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Original Article

Clinical features of nursing and healthcare-associated pneumonia due to COVID-19

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ABSTRACT

Introduction: The objective of this study was to clarify the clinical differences between nursing and healthcare-associated pneumonia (NHCAP) and community-acquired pneumonia (CAP) due to COVID-19. We also investigated the clinical characteristics to determine whether there is a difference between the variant and non-variant strain in patients with NHCAP due to COVID-19. In addition, we analyzed the clinical outcomes in NHCAP patients with mental disorders who were hospitalized in a medical institution for treatment of mental illness.
Methods: This study was conducted at five institutions and assessed a total of 836 patients with COVID-19 pneumonia (154 cases were classified as NHCAP and 335 had lineage B.1.1.7.).
Results: No differences in patient background, clinical findings, disease severity, or outcomes were observed in patients with NHCAP between the non-B.1.1.7 group and B.1.1.7 group. The median age, frequency of comorbid illness, rates of intensive care unit stay, and mortality rate were significantly higher in patients with NHCAP than in those with CAP. Among the patients with NHCAP, the mortality rate was highest at 37.5% in patients with recent cancer treatment, followed by elderly or disabled patients receiving nursing care (24.3%), residents of care facilities (23.0%), patients receiving dialysis (13.6%), and patients in mental hospitals (9.4%).
Conclusions: Our results demonstrated that there were many differences in the clinical characteristics between NHCAP patients and CAP patients due to COVID-19. It is necessary to consider the prevention and treatment content depending on the presence or absence of applicable criteria for NHCAP.

1. Introduction

Pneumonia including aspiration pneumonia is the third leading cause of mortality in Japan and most cases are elderly persons (≥65 years old). A major feature of Japan is that there are high percentage of elderly persons. In line with the actual situation in Japan, the Japan Respiratory Society (JRS) guidelines defined a new pneumonia category as the nursing and healthcare-associated pneumonia (NHCAP) [1] separate from community-acquired pneumonia (CAP) [2]. To confirm the validity of new category, many Japanese researchers have verified NHCAP and made the differences clear between NHCAP and CAP [3–8]. Median age and frequency of comorbid illness were significantly higher in patients with NHCAP than those with CAP. Several differences were also observed among four NHCAP subgroups.

Coronavirus disease 2019 (COVID-19), caused by the novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), emerged in 2019 [9]. Approximately 5–20% of patients with COVID-19 develop severe life-threatening pneumonia with respiratory failure [9]. SARS-CoV-2 causes frequent outbreaks in facilities such as welfare facilities for persons with disabilities, long-term care health facilities, and mental hospitals that meet the criteria for NHCAP. Older age and comorbid illness are relevant to both worse severity and fatal outcome in patients with COVID-19 [10]. In addition, several studies demonstrated increased risks of SARS-CoV-2 infection, disease severity, and mortality in persons with mental disorders [11–14].

The objective of this study was to clarify the clinical differences between NHCAP and CAP due to COVID-19. In particular, we focused on patient background, clinical findings, disease severity, and outcomes in patients with NHCAP. We also investigated the clinical characteristics to

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List of abbreviations

CAP	Community-acquired pneumonia
COVID-19	Coronavirus disease 2019
ICU	Intensive care unit
JRS	Japanese Respiratory Society
NHCAP	Nursing and healthcare-associated pneumonia
SARS-CoV-2	Severe acute respiratory syndrome coronavirus 2

determine whether there was a difference between variant and non-variant strains in patients with NHCAP due to COVID-19. In addition, we analyzed the clinical outcomes in NHCAP patients with mental disorders who hospitalized in a medical institution for the treatment of mental illness.

2. Patients and methods

2.1. Study populations

The present study was conducted at five institutions (Kansai Medical University Hospital, Kansai Medical University Medical Center, Kansai Medical University Kori Hospital, Kansai Medical University Kuzuha Hospital, and Kansai Medical University Temmabashi General Clinic) between February 2020 and June 2021. We enrolled adult patients diagnosed with NHCAP and CAP, defined in accordance with the JRS guidelines [1,2]. COVID-19 was diagnosed with positive reverse transcription polymerase chain reaction results from sputum or nasopharyngeal swab specimens in accordance with the protocol recommended by the National Institute of Infectious Diseases, Japan. From March 2021, a new lineage of the SARS-CoV-2, named B.1.1.7 [15], had rapidly spread throughout Japan and reached almost 100% replacement by the B.1.1.7 variant in June 2021. Lineage B.1.1.7 includes multiple changes, including an N501Y (Asn501Tyr) substitution in the spike protein that enhances binding to the human ACE2 receptor, through which the virus enters the cell [16,17]. Thus, we analyzed the non-B.1.1.7 and B.1.1.7 groups separately.

