Original Article

Epidemiology and clinical features of common community human coronavirus disease

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Background: We would evaluate the epidemiology, clinical aspects, and prognostic factors of patients of all ages admitted with human corona virus (HCoV).

Methods: This study was retrospectively performed at five university teaching hospitals between 1st January 2018 and 31th March 2020. Routine molecular testing using for multiplex real-time reverse transcription-polymerase chain reaction (RT-PCR) methods was conducted on the respiratory viruses. We assessed the demographics, laboratory findings, and treatment of patients infected with coronavirus.

Results: There were 807 coronavirus-infected patients from 24,311 patients with respiratory virus PCR test admitted to five hospitals over 27 months. All-cause mortality rates of patients admitted for seasonal HCoV disease were 3.1% in all patients and 10.8% in patients aged ≥18 years. The Cox proportional hazard regression analysis was performed in patients aged ≥18 years. After adjusting for other clinical variables, general weakness symptoms [hazard ratio (HR), 2.651; 95% confidence interval (CI), 1.147–6.125, P=0.023], National Early Warning Score (NEWS) ≥2 (HR, 5.485; 95% CI, 1.261–23.858, P=0.023), and coronavirus subtype OC43 (HR, 2.500; 95% CI, 1.060–5.897, P=0.036) were significantly associated with death from coronavirus.

Conclusions: Coronavirus infection can reveal a higher mortality rate in patients of ≥18 than those of <18 years, thus, adult patients require more careful treatment. Furthermore, in adult patients, the factors associated with death from coronavirus include general weakness symptoms, NEWS higher than 2, and OC43 subtype.

Keywords: Coronavirus; viral disease; mortality

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Introduction

The coronavirus disease 19 (COVID-19) is responsible for pandemic outbreak with high mortality. Worldwide, more than 100,000,000 COVID 19 patients have occurred, resulting in more than 2,000,000 deaths. In Korea, 79,311 COVID 19 patients have occurred, resulting in 1,441 deaths with a mortality rate of 1.82 %. (2nd February, 2020) (1). Before COVID-19, severe respiratory diseases from common community human coronaviruses (HCoV) including severe acute respiratory syndrome coronavirus 2 (SARS) and Middle-East respiratory syndrome coronavirus (MERS-CoV) had always been around (2-5). Species 229E, OC43, NL63, and HKU1 are commonly known subtypes of HCoVs (5). These HCoVs are considered relatively benign respiratory pathogens in humans leading to upper respiratory tract diseases (5), occasionally, it has been reported lower respiratory tract infections in immune-compromised patients or severe illnesses required acute care (6-8). Although HCoVs are widespread globally, their frequency and course of varies significantly according to ages, region, or season (2,3,5,8-10). Despite these features of their epidemiology, recent clinical studies (8-12) about coronaviruses have been conducted in children and adolescents; there are limited number of studies investigating patients of all ages (2,8). In addition, few studies about epidemiology about HCoVs have been done since 2018. Therefore, an analysis of the clinical course or prognostic factors of these common HCoV diseases could provide important information about epidemiology of common HCoV and other seasonal common respiratory viruses, and a clue to overcome the current COVID-19 pandemic. We would expand the existing evidence base and provide new insights into HCoV disease by analyzing the epidemiology, clinical aspects, and prognostic factors of patients admitted with coronavirus.

We present the following article/case in accordance with the STROBE reporting checklist (available at http://dx.doi.org/10.21037/jtd-20-3190).

