender, vaccination, hypertension, stroke, chronic obstructive pulmonary disease (COPD)/chronic bronchitis/asthma, and some laboratory tests were statistically different between the two groups. In the receiver operating characteristic (ROC) analysis, PLT and CRP had higher area under the ROC curve values. In the multivariate analysis, age, hypertension, COPD/chronic bronchitis/asthma, and CRP were correlated with moderate and severe COVID-19. Moreover, age was correlated with longer incubation. In the Kaplan-Meier curve analysis, gender (male), CRP, and NLR were associated with longer time to subsequent negative NAAT. **Conclusions:** Older patients with hypertension and lung diseases were likely to have moderate or severe COVID-19, and younger patients might have a shorter incubation. A male patient with high CRP and NLR levels might take more time to turn back negative in the NAAT.

Key words: SARS-CoV-2, omicron, epidemiology, laboratory tests, nucleic acid amplification test

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INTRODUCTION

The novel coronavirus usually infects humans through the respiratory tract and causes damage to the respiratory system and various organs of the human body.^[1] Since the first outbreak at the end of 2019, the novel coronavirus is still raging worldwide, causing great economic and health burden. In the midst of the coronavirus disease

2019 (COVID-19) pandemic, new virus mutants continue to emerge, such as alpha, beta, gamma, delta, and omicron, some of which have stronger virulence or stronger immune escape ability.^[2] Presently, the most relevant variant worldwide is the omicron mutant.^[2-4]

In November 2021, Botswana reported the first case of omicron sequencing. A few days later, Hong Kong, China reported another

case of omicron sequencing in a traveler from South Africa.^[5] In South Africa, COVID-19 cases increased by an average of 280 cases daily in the week before omicron was detected and further increased to 800 cases a day in the following week.^[6] Omicron has some deletions and more than 30 mutations.^[5] These deletions and mutations lead to increased transmissibility, stronger viral binding affinity, and higher antibody escape rates.^[7,8] For governments and the public, the main concerns regarding omicron include whether it is more contagious or has more severe clinical manifestations and side effects and whether it can bypass vaccine protection.

Jilin is a province located in the northeast of China with a population of 27 million. In 2020, we performed a local epidemiological analysis involving all patients with COVID-19 in Jilin Province.^[9] In 2022, Jilin Province was again affected by the new coronavirus variant omicron. As of May 5, 2022, there have been more than 40,000 confirmed cases, with more than 39,000 cured cases and five cases of death in Jilin Province. In this study, we comprehensively analyzed 311 patients who recovered from the disease living in Jilin Province, China. We collected data on the patients' demographic characteristics, COVID-19 illness, symptoms, lung computed tomography (CT), and peripheral blood laboratory results for statistics to identify the factors affecting the severity of COVID-19 and to provide insights into its spread and early indications. Hopefully, our experience will provide support to more areas worldwide in dealing with the new variant.

METHODS

We conducted a retrospective study on the clinical characteristics of adult patients with confirmed severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection based on symptoms and the positive nucleic acid amplification test (NAAT) result of nasal and/or pharyngeal swab specimens. Data on 311 patients were randomly extracted from Changchun Infectious Disease Hospital and Hepatobiliary Disease Hospital of Jilin Province from March 10, 2022 to May 6, 2022. According to the interim guidance of the World Health Organization and the ninth edition of the Diagnosis and Treatment Protocol for COVID-19 Patients in China, the patients were divided into the mild (M) ($n = 259$) and moderate and severe (MS) ($n = 52$) groups. The inclusion criteria for the M group were as follows: (1) epidemiology history; (2) acute onset of fever, cough, fatigue, sore throat, headache, ageusia, diarrhea, and other symptoms; (3) age ≥ 18 years; (4) positive NAAT result for SARS-CoV-2; and (5) two successive negative NAAT results as a necessary condition for discharge. For the MS group, patients should meet at least one additional condition,

as follows: (1) a typical CT image of viral pneumonia; (2) $\text{PaO}_2/\text{FiO}_2 \leq 300$ mmHg; (3) oxygen saturation in resting state $\leq 93\%$; or (4) shortness of breath and/or respiratory rate ≥ 30 times per minute. This study was approved by the Ethics Committee of the First Hospital of Jilin University (Approval No. 22y050-001). This is a retrospective study and the informed consent was obtained.