The severity of pneumonia was evaluated using predictive rules via the A-DROP system proposed by the JRS guidelines: age over 70 years in male and over 75 years in female, dehydration, respiratory failure, orientation disturbance, and low blood pressure [2,18]. Informed consent was obtained from all patients, and the study protocol was approved by the Ethics Committee of Kansai Medical University (approval number 2020319).

2.2. Statistical analysis

Statistical analysis was performed using Stat View version 5.0. (SAS Institute Inc, Cary, NC, USA). The incidence of clinical findings was analyzed using Fisher's Exact test. Continuous variables were compared using the Student's *t*-test when variables were normally distributed, and the Mann–Whitney *U* test was used when variables were non-normally distributed.

3. Results

3.1. Patient characteristics

The data for a total of 836 patients (538 men and 298 women with a median age of 64 years) with COVID-19 pneumonia were analyzed. Of the 836 COVID-19 pneumonia patients, 335 had lineage B.1.1.7 and 154 cases were classified as NHCAP [1]. Of these, 79 (15.8%) cases were non-B.1.1.7 group and 75 (22.4%) cases were B.1.1.7 group, respectively (Table 1). Among the NHCAP criteria, there were no differences between the two groups (Table 1). In Group A, 32 cases had mental disorders and who were hospitalized in a medical institution for the treatment of mental illness.

Table 1
Background of patients with COVID-19 pneumonia in the non-B.1.1.7 and B.1.1.7 groups.

Characteristics	Non-B.1.1.7	B.1.1.7	*p* value
Pneumonia classification	n = 501	n = 335	
Community acquired	422 (84.2)	260 (77.6)	
Nursing and healthcare associated	79 (15.8)	75 (22.4)	
NHCAP criteria[a]	n = 79	n = 75	
Group A: Pneumonia diagnosed in a resident of an extended care facility, long-term care health facilities or psychiatric hospital	38 (48.1)	38 (50.7)	0.8720
Group B: Pneumonia diagnosed in a person who has been discharged from a hospital within the preceding 90 days	3 (3.8)	2 (2.7)	>0.9999
Group C: Pneumonia diagnosed in an elderly or disabled person who is receiving nursing care with an Eastern Cooperative Oncology Group performance status of 3 or 4	40 (50.6)	34 (45.3)	0.5234
Group D: Pneumonia diagnosed in a person who is receiving regular endovascular treatment as an outpatient (dialysis, antibiotic therapy, chemotherapy, immunosuppressant therapy)	22 (27.8)	22 (29.3)	0.8601

Data represent the numbers of patients and numbers in parentheses are percentages.
[a] Including overlapping cases.

Tables 2 and 3 show the underlying conditions and clinical findings of NHCAP and CAP patients in the non-B.1.1.7 and B.1.1.7 groups at the first examination, respectively. Patients with NHCAP were significantly older than those with CAP ($p < 0.0001$), but the male/female ratio did not differ between NHCAP and CAP in both the non-B.1.1.7 and B.1.1.7 groups. Among co-morbid conditions, cerebrovascular disease, chronic renal disease, and neoplastic disease were significantly more frequent in patients with NHCAP compared with those with CAP in both groups. Among clinical signs and symptoms, many symptoms were less frequent in patients with NHCAP compared with those with CAP in both groups.

3.2. Pneumonia severity on admission

The severity on admission of NHCAP and CAP was assessed by means of the A-DROP systems of the JRS (Tables 2 and 3). The average A-DROP scores in patients with NHCAP were significantly higher than in patients with CAP in both non-B.1.1.7 and B.1.1.7 groups (non-B.1.1.7 group, CAP 0.95 ± 1.12 versus NHCAP 2.01 ± 0.79, $p < 0.0001$; B.1.1.7 group, CAP 1.31 ± 0.96 versus NHCAP 1.83 ± 0.82, $p = 0.0122$). Pneumonia severity was also evaluated using predictive rules with a 5-point scoring system for hospital-acquired pneumonia from the JRS: I-ROAD (immunodeficiency, age, respiratory failure, orientation disturbance, and dehydration) [19]. The average I-ROAD scores in patients with NHCAP were also significantly higher than those of patients with CAP in both groups.