Methods

Study design

The study was performed at five university teaching hospitals located in four administrative districts in Korea. Two hospitals were an 820-bed in Anyang-si and a 737-bed in Dongtan-si, Gyeonggi-do. The other two hospitals were 585-bed and 600-bed hospitals in Seoul. The other hospital was a 404-bed in Chuncheon-si, Gangwon-do. We retrospectively analyzed the medical records of patients who were admitted with a laboratory-confirmed coronavirus between 1 January 2018 and 31 March 2020. Routine molecular testing for coV-229E, coV-OC43 and coV-NL63 was conducted using a multiplex real-time reverse transcription-polymerase chain reaction method. We also tested for other respiratory viruses including influenza virus, respiratory syncytial virus (RSV), human adenovirus, human rhinovirus, human metapneumovirus, bocavirus, enterovirus and parainfluenza virus. Samples for bacterial culture obtained from sputum or trans-trachea aspiration in sterile methods, following safety protocols and procedure. The collected samples were aseptically inoculated to pre-prepared sterile MacConkey agar (Oxoid, UK) media, Blood agar, Chocolate agar (Becton-Dickinson, Sparks, MD, USA) and incubated at 37 ℃ for 24 hours. Matrix-assisted laser desorption ionization-time of flight mass spectrometry with Vitek-MS (BioMerieux, Marcy I'Etoile, France) was used for identification.

All clinical specimens were obtained from the upper respiratory tract using a nasopharynx or throat swab. The authors are accountable for all aspects of the work and ensure that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. This study was approved by the institutional review board of Hallym University Kangnam Sacred Heart Hospital (HKS 2020-04-027). Patient information was anonymized and de-identified before analysis; therefore, requirements for informed consent were waived. This study was conducted in accordance with the Declaration of Helsinki (as revised in 2013).

Variables

We assessed the demographics of the patients with a coronavirus. Gender, age, body mass index (BMI), comorbidities and pre-hospital care were recorded on admission. We analyzed the clinical data on admission including the diagnosis, symptoms and duration of symptoms. Mortality was defined as the death of a patient during hospitalization. Chronic vascular disease is defined as old cerebral disease and ischemic heart disease. Chronic airway disease is defined as asthma and chronic obstructive pulmonary disease. Chronic kidney disease is defined as having a GFR of less than 50. Chronic liver disease is

defined liver cirrhosis and chronic hepatitis B or C. The National Early Warning Score (NEWS) (13) on admission was used to evaluate the risk of coronavirus-infected patients. NEWS was assessed with measurement of seven items including respiratory rate, oxygen saturations, any supplemental oxygen, temperature, systolic blood pressure, mental status, and heart rate. The sum of NEWS is scored from 0 to 20 points. We used NEWS in patients over 18 years old. We also investigated the coronavirus infected patient's laboratory findings, serum mycoplasma antibody IgM and bacterial cultures grown from lower respiratory tract samples. Antibacterial agents and anti-viral agents were defined if a patient was prescribed during hospitalization. Mortality was calculated including death for any reason during hospitalization with coronavirus infection.

Statistics

Frequencies are expressed as numbers (%) and descriptive data are expressed as medians with the interquartile range (IQR). We compared the clinical features, viruses, and bacterial types according to age group. Elder group is patient older than 18 years and younger group is patient younger than 18 years because many more children were infected with a coronavirus. The Chi-square test or Fisher's exact test were used for categorical variables, and continuous variables were compared using the Mann-Whitney *U* test. We analyzed the prognostic factors only in patients ≥18 years of age because mortality rate was significant in adults. There were patients who did not measure their weight or height at hospitalization, so the body mass indexes of 164 patients were missing, and the statistics were analyzed by processing the missing value. The univariate analysis of risk factors for mortality was performed by creating a categorized variable based on the median value of clinical and laboratory characteristics in adult patients infected with coronavirus. Factors significantly associated with survival were analyzed further in a Cox proportional hazard model to adjust for the potential confounding effects of each factor. Hazard ratios (HR) with 95% confidence intervals (CI) were used to report the results. The survival duration was defined as the date of follow-up after being discharged from hospital by analyzing medical records. The five variables were included in a Cox's regression analysis because all were associated with P values <0.05 in a univariate analysis. However, we excluded corona subtype NL63 from the multivariate analysis, because of the influence of choices divided among the subtypes of coronavirus. Cumulative survival curves were derived using the Kaplan-Meier method with reference to corona subtype OC43, pneumonia, and general weakness. Statistical analysis was performed using SPSS software (version 18).