Using a medical information system, the data on the clinical characteristics of the patients, including laboratory tests and demographic characteristics, were obtained from the database. For the laboratory assessments, data on leukocyte count, hemoprotein, platelet count (PLT), neutrophil count (NE), lymphocyte count, C-reactive protein (CRP), total bilirubin (TBIL), blood urea nitrogen (BUN), serum creatinine (SCR) were collected, and the neutrophil-to-lymphocyte ratio (NLR) and platelet-to-lymphocyte ratio (PLR) were calculated for analysis. Time to subsequent negative NAAT was defined as the duration between the dates of the first positive NAAT result and the second of the two successive negative NAAT results. The incubation period was defined as the time between exposure to the virus and the onset of clinical symptoms. Then, we analyzed the correlation among the clinical characteristics, COVID-19 illness, time to subsequent negative NAAT, and incubation period.

In this study, the means \pm standard deviations (SD) and/or interquartile ranges were used to summarize continuous variables. Numbers and/or percentages were used to describe categorical and ordinal variables. The Wilcoxon rank sum test and t-test were performed for continuous variables. The chi-square test and Fisher's exact test were applied to categorical variables. To calculate the optimal cutoff values for the laboratory tests, such as NLR and CRP, receiver operating characteristic (ROC) analysis was conducted. Logistic regression analysis was performed to identify the hazard ratios and 95% confidence intervals, which were used to evaluate the relative risk between COVID-19 illness and clinical characteristics. The Kaplan–Meier curve and Cox regression analyses were performed to determine the influence of clinical characteristics on the time to subsequent negative NAAT and incubation period. Statistical Package for the Social Sciences 19.0 (IBM Corp., Armonk, USA) was used to perform all statistical analyses, and P -values of less than 0.05 were used to indicate statistical significance.

RESULTS

Clinical characteristics

The laboratory tests and demographic characteristics of the patients in this study are described in Table 1. In the M group, the average age was 47.5 ± 16.3 years, ranging from 19 to 88 years. In the MS group, the average age was 63.7

Table 1: Demographics and clinical classification of 311 patients with the SARS-CoV-2 omicron variant