3.3. Clinical outcomes

Rates of intensive care unit (ICU) stay and in-hospital mortality were significantly higher in patients with NHCAP compared with those with CAP in both groups (Tables 2 and 3). In patients with NHCAP, these rates were similar in the non-B.1.1.7 and B.1.1.7 groups (ICU stay, non-B.1.1.7 group 60.8% versus B.1.1.7 group 61.3%, $p > 0.9999$; in-hospital mortality, non-B.1.1.7 group 19.0% versus B.1.1.7 group 21.3%, $p = 0.8411$). In contrast, in patients with CAP, these rates were higher in B.1.1.7 group than non-B.1.1.7 group (ICU stay, non-B.1.1.7

Table 2
Underlying conditions and clinical findings in patients with COVID-19 pneumonia in the non-B.1.1.7 group.

Variables	Community-acquired pneumonia	Nursing and healthcare-associated pneumonia	*p* value
No. of patients	422	79	
Median age (IQR), years	62 (41–73)	80 (70–85)	<0.0001
No. of males/females	263/159	48/31	0.8015
No. (%) of patients with comorbid illnesses			
Diabetes mellitus	82 (19.4)	21 (26.6)	0.1717
Chronic lung disease	45 (10.7)	12 (15.2)	0.2485
Chronic heart disease	20 (4.7)	20 (25.3)	<0.0001
Cerebrovascular disease	15 (3.6)	17 (21.5)	<0.0001
Chronic renal disease	17 (4.0)	15 (19.0)	<0.0001
Neoplastic disease	17 (4.0)	14 (17.7)	<0.0001
Chronic liver disease	11 (2.6)	4 (5.1)	0.2723
Autoimmune disease	13 (3.2)	2 (2.5)	>0.9999
No. (%) of patients with the following clinical signs and symptoms			
History of fever (≥37.0 °C)	351 (83.2)	71 (89.9)	0.1773
Cough	224 (53.1)	29 (36.7)	0.0097
Fatigue	152 (36.0)	17 (21.5)	0.0135
Shortness of breath	117 (27.7)	21 (26.6)	0.8915
Sore throat	93 (22.0)	4 (5.1)	0.0002
Loss of taste	62 (14.7)	4 (5.1)	0.0180
Anosmia	51 (12.1)	3 (3.8)	0.0287
Headache	52 (12.3)	2 (2.5)	0.0088
Diarrhea	47 (11.1)	4 (5.1)	0.1089
Sputum production	41 (9.7)	8 (10.1)	0.8389
Runny nose	35 (8.3)	1 (1.3)	0.0292
Joint pain	28 (6.6)	0	0.0134
Chest pain	17 (4.0)	1 (1.3)	0.3315
Muscle ache	16 (3.8)	1 (1.3)	0.4939
Nausea or vomiting	13 (3.1)	4 (5.1)	0.3241
Abdominal pain	5 (1.2)	1 (1.3)	>0.9999
No. (%) of patients with each pneumonia severity score			
0	195 (46.2)	2 (2.5)	<0.0001
1	111 (26.3)	18 (22.8)	0.5764
2	74 (17.5)	36 (45.6)	<0.0001
3	29 (6.9)	23 (29.1)	<0.0001
4	9 (2.1)	0	0.3665
5	4 (0.9)	0	>0.9999
No. (%) of patients with treatment			
Antibiotic therapy	131 (31.0)	60 (75.9)	<0.0001
Antiviral therapy	247 (58.5)	77 (97.5)	<0.0001
Glucocorticoid therapy	183 (43.4)	64 (81.0)	<0.0001
No. (%) of patients with respiratory care			
HFNC	116 (27.5)	18 (22.8)	0.410
IMV	96 (22.7)	38 (48.1)	<0.0001
ECMO	25 (5.9)	10 (12.7)	0.049
No. (%) of patients admitted to intensive care unit	121 (28.7)	48 (60.8)	<0.0001
No. (%) of patients with in-hospital mortality	7 (1.7)	15 (19.0)	<0.0001

Continuous values are presented as medians and interquartile ranges (IQRs) and categorical/binary values as counts and percentages. HFNC, high flow nasal canula. IMV, invasive mechanical ventilation. ECMO, extracorporeal membrane oxygen.