Results

There were 807 coronavirus-infected patients (3.3%) from 24,311 patients with respiratory virus PCR test admitted to five hospitals over 27 months. According to the age group, 553 (69%) patients hospitalized for coronavirus infection were <10 years, followed by 63 (7.8%) patients in the 70s, and 58 (7.2%) patients in the 60s. The more patients were admitted in December 2019 as well as January and February 2020. The HCoVs OC43 and NL63 occurred more frequently during winter but decreased in summer, and 229E was rare in winter 2019 compared to 2018 and 2020 (*Figure 1*).

The median BMI of elder group with a coronavirus was 22.1 kg/m^2, which was higher than that of younger group. Elder group was diagnosed with pneumonia when hospitalized, and young group was hospitalized for viral infection, bronchitis, or laryngitis. Elder group more often stayed in other hospitals or nursing homes before hospitalization compared with younger group. The main symptom of coronavirus-infected patients was fever in more than 90% of younger group, while 44.4% of elder group had a fever. Symptoms of general weakness and dyspnea were frequently reported in elder group, and coryza was reported in younger group all patients who died were elder group. All-cause mortality rates of patients admitted for seasonal HCoV disease were 3.1% in all patients, and 10.8% in patients aged 18 years or older (*Table 1*).

The white blood cell, lymphocyte counts were higher in younger group, and C-reactive protein and procalcitonin levels were higher in elder group. The coronavirus subtypes comprised of 51.3% OC43, 33.1% NL63, and 15.4% 229E. Other respiratory virus co-infected cases were 57.4% in patients under the age of 18, more than 19.0% in elder group Influenza was the most common co-infected virus in elder group and respiratory syncytial virus A was the most frequent in younger group. The most common concomitantly infected bacteria were *Klebsiella pneumonia* and *Pseudomonas aeruginosa* in elder group and *Mycoplasma* in younger group (*Table 2*). The analysis of 25 mortality cases is shown in *Table 3*.

In the univariate analysis of the risk of mortality for patients admitted for coronavirus, it was higher in those

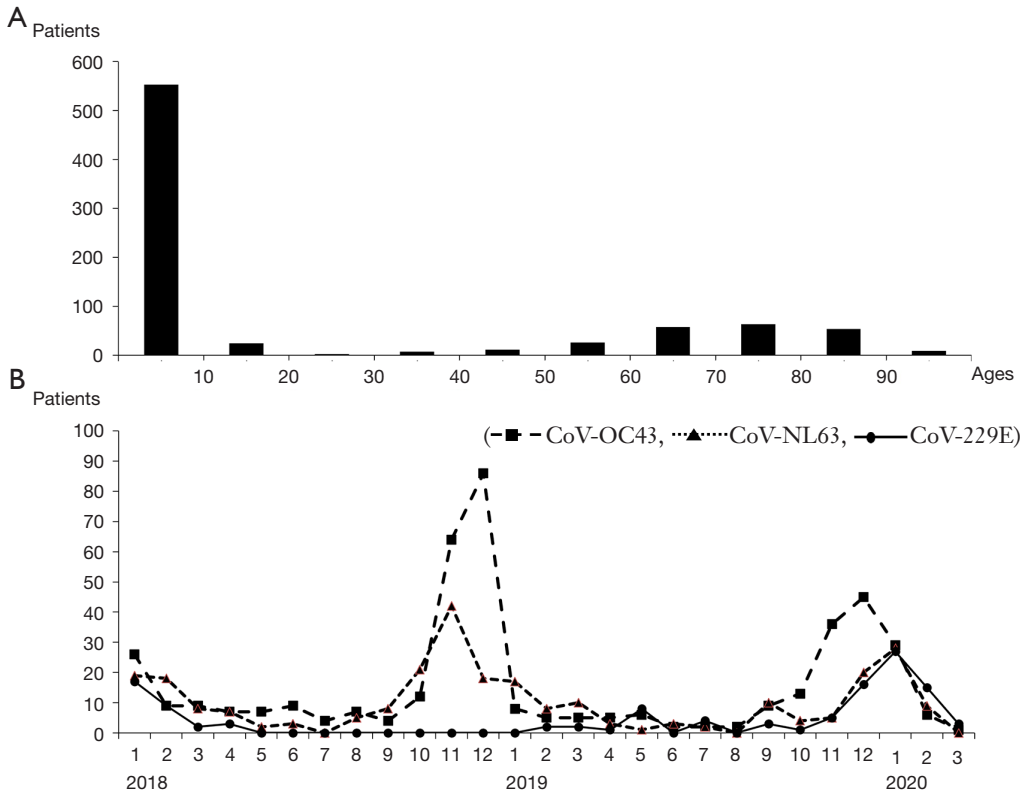

Figure 1 Distribution of human coronavirus (HCoVs) case. (A) Age distributions of HCoVs; (B) monthly prevalence of HCoVs detected among admitted patients between 1 January 2018 and 31 March 2020.