Variable	Total (n = 311)	M group (n = 259)	MS group (n = 52)	P-value
Age, n (%)				
< 60 years	245 (78.8)	224 (86.5)	21 (40.4)	< 0.001
≥ 60 years	66 (21.2)	35 (13.5)	31 (59.6)	
Gender, n (%)				
Male	120 (38.6)	89 (34.4)	31 (59.6)	0.001
Female	191 (61.4)	170 (65.6)	21 (40.4)	
Incubation period (days)	3.05 ± 2.63	3.07 ± 2.59	2.94 ± 2.81	0.78
Time to subsequent negative NAAT (days)	15.25 ± 7.03	14.91 ± 6.98	16.96 ± 7.09	0.055
Vaccination, n (%)				
Yes	247 (79.4)	214 (82.6)	33 (63.5)	0.004
No	64 (20.6)	45 (17.4)	19 (36.5)	
Therapeutic strategy, n (%)				
Traditional Chinese medicine	211 (67.8)	162 (62.5)	49 (94.23)	< 0.001
Lianhua Qingwen capsule	139 (44.7)	134 (51.7)	5 (9.6)	< 0.001
Antibiotics	7 (2.2)	1 (0.4)	6 (11.5)	0.369
Symptoms before admission, n (%)				
Cough	217 (70.0)	178 (68.7)	39 (75.0)	0.369
Fever	106 (34.1)	88 (34.0)	18 (34.6)	0.929
Sore throat	94 (30.2)	77 (29.7)	17 (32.7)	0.671
Muscle soreness	57 (18.3)	46 (17.8)	11 (21.2)	0.564
Expectoration	36 (11.6)	24 (9.3)	12 (23.1)	0.005
Dyspnea	31 (10.0)	21 (8.1)	10 (19.2)	0.015
Dizziness	25 (8.0)	18 (6.9)	7 (13.5)	0.115
Diarrhea	14 (4.5)	13 (5.0)	1 (1.9)	0.326
Headache	19 (6.1)	14 (5.4)	5 (9.6)	0.247
Ageusia	8 (2.6)	7 (2.7)	1 (1.9)	0.746
Nasal obstruction	3 (1.0)	3 (1.2)	0	0.435
Fatigue	14 (4.5)	10 (3.9)	4 (7.7)	0.224
Others	5 (1.6)	5 (1.9)	0	0.312
Only one symptom	144 (46.3)	131 (50.6)	13 (25.0)	0.001
Two or more symptoms	167 (53.7)	128 (49.4)	39 (75.0)	
Comorbidities, n (%)				
No comorbidity	187 (60.1)	170 (65.6)	17 (32.7)	< 0.001
Hypertension	71 (22.8)	46 (17.8)	25 (48.1)	< 0.001
Coronary heart disease	22 (7.1)	18 (6.9)	4 (7.7)	0.772
Diabetes	30 (9.6)	21 (8.1)	9 (17.3)	0.067
Stroke	11 (3.5)	6 (2.3)	5 (9.6)	0.023
Liver disease	11 (3.5)	7 (2.7)	4 (7.7)	0.093
History of malignant tumor	9 (2.9)	6 (2.3)	3 (5.8)	0.177
COPD/chronic bronchitis/asthma	8 (2.6)	3 (1.1)	5 (9.6)	0.004
Gout	8 (2.6)	7 (2.7)	1 (1.9)	0.747
Mental illness	5 (1.6)	5 (1.9)	0	0.594
Laboratory tests				
WBC (× 10 ⁹ /L)	5.39 ± 2.08	5.28 ± 1.88	5.93 ± 2.82	0.119
HB (g/L)	137.76 ± 18.95	136.50 ± 20.72	139.04 ± 24.24	0.435
PLT (× 10 ⁹ /L)	213.26 ± 65.70	218.06 ± 64.03	189.38 ± 68.27	0.004
NE (× 10 ⁹ /L)	3.00 ± 1.69	2.87 ± 1.44	3.62 ± 2.54	0.043
LY (× 10 ⁹ /L)	1.75 ± 0.72	1.76 ± 0.71	1.69 ± 0.76	0.514
CRP (mg/L)	12.05 ± 24.75	9.60 ± 20.84	24.14 ± 36.94	0.008
TBIL (μmol/L)	9.40 ± 8.70	9.24 ± 6.83	11.21 ± 9.46	0.167
BUN (mmol/L)	4.28 ± 1.28	4.30 ± 1.35	4.96 ± 2.13	0.038
SCR (μmol/L)	60.60 ± 19.03	59.67 ± 18.11	65.23 ± 22.71	0.055
NLR	2.08 ± 1.91	1.93 ± 1.45	2.87 ± 3.29	0.047
PLR	144.57 ± 87.52	144.24 ± 78.96	146.18 ± 122.53	0.913

SARS-CoV-2: severe acute respiratory syndrome coronavirus 2; NAAT: negative nucleic acid amplification test; M group: mild group; MS group: moderate and severe group; WBC: white blood cell count; HB: hemoprotein; PLT: platelet count; NE: neutrophil count; Ly: lymphocyte count; CRP: c-reactive protein; TBIL: total bilirubin; BUN: blood urea nitrogen; SCR: serum creatinine; NLR: neutrophil-to-lymphocyte ratio; PLR: platelet-to-lymphocyte ratio; COPD: chronic obstructive pulmonary disease.

Table 2: Area under curve and optimal cut-off value of PLT, NE, CRP, BUN, SCR and NLR

Variable	Area under curve	S.E.	95% CI	Optimal cut-off value	P-value
PLT	0.635	0.047	0.272–0.457	294	0.002
NE	0.580	0.045	0.491–0.669	3.65	0.069
CRP	0.737	0.034	0.671–0.804	4.785	< 0.001
BUN	0.574	0.047	0.482–0.665	4.83	0.093
NLR	0.580	0.045	0.491–0.669	2.995	0.069

PLT: platelet count; NE: neutrophil count; CRP: c-reactive protein; BUN: blood urea nitrogen; NLR: neutrophil-to-lymphocyte ratio; S.E.: standard error; CI: confidence interval; SCR: serum creatinine.