Table 3
Underlying conditions and clinical findings in patients with COVID-19 pneumonia in the B.1.1.7 group.

Variables	Community-acquired pneumonia	Nursing and healthcare-associated pneumonia	*p* value
No. of patients	260	75	
Median age (IQR), years	62 (46–72)	72 (64–82)	<0.0001
No. of males/females	182/78	45/30	0.1228
No. (%) of patients with comorbid illnesses			
Diabetes mellitus	47 (18.1)	18 (24.0)	0.2506
Chronic lung disease	34 (13.1)	9 (12.0)	>0.9999
Chronic heart disease	16 (6.2)	7 (9.3)	0.3124
Cerebrovascular disease	8 (3.1)	12 (16.0)	0.0002
Chronic renal disease	8 (3.1)	16 (21.3)	<0.0001
Neoplastic disease	6 (2.3)	8 (10.7)	0.0042
Chronic liver disease	6 (2.3)	3 (4.0)	0.4246
Autoimmune disease	5 (1.9)	2 (2.7)	0.6558
No. (%) of patients with the following clinical signs and symptoms			
History of fever (≥37.0 °C)	225 (86.5)	70 (90.3)	0.1554
Cough	169 (65.0)	40 (53.3)	0.0786
Fatigue	94 (36.2)	16 (21.3)	0.0176
Shortness of breath	91 (35.0)	18 (24.0)	0.0928
Sore throat	57 (21.9)	11 (14.7)	0.1944
Loss of taste	52 (20.0)	3 (4.0)	0.0006
Anosmia	47 (18.1)	2 (2.7)	0.0003
Headache	32 (12.3)	1 (1.3)	0.0033
Diarrhea	27 (10.4)	0	0.0012
Sputum production	35 (13.5)	19 (25.3)	0.0197
Runny nose	23 (8.8)	1 (1.3)	0.0223
Joint pain	11 (4.2)	3 (4.0)	>0.9999
Chest pain	5 (1.9)	0	0.5911
Muscle ache	4 (1.5)	0	0.5787
Nausea or vomiting	11 (4.2)	3 (4.0)	>0.9999
Abdominal pain	1 (0.4)	0	>0.9999
No. (%) of patients with each pneumonia severity score			
0	56 (21.5)	1 (1.3)	<0.0001
1	104 (40.0)	30 (40.0)	>0.9999
2	63 (24.2)	25 (33.3)	0.1362
3	37 (14.2)	19 (25.3)	0.0338
4	0	0	>0.9999
5	0	0	>0.9999
No. (%) of patients with treatment			
Antibiotic therapy	67 (25.8)	46 (61.3)	<0.0001
Antiviral therapy	191 (73.5)	74 (98.7)	<0.0001
Glucocorticoid therapy	172 (66.2)	64 (85.3)	0.001
No. (%) of patients with respiratory care			
HFNC	73 (28.1)	18 (24.0)	0.557
IMV	96 (36.9)	39 (52.0)	0.023
ECMO	23 (8.8)	7 (9.3)	0.823
No. (%) of patients admitted to intensive care unit	119 (45.8)	46 (61.3)	0.0187
No. (%) of patients with in-hospital mortality	9 (3.5)	16 (21.3)	<0.0001

Continuous values are presented as medians and interquartile ranges (IQRs) and categorical/binary values as counts and percentages. HFNC, high flow nasal canula. IMV, invasive mechanical ventilation. ECMO, extracorporeal membrane oxygen.

group 28.7% versus B.1.1.7 group 45.8%, $p < 0.0001$; in-hospital mortality, non-B.1.1.7 group 1.7% versus B.1.1.7 group 3.5%, $p = 0.1909$).

3.4. Differences in clinical characteristics among NHCAP subgroups

No clinical differences were observed in patients with NHCAP between the non-B.1.1.7 and B.1.1.7 groups. Thus, we performed a subanalysis in four NHCAP subgroups (Group A to D) using all NHCAP patients. Several differences were observed among the four NHCAP subgroups (Table 4). NHCAP patients in Group C were significantly older than those in patients in Groups B and D ($p < 0.0001$). Rates of ICU stay were significantly higher in patients in Group D than patients in Groups A ($p = 0.011$) and C ($p = 0.0034$). Mortality rate were highest in Group C (24.3%), followed by Group D (20.5%), Group B (20.0%), and Group A (13.3%).