with the pneumonia, general weakness, the 2 points or more on the NEWS, CRP ≥74 mg/dL, or the OC43 corona subtype. After adjusting for other clinical variables, general weakness symptoms [hazard ratio (HR), 2.651; 95% confidence interval (CI), 1.147–6.125, P=0.023], NEWS ≥2 (HR, 5.485; 95% CI, 1.261–23.858, P=0.023), and coronavirus subtype OC43 (HR, 2.500; 95% CI, 1.060–5.897, P=0.036) (*Table 4*). *Figure 2* shows the survival curve.

Discussion

All-cause mortality rates of patients admitted for seasonal HCoV disease were 3.1% in all patients, and 10.8% in adults. This high mortality rate contrasts with the fact that coronavirus is typically a benign infection that causes a mild upper respiratory infection (5). The mortality rate in this study was lower than the global mortality rate of 4.1% and higher than the mortality rate of South Korea (2.1%) due to COVID-19 as of February 2021. The reason for the higher mortality in our study might be that we analyzed patients requiring hospitalization, while the COVID-19 mortality rate was calculated including asymptomatic patients. In the study about HCoV respiratory tract infections in adults admitted to acute care (8), all-cause mortality was high at 7%, which was similar to adult mortality rate in our study. The one-year mortality rate was 25.8% in patents ≥60 years who were hospitalized for RSV infection (14). The mortality was 13.3% in patients over 65 years of age and 26.8% in intensive care unit in our study. In our study, the mortality rate was high in the elderly. The reasons for the high mortality rate in older patients with viral infection can be thought of many comorbid diseases, poor immunity, or a high probability of pneumonia (15). The world's population is aging due to declines in both mortality and birth rates (16,17). Therefore, such an increase in the number of elderly patients will lead to a higher mortality rate from respiratory viral diseases in the future.

In our study, the majority of patients (71%) with coronavirus were under 18 years old. There were 45% of

Table 1 Clinical characteristics of coronavirus-infected patients

Characteristics	All patients (n=807)	Elder group (n=232)	Younger group (n=575)	P value
Age, year	2 (1–55)	72 (61–81)	1 (0–3)	–
Male	467 (57.9%)	130 (56.0%)	337 (58.6%)	0.503
Body mass index, kg/m^2	17.3 (16.0–20.1)	22.1 (19.7–25.4)	16.7 (15.7–18.1)	<0.001
Smoking history				
Never smoked	768 (95.2%)	194 (83.6%)	574 (99.8%)	<0.001
Former smoked	23 (2.9%)	22 (9.5%)	1 (0.2%)	<0.001
Current smoked	16 (2.1%)	16 (6.9%)	0	<0.001
Diagnosis				
Viral infection	109 (13.5%)	4 (1.7%)	105 (18.3%)	<0.001
Pneumonia	315 (39.0%)	141(60.8%)	174 (30.3%)	<0.001
Bronchitis	112 (13.9%)	5 (2.2%)	107 (18.6%)	<0.001
Laryngitis or pharyngitis	78 (9.7%)	2 (0.9%)	76 (13.2%)	<0.001
Febrile convulsion	48 (5.9%)	1 (0.4%)	47 (8.2%)	<0.001
Influenza	25 (3.1%)	10 (4.3%)	15 (2.6%)	0.196
Acute exacerbation of COPD or asthma	10 (1.2%)	5 (2.2%)	5 (0.9%)	0.13
Kawasaki disease	8 (1.0%)	0	8 (1.4%)	0.073
Other	102 (12.6%)	63 (27.2%)	39 (6.8%)	<0.001
Comorbidity				
Hypertension	115 (14.3%)	115 (49.6%)	0	<0.001
Diabetes	57 (7.1%)	57 (24.6%)	0	<0.001
Chronic airway disease	48 (5.9%)	44 (19.0%)	4 (0.7%)	<0.001
Cancer	46 (5.7%)	45 (19.4%)	1 (0.2%)	<0.001
Chronic vascular disease	42 (5.2%)	42 (18.1%)	0	<0.001
Chronic kidney disease	31 (3.8%)	31 (13.4%)	0	<0.001
Chronic liver disease	8 (1%)	8 (3.4%)	0	<0.001
Residence type				
Home	760 (94.2%)	187 (80.7%)	573 (99.6%)	<0.001
Hospital	38 (4.7%)	37 (15.9%)	1 (0.2%)	<0.001
Health care center	9 (1.1%)	8 (3.4%)	1 (0.2%)	<0.001
Duration of symptoms, days	3 (1–5)	3 (1–7)	2 (1–4)	0.003
Symptoms				
Fever	622 (77.1%)	103 (44.4%)	519 (90.3%)	<0.001
General weakness	47 (5.8%)	40 (17.2%)	7 (1.2%)	<0.001
Myalgia	16 (2.0%)	13 (5.6%)	3 (0.5%)	<0.001