± 16.4 years, ranging from 27 to 93 years. The proportion of female patients was higher in the M group than in the MS group (61.4% vs. 40.4%) ($P < 0.05$). No significant differences in the time to subsequent negative NAAT and incubation period were observed between the two groups. The percentage of unvaccinated patients was significantly higher in the MS group than in the M group (36.5% vs. 17.4%) ($P < 0.05$). Regarding therapeutic strategy, 211 patients received traditional Chinese medicine, 139 patients took Lianhua Qingwen capsules, and 7 patients received antibiotics. Common symptoms, including cough, fever, sore throat, muscle soreness, expectoration, dyspnea, dizziness, diarrhea, headache, ageusia, nasal obstruction, and fatigue, were recorded, and cough (70.0%) was the most common symptom before admission. Furthermore, 167 patients had two or more symptoms. Then, 124 patients had comorbidities, such as hypertension (22.8%), coronary heart disease (7.1%), diabetes (9.6%), stroke (3.5%), liver disease (3.5%), history of malignant tumor, chronic obstructive pulmonary disease (COPD)/chronic bronchitis/asthma (2.6%), gout (2.6%), and mental illness (1.6%). Between the two groups, PLT, NE, CRP, BUN, and NLR were significantly different ($P < 0.05$).

Multivariate analysis of the factors affecting COVID-19 illness

We performed the ROC analysis on PLT, NE, CRP, BUN, and NLR to calculate the optimal cutoff values. The ROC curves are shown in Figure 1. The optimal cutoff values for PLT, NE, CRP, BUN, and NLR were 294, 3.650, 4.785, 4.830, and 2.995, respectively. Furthermore, the areas under the ROC curve are described in Table 2. As the potential diagnostic biomarkers for MS COVID-19, PLT, CRP, and eligible demographic characteristics, including age, gender, vaccination, symptoms before admission (*i.e.*, expectoration and dyspnea), and comorbidities (*i.e.*, hypertension, COPD/chronic bronchitis/asthma, and stroke), were investigated through the logistic regression analysis to determine the predictive effect on COVID-19 illness. Table 3 shows that age (≥ 60 years), hypertension, COPD/chronic bronchitis/asthma, and CRP (≥ 4.785 mg/L) were negatively correlated with mild COVID-19 ($P < 0.05$), and the odds ratios were 2.707, 3.285, 9.508, and 5.792, respectively. According to the results, the patients who had

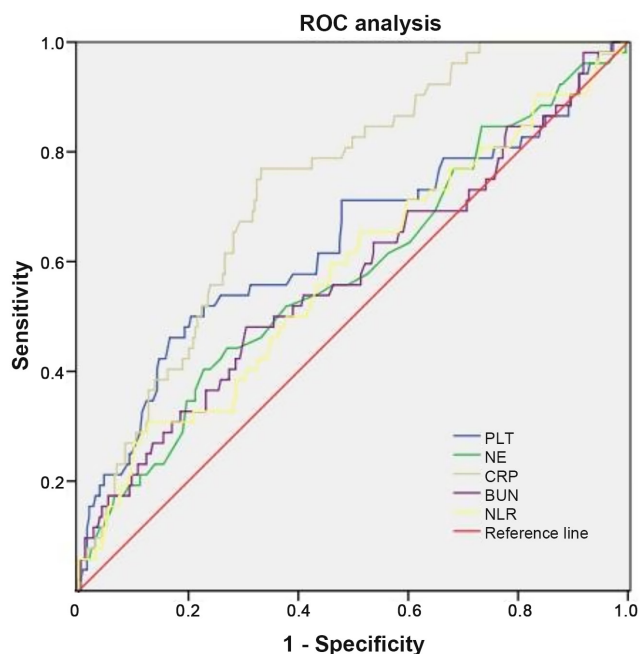


Figure 1: ROC analysis of PLT, NE, CRP, BUN and NLR for moderate and severe COVID-19 illness. The optimal cut-off values: PLT (294), NE (3.65), CRP (4.785), BUN (4.83), NLR (2.995). The area under curve: PLT (0.635), NE (0.580), CRP (0.737), BUN (0.574), NLR (0.580). PLT: platelet count; NE: neutrophil count; CRP: c-reactive protein; BUN: blood urea nitrogen; NLR: neutrophil-to-lymphocyte ratio; ROC: receiver operating characteristic.

the aforementioned factors would be more likely to have moderate or severe COVID-19.