3.5. Characteristics in patients with mental disorders

Table 5 shows the underlying conditions and clinical findings in 32 patients with mental disorders who were hospitalized in a medical institution for the treatment of mental illness (22 schizophrenia, 4 mental retardation, 4 depressive disorders and 2 neurotic disorders), 122 patients with NHCAP excluding mental hospitals and 682 patients with CAP, respectively. Patients in mental hospitals were significantly

Table 4
Clinical characteristics of patients with nursing and healthcare-associated pneumonia due to COVID-19 according to different groups[a].

Variables	Group A	Group B	Group C	Group D
No. of patients	76	5	74	44
Median age (IQR), years	77 (67–85)	73 (65–79)	82 (75–86)	72 (64–80)
No. of males/females	43/33	5/0	35/39	29/15
No. (%) of patients with comorbid illnesses	57 (75.0)	5	62 (83.8)	44 (100)
No. (%) of patients with each pneumonia severity score				
0	1 (1.3)	0	2 (2.7)	0
1	35 (46.1)	2	24 (32.4)	6 (13.6)
2	22 (28.9)	1	27 (36.5)	26 (59.1)
3	18 (23.7)	2	21 (28.4)	12 (27.3)
4	0	0	0	0
5	0	0	0	0.
No. (%) of patients admitted to intensive care unit	35 (46.1)	4	36 (48.6)	34 (77.3)
No. (%) of patients with in-hospital mortality	10 (13.2)	1	18 (24.3)	9 (20.5)

Continuous values are presented as medians and interquartile ranges (IQRs) and categorical/binary values as counts and percentages.
[a] Including overlapping cases.

younger than those with NHCAP ($p < 0.0001$), but similar to those with CAP. The frequency of comorbid illness in patients in mental hospitals was significantly lower than those with NHCAP ($p < 0.0001$), but the similar to those with CAP.

The average A-DROP scores in patients from mental hospitals were significantly higher than that in patients with CAP (Mental hospital 1.56 ± 0.83 versus CAP 1.02 ± 1.08, $p = 0.0413$). Rates of ICU stay in patients in mental hospitals were higher than that in patients with CAP (Mental hospital 53.1% versus CAP 35.2%), but these differences did not reach statistical significance. Rates of in-hospital mortality in patients from mental hospitals was significantly higher than that of patients with CAP (Mental hospital 9.4% versus CAP 2.3%, $p = 0.0486$).

4. Discussion

COVID-19 mainly occurs in the outpatient setting and CAP is more frequent than NHCAP among types of pneumonia. However, many outbreaks due to SARS-CoV-2 have occurred in nursing homes and mental hospitals, thereby meeting the criteria for NHCAP. The present results revealed differences in patient background, clinical findings, disease severity, and clinical outcomes between NHCAP and CAP due to COVID-19. The median age and frequency of comorbid illness, which are associated with greater severity of COVID-19 [10], were significantly higher in patients with NHCAP than those with CAP ($p < 0.0001$). Rates of ICU stay and in-hospital mortality were also significantly higher in patients with NHCAP than those with CAP. These differences were similar to previous reports that investigated the differences in NHCAP and CAP due to bacterial infection [3–8,20,21]. Our results also demonstrated that there were no differences in the clinical characteristics of patients with NHCAP between the non-B.1.1.7 group and B.1.1.7 group. Thus, giving priority for SARS-CoV-2 vaccination to elderly people and people with comorbid illnesses is thought to be reasonable. In fact, SARS-CoV-2 vaccination of people who met the NHCAP criteria was successful in the 5th wave of COVID-19 in Japan because number of severely ill patients and deaths due to COVID-19 in the elderly persons was markedly reduced [22].

Patients with mental disorders who are hospitalized in a medical institution for treatment of mental illness were included in NHCAP Group A. Our previous studies demonstrated that the pneumonia severity and mortality rate in patients in mental hospitals were lowest among the patients NHCAP and similar to those with CAP [20,21]. These findings may be related to the younger age and lower frequency of comorbid illnesses in patients in mental hospitals, as observed in this study. However, in the present study, the ICU stay and mortality rate were higher in patients in mental hospitals than those of patients with CAP (Table 5), as reported other studies [11–14]. Thus, it was appropriate to add patients with severe mental disorders to the vaccination priority program.