Table 1 (*continued*)

Table 1 (*continued*)

Characteristics	All patients (n=807)	Elder group (n=232)	Younger group (n=575)	P value
Headache	14 (1.7%)	9 (3.9%)	5 (0.9%)	0.003
Sore throat	23 (2.9%)	7 (3.0%)	16 (2.8%)	0.856
Coryza	290 (35.9%)	13 (5.6%)	277 (48.2%)	<0.001
Cough	509 (63.1%)	101 (43.5%)	408 (71.0%)	<0.001
Sputum	297 (37%)	80 (37.7%)	217 (37.7%)	0.385
Dyspnea	116 (14.4%)	73 (31.5%)	43 (7.5%)	<0.001
Hemoptysis	11 (1.4%)	11 (4.7%)	0	<0.001
Vomiting	92 (11.4%)	15 (6.5%)	77 (13.4%)	0.005
Diarrhea	48 (5.9%)	5 (2.2%)	43 (7.5%)	0.004
Seizure	60 (7.4%)	4 (1.7%)	56 (9.7%)	<0.001
Lymph enlargement	12 (1.5%)	0	12 (2.1%)	0.027
NEWS	–	2 (1–4)	–	–
Duration of admission, days	4 (3–6)	8 (4–15)	3 (2–4)	<0.001
Antiviral agent	45 (5.6%)	24 (10.4%)	21 (3.6%)	<0.001
Peramivir	15 (1.9%)	10 (4.3%)	5 (0.9%)	
Tamiflu	25 (3.1%)	11 (4.8%)	14 (2.4%)	
Other	5 (2.2%)	3 (1.3%)	2 (0.3%)	
Antibacterial agent	532 (65.9%)	207 (89.2%)	325 (56.5%)	<0.001
ICU	71 (8.7%)	71 (30.2%)	0	<0.001
Death	25 (3.1%)	25 (10.8%)	0	<0.001

Data are presented as the median value (interquartile range) or number. Elder group is patient ≥18 years and younger group is patient <18 years. COPD, chronic obstructive pulmonary disease; NEWS, National Early Warning Score; NEWS is calculated only in elder group.

coronavirus cases under 18 years old in US (2) and 80% under 15 years old in Zambia (18). It can be seen that coronavirus infection occurs frequently at younger age.

The outbreaks for each subtype of coronavirus (*Figure 1B*), generally started in October and were prevalent from late autumn to winter until January and January the following year. In a US study dealing with the outbreak of coronavirus from 2014 to 2017, the outbreak was around January every year, and in the Zambia study, which saw an outbreak from December 2018 to December 2019, the outbreak was from September to November 2018 (2,18). It can be seen that coronavirus occurs a lot from late autumn to early spring.