Kaplan-Meier curves and Cox regression analysis of the factors affecting the incubation period

To investigate the factors that influence the incubation period, the Kaplan-Meier curve analysis was performed involving potential factors. The eligible demographic characteristics, including age, gender, vaccination, and comorbidities (*i.e.*, hypertension, COPD/chronic bronchitis/asthma, and stroke) were included to identify their effects on the incubation period. The incubation period of the M group was 3.07 ± 2.59 days, ranging from 0 to 13 days, and that of the MS group was 2.94 ± 2.81 days, ranging from 0 to 11 days. No significant difference was observed between the two groups ($P = 0.78$). Table 4 and Figure 2 show that older patients (≥ 60 years) were

Table 3: Laboratory tests and demographic characteristics to predict COVID-19 illness

Variable	Multivariate analysis model 1				Multivariate analysis model 2			
	OR	S.E.	95% CI	P-value	OR	S.E.	95% CI	P-value
Age (≥ 60 years)	2.249	0.406	1.016–4.980	0.046	2.707	0.371	1.309–5.599	0.007
Gender (Male)	1.425	0.431	0.302–1.633	0.411	-	-	-	-
No vaccination	1.942	0.424	0.225–1.182	0.118	-	-	-	-
Expectoration	2.511	0.521	0.904–6.970	0.077	-	-	-	-
Dyspnea	1.379	0.531	0.488–3.903	0.544	-	-	-	-
Hypertension	3.473	0.410	1.556–7.750	0.002	3.285	0.384	1.547–6.973	0.002
Stroke	1.294	0.743	0.302–5.552	0.728	-	-	-	-
COPD/chronic bronchitis/asthma	11.546	0.969	1.728–77.161	0.012	9.508	0.877	1.705–53.031	0.010
PLT ($\geq 294 \times 10^9/L$)	1.034	0.575	0.335–3.190	0.954	-	-	-	-
CRP (≥ 4.785 mg/L)	4.189	0.405	1.893–9.270	< 0.001	5.792	0.377	2.768–12.120	< 0.001

COVID-19: coronavirus disease 2019; COPD: chronic obstructive pulmonary disease; PLT: platelet count; CRP: c-reactive protein; OR: odds ratio; S.E.: standard error; CI: confidence interval.

Table 4: Demographic characteristics to predict incubation period

Variable	Mean	S.E.	95% CI	P-value
Age				
< 60 years	2.891	0.161	2.575–3.207	0.033
≥ 60 years	3.451	0.325	2.814–4.087	
Gender				
Male	2.708	0.223	2.270–3.146	0.062
Female	3.272	0.197	2.887–3.657	
Vaccination				
Yes	3.105	0.164	2.784–3.427	0.681
No	2.859	0.353	2.168–3.551	
Hypertension				
Yes	2.972	0.331	2.323–3.620	0.937
No	3.079	0.167	2.752–3.406	
COPD/chronic bronchitis/asthma				
Yes	3.125	1.125	0.920–5.330	0.810
No	3.053	0.150	2.758–3.347	
Stroke				
Yes	3.727	1.010	1.748–5.707	0.387
No	3.030	0.150	2.736–3.324	

COPD: chronic obstructive pulmonary disease; S.E.: standard error; CI: confidence interval.

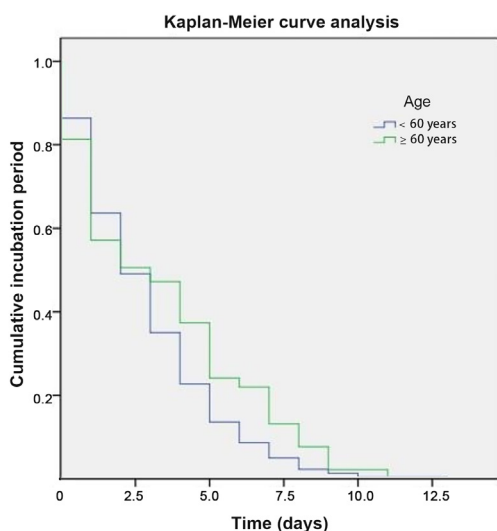


Figure 2: Kaplan-Meier curve analysis of age for incubation period. The elder patients (≥ 60 years) were more likely to have a longer incubation period than the younger (< 60 years). $P < 0.05$.

more likely to undergo a longer incubation period than younger one (< 60 years) ($P < 0.05$).