Within Group D, 16 patients were receiving regular endovascular treatment with anti-cancer drugs as an outpatient and 28 patients were receiving dialysis. A large Japanese cohort study demonstrated that patients with solid tumors or receiving dialysis experienced more-severe COVID-19 [10]. Among patients with NHCAP, the mortality rate was highest at 37.5% in patients with recent cancer treatment, followed by elderly or disabled people who were receiving nursing care with performance status scores of 3 or 4 (Group C, 24.3%), residents of an extended care facility or long-term care health facility (Group A, 23.0%), patients receiving dialysis (13.6%), and patients with mental disorders who were hospitalized in a medical institution for the treatment of mental illness (9.4%). Our previous study demonstrated that the mortality rate was higher in patients in Group A and C than Group D [20]. Chavez-MacGregor and colleagues found that patients with recent cancer treatment and COVID-19 had a significantly higher risk of adverse outcomes (odds ratio: death 1.74, ICU stay 1.69, and hospitalization 1.19), and patients with no recent cancer treatment had similar

Table 5
Clinical characteristics of patients with two types of nursing and healthcare-associated pneumonia and community-acquired pneumonia due to COVID-19.

Variables	Mental hospital (MH)	Nursing and healthcare-associated pneumonia (NHCAP)[a]	Community-acquired pneumonia (CAP)	*p* value MH vs NHCAP	*p* value MH vs CAP
No. of patients	32	122	682		
Median age (IQR), years	65 (56–73)	79 (70–84)	62 (44–72)	<0.0001	0.1563
No. of males/females	22/10	71/51	445/237	0.3152	0.8495
No. (%) of patients with comorbid illnesses	12 (37.5)	110 (90.2)	367 (53.8)	<0.0001	0.1015
No. (%) of patients with each pneumonia severity score					
0	1 (3.1)	2 (1.6)	251 (36.8)	0.5054	<0.0001
1	18 (56.3)	30 (24.6)	215 (31.5)	<0.0001	0.0060
2	7 (21.9)	54 (44.3)	137 (20.1)	0.0254	0.8218
3	6 (18.8)	36 (29.5)	66 (9.7)	0.2700	0.1233
4	0	0	9 (1.3)	>0.9999	>0.9999
5	0	0	4 (0.6)	>0.9999	>0.9999
No. (%) of patients admitted to intensive care unit	17 (53.1)	75 (61.5)	240 (35.2)	0.4225	0.0575
No. (%) of patients with in-hospital mortality	3 (9.4)	28 (23.0)	16 (2.3)	0.1351	0.0486

Continuous values are presented as medians and interquartile ranges (IQRs) and categorical/binary values as counts and percentages.
[a] Excluding mental hospital.

outcomes to those without cancer [23]. However, the outcomes in patients with recent cancer treatment and COVID-19 are still controversial [24–27].

In this study, cases of pneumonia mixed with other microorganisms were excluded because small sample size. A systematic review and meta-analysis demonstrated the bacterial co-infection and secondary infection in patients with COVID-19 was observed in 3.5%–7% [28,29]. Our study demonstrated the bacterial co-infection with COVID-19 was observed in 2.1%. The prevalence rate of co-infection may different according to pneumonia severity.

Our study had several limitations. The main purpose of this study was to clarify the differences between NHCAP and CAP due to COVID-19. In addition, we performed a subanalysis in four NHCAP subgroups (Groups A to D). Thus, sample size was small in each of the NHCAP subgroups. In particular, we were unable to evaluate Group B patients who has been discharged from a hospital within the preceding 90 days. Mortality rate may be affected in patients with recent cancer treatment, patients receiving dialysis, and patients in mental hospitals. Further studies with a larger sample size in each NHCAP subgroups are needed.

In conclusion, the median age, frequency of comorbid illness, rates of ICU stay, and mortality rate were significantly higher in patients with NHCAP than in those with CAP due to COVID-19. These findings were identical between the non-B.1.1.7 group and B.1.1.7 group. It is necessary to consider the prevention and treatment content depending on the presence or absence of applicable criteria for NHCAP.

Ethical approval and consent to participate

The study protocol was approved by the Ethics Committee at Kansai Medical University and all participating facilities. Informed consent was obtained from all individual participants in the study.

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Author's contributions

All the authors conceived the study, participated in its design and coordination, and collected and managed the data, including quality control. NM, YN and SN drafted the manuscript, and all authors contributed substantially to its revision. All the authors read and approved the final manuscript.

Availability of data and materials

The data will not be shared because of participant confidentiality.

Consent for publication

Not applicable.

Declaration of competing interest

The authors declare that they have no competing interests.

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