Kaplan-Meier curves and Cox regression analysis of the factors affecting the time to subsequent negative NAAT

To identify the factors affecting the time to subsequent negative NAAT, the Kaplan-Meier curve analysis was performed involving potential factors. The eligible demographic characteristics, including age, gender, vaccination, symptoms before admission (*i.e.*, expectoration and dyspnea), comorbidities (*i.e.*, hypertension, COPD/chronic bronchitis/asthma, and stroke), therapeutic strategy (*i.e.*, traditional Chinese medicine and Lianhua Qingwen capsules), and PLT, NE, CRP, BUN, and NLR were analyzed to clarify their effects on the time to subsequent negative NAAT. Similarly, no significant differences were observed between the two groups ($P =$

0.055). The time to subsequent negative NAAT was 14.91 ± 6.98 days, ranging from 2 to 36 days in the M group, and that in the MS group was 16.96 ± 7.09 days,

ranging from 5 to 32 days. Table 5 and Figure 3 show that male, CRP (≥ 4.785 mg/L), and NLR (≥ 2.995) were correlated with a longer time to subsequent negative NAAT

Table 5: Laboratory tests and demographic characteristics to predict time to subsequent negative NAAT

Variable	Mean	S.E.	95% CI	P-value
Age				
< 60 years	15.195	0.455	14.303–16.088	0.587
≥ 60 years	15.396	0.805	13.818–16.973	
Gender				
Male	16.333	0.721	14.920–17.746	0.013
Female	14.576	0.459	13.676–15.476	
Vaccination				
Yes	15.166	0.429	14.325–16.007	0.367
No	15.594	1.010	13.615–17.572	
Expectoration				
Yes	16.500	1.320	13.912–19.088	0.194
No	15.091	0.416	14.276–15.906	
Dyspnea				
Yes	13.613	1.016	11.622–15.604	0.082
No	15.436	0.427	14.599–16.273	
Hypertension				
Yes	15.479	0.869	13.776–17.182	0.692
No	15.188	0.449	14.308–16.067	
COPD/chronic bronchitis/asthma				
Yes	16.250	3.087	10.200–22.300	0.686
No	15.228	0.402	14.441–16.015	
Stroke				
Yes	17.364	2.487	12.488–22.239	0.354
No	15.177	0.403	14.387–15.967	
Traditional Chinese medicine				
Yes	15.469	0.562	14.368–16.570	0.773
No	14.897	0.724	13.479–16.315	
Lianhua Qingwen capsule				
Yes	15.433	0.616	14.225–16.640	0.577
No	15.064	0.640	13.809–16.319	
PLT				
< $294 \times 10^9/L$	15.399	0.422	14.571–16.226	0.345
$\geq 294 \times 10^9/L$	14.114	1.203	11.757–16.472	
NE				
< $3.65 \times 10^9/L$	15.355	0.448	14.477–16.233	0.949
$\geq 3.65 \times 10^9/L$	14.962	0.856	13.285–16.640	
CRP				
< 4.785 mg/L	13.632	0.482	12.688–14.577	< 0.001
≥ 4.785 mg/L	17.635	0.627	16.406–18.864	
BUN				
< 4.83 mmol/L	15.725	0.495	14.755–16.694	0.105
≥ 4.83 mmol/L	14.317	0.665	13.015–15.620	
NLR				
< 2.995	14.828	0.420	14.006–15.651	0.021
≥ 2.995	17.531	1.120	15.335–19.726	

NAAT: negative nucleic acid amplification test; COPD: chronic obstructive pulmonary disease; PLT: platelet count; NE: neutrophil count; CRP: c-reactive protein; BUN: blood urea nitrogen; NLR: neutrophil-to-lymphocyte ratio; S.E.: standard error; CI: confidence interval.

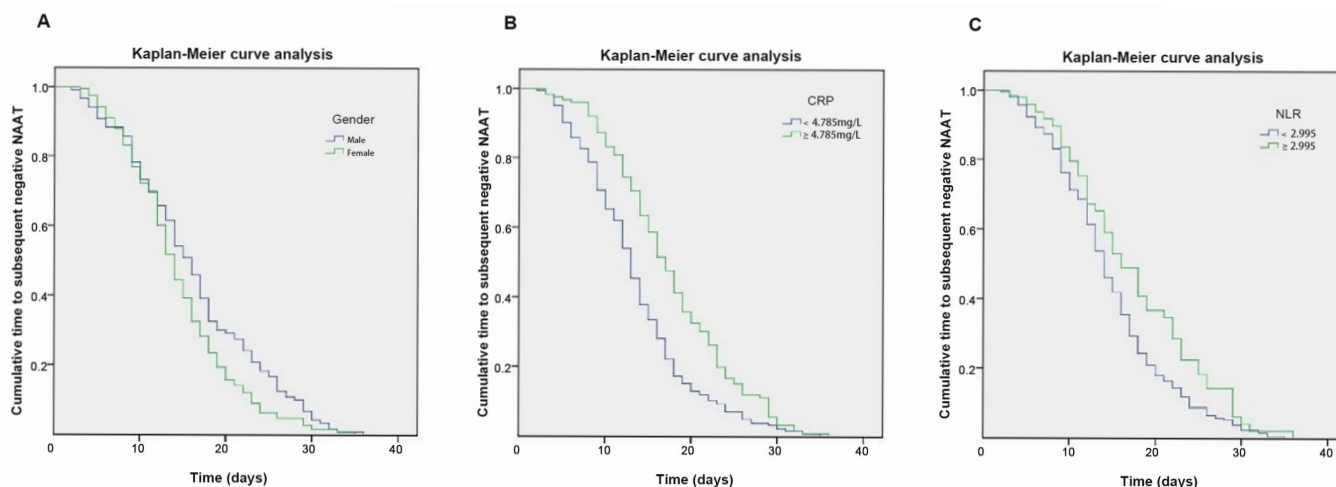


Figure 3: Kaplan-Meier curve analysis of gender (A), CRP (B) and NLR (C) for time to subsequent negative NAAT. Male, elevated values of CRP (≥ 4.785 mg/L) and NLR (≥ 2.995) were more inclined to undergo a longer time to subsequent negative NAAT than female, lowered values of CRP (< 4.785 mg/L) and NLR (< 2.995). ($P < 0.05$). CRP: c-reactive protein; NLR: neutrophil-to-lymphocyte ratio; NAAT: nucleic acid amplification test.

Table 6: Laboratory tests and demographic characteristics to predict time to subsequent negative NAAT

Variable	Multivariate analysis model 1				Multivariate analysis model 2			
	OR	S.E.	95% CI	P-value	OR	S.E.	95% CI	P-value
Gender (Male)	1.145	0.124	0.897–1.460	0.276	-	-	-	-
CRP (≥ 4.785 mg/L)	1.493	0.126	0.523–0.858	0.001	1.616	0.117	0.492–0.778	< 0.001
NLR (≥ 2.995)	1.220	0.163	0.596–1.128	0.222	-	-	-	-

NAAT: negative nucleic acid amplification test; CRP: c-reactive protein; NLR: neutrophil-to-lymphocyte ratio; OR: odds ratio; S.E.: standard error; CI: confidence interval.

($P < 0.05$). Then, a multivariate analysis of male, CRP, and NLR was performed. Table 6 reveals that only CRP (≥ 4.785 mg/L) was an independent risk factor for a longer time to subsequent negative NAAT ($P < 0.05$).

DISCUSSION

COVID-19 is an infectious disease caused by SARS-CoV-2.^[10–13] Most people infected with the virus will experience mild-to-moderate respiratory illness.^[14,15] However, some will become seriously ill and require medical attention.^[16–19] Older individuals and those with underlying medical conditions, such as cardiovascular disease, chronic respiratory disease, diabetes, and cancer, are more likely to have serious illnesses.^[20–23] Anyone can get sick with COVID-19 and become seriously ill or die at any age.^[24–26] The virus can spread from an infected person's mouth or nose via small liquid particles when they cough, sneeze, speak, sing, or breathe. These particles range from larger respiratory droplets to smaller aerosols.^[10,11,27]

Ever since scientists from Botswana and South Africa warned the world that the SARS-CoV-2 variant omicron could spread quickly,^[28,29] researchers worldwide have been racing to understand the threat it poses to the world. The main concern about this variant is that it has high

transmissibility. In contrast to the epidemic in 2020, when there were fewer than 100 confirmed cases in Jilin Province, China,^[9] the current pandemic has reached more than 40,000 cases, as underlined by its rapid spread in different countries.^[30] The epidemic has affected many cities in China and even had a huge impact on first-tier cities, such as Beijing and Shanghai.

This study included 311 patients who were randomly extracted from two hospitals in Jilin Province, China. We conducted a retrospective study on the clinical characteristics of adult cases with confirmed infection of the SARS-CoV-2 omicron variant. The mean age of the novel coronavirus cases was 50.2 years after excluding patients aged < 18 years. Patients in the MS group were significantly older than those in the M group. The number of female patients was higher, which is consistent with the results of some other studies^[31–33]; however, there were slightly more men than women in the MS group. The incubation period in this study was approximately 3.05 days (range, 0–13 days), which was shorter than 4.2 days in Lee's study and 3.6 days in Du's study.^[32,34] In this study, unvaccinated patients are prone to further disease progression. However, scientists are likely to see reduced effectiveness of vaccines in preventing infection worldwide.^[35] This study revealed that the omicron variant may be more

than 10 times as contagious as the original virus or twice as infectious as the delta variant and could be twice as likely to escape the current vaccine than the delta variant.^[36] We found that cough, fever, sore throat, muscle soreness, and expectoration were the top five symptoms. Therefore, fever is not the only symptom, and patients with upper respiratory symptoms should also be vigilant.^[37,38]

Peripheral inflammatory markers, such as leukocyte count, NE, NLR, PLR, and CRP levels, have been identified as independent predictors of prognosis in inflammatory diseases.^[22,39,40] Moreover, NLR and PLR have recently been found to be associated with the prognosis of noninflammatory diseases, such as amputation, acute mesenteric artery embolism, and thrombosis.^[41,42] Other peripheral blood indicators, including TBIL, BUN, and SCR, were also identified. In this study, although there were differences in PLT, NE, CRP, BUN, and NLR among the cases, we found that higher age, hypertension, or chronic lung disease and higher CRP levels were associated with MS COVID-19 after the multivariate analysis. This is similar to the results of a previous study,^[43] in which NLR values were significantly increased in patients with severe COVID-19, but is different from the findings that NLR was an independent risk factor for severe illness in patients with COVID-19.^[44–46] A pooled analysis by Lippi^[47] showed a 2.5-fold increased risk of death from hypertension in patients with COVID-19; however, no other studies have examined the association between disease severity classification and complications of the omicron variant infection.

Quantifying the length of the incubation period for COVID-19 is a key research issue, as this information can guide public health control measures for infectious diseases.^[48] Studies^[49,50] have shown a strong association between the incubation period of the virus and the severity of disease presentation. In this study, the incubation period of the omicron variant was only 3.05 days, which is consistent with the milder clinical symptoms that the omicron variant usually causes. Meanwhile, we found that advanced age was the only factor affecting the incubation period in this study. We also focused on the influence of different influencing factors on the time from nucleic acid positivity to continuous negative NAAT. Male, CRP > 4.785 mg/L, and NLR > 2.995 may prolong this time and increase the length of hospital stay. Of note, CRP is an independent factor that affects the time from nucleic acid positivity to continuous negative NAAT in our analysis. We did not find any similar results in other omicron-related studies.

We conducted a retrospective study on the clinical characteristics of adult cases with confirmed infection with the SARS-CoV-2 omicron variant. The data are relatively comprehensive and have certain local characteristics, which

can also reflect the clinical characteristics of the SARS-CoV-2 omicron variant in China at this time. However, this study is limited by its retrospective nature. We did not obtain all the patients' information; however, a certain number of patients were randomly selected for our cohort. We did not sequence the entire genome of all patients to determine if they were infected with the SARS-CoV-2 omicron variant. Furthermore, the study did not include the treatment and outcome of certain patients who were transferred to advanced hospitals because of exacerbation of their disease.

CONCLUSIONS

Based on this study, older patients (≥ 60 years) with hypertension and lung diseases were more likely to have moderate or severe COVID-19, and younger patients (< 60 years) might have a shorter incubation period. A male patient with high CRP (≥ 4.785 mg/L) and NLR (≥ 2.995) values might take more time to turn back negative in the NAAT. CRP (≥ 4.785 mg/L) was an independent risk factor for a longer time to subsequent negative NAAT. The SARS-CoV-2, which has already infected 500 million individuals and caused more than 6 million deaths worldwide, is prone to genetic evolution with the development of mutations over time. The pandemic remains a huge challenge for the world, and it will continue to be the focus of global attention.

Availability of Data and Materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Author Contributions

Liu H prepared the manuscript. Wang S did the statistical analysis. Yang S, Luo J and Jie J collected the data. Luo SX revised the manuscript. Song L and Peng L designed the study and provided the funding. Li D and Hua S reviewed the results and made critical comments on the manuscript.

Ethics Approval and Consent to Participate

This study was approved by the Ethics Committee of the

First Hospital of Jilin University (Approval No. 22y050-001). This is a retrospective study and the informed consent was obtained.

Conflict of Interest

The authors declare that they have no competing interests.

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