The patterns of corona infection in adults and children are very different. More than 60% of adult coronavirus patients were hospitalized with pneumonia, but about 30% of patients <18 years had pneumonia. These data show that coronavirus infection more often progresses to a lower respiratory tract infection in adults. Fever occurs in 90% of cases in younger age, but in only 44% of adult. In adults, particularly older adults, basal temperature is low and the inability to control temperature makes the febrile reaction weak, so there is often no fever from the infection (15). In addition, symptoms of upper respiratory infection including coryza, sore throat were more common in coronavirus patients in younger age, whereas general weakness or shortness of breath often occurred in adults. This is related to the observation that low respiratory infection or systemic disease such as pneumonia was more common in adults.

Like other studies of coronavirus-infected patients

Table 2 Laboratory, viral, and bacterial findings of coronavirus infected patients

Characteristics	All patients (n=807)	Elder group (n=232)	Younger group (n=575)	P value
Laboratory finding				
White cell count, 10^3/μL	10.3 (7.4–13.6)	9.41 (6.74–13.2)	10.8 (7.80–14.0)	0.001
Lymphocyte count, 10^3/μL	2.99 (1.43–5.72)	1.44 (0.88–3.37)	3.50 (2.03–5.93)	<0.001
Platelet count, 10^3/μL	296 (229–377)	245 (169–307)	314 (246–395)	<0.001
Hemoglobin, g/dL	12.2 (11.3–13.0)	12.0 (10.4–13.6)	12.2 (11.6–12.8)	0.207
C-reactive protein, mg/dL	16.4 (4.10–52.3)	74.1 (20.9–149.2)	10.5 (3.0–26.5)	<0.001
Coronavirus subtype				
OC43	416 (51.5%)	92 (39.7%)	324 (56.3%)	<0.001
NL63	267 (33.1%)	61 (26.3%)	206 (35.8%)	0.009
229E	124 (15.4%)	79 (34.1%)	45 (7.8%)	<0.001
Co-infecting viruses	374 (46.3%)	44 (19.0%)	330 (57.4%)	<0.001
Influenza	51 (6.3%)	26 (11.2%)	25 (4.3%)	
RSV A	102 (12.6%)	5 (2.2%)	97 (16.8%)	
Rhinovirus	100 (12.4%)	6 (2.6%)	94 (16.3%)	
Adeno virus	86 (10.7%)	8 (3.5%)	78 (13.6%)	
RSV B	39 (4.8%)	4 (1.7%)	35 (6.1%)	
Boca virus	28 (3.5%)	1 (0.4%)	27 (4.7%)	
Enterovirus	23 (2.9%)	0	23 (4.0%)	
Parainfluenza virus	23 (2.9%)	0	23 (4.0%)	
Metapneumovirus	14 (1.7%)	3 (1.3%)	11 (1.9%)	
Others	4 (0.5%)	0	4 (0.7%)	
Co-infecting bacteria	65 (8.1%)	40 (17.2%)	25 (4.3%)	<0.001
Mycoplasma	21 (2.6%)	1 (0.04%)	20 (3.5%)	
Klebsiella pneumonia	15 (1.9%)	10 (4.3%)	5 (0.9%)	
Pseudomonas aeruginosa	9 (1.1%)	9 (3.8%)	0	
Haemophilus influenza	6 (0.74%)	6 (2.6%)	0	
Staphylococcus aureus	4 (0.5%)	4 (1.7%)	0	
Others	10 (1.2%)	10 (4.3%)	0	

Data are presented as the median value (interquartile range) or number. Elder group is patient ≥18 years and younger group is patient <18 years. RSV, respiratory syncytial virus.

(2,19), the OC43 type was the most prevalent among the coronavirus subtypes, and 229E was less frequent, but adult coronavirus patients were more infected with 229E in our study. Other studies (5,10) have reported that coronaviruses are often co-infected with other respiratory viruses. The presence of co-infection, particularly RSV, is associated with an increased likelihood of low respiratory tract infection in multivariate models (20). However, in our study, several respiratory viruses were co-infected in younger patients with coronavirus, whereas co-infection with respiratory viruses in adult except influenza was very low. One study from South Africa detected a co-infecting respiratory virus

Table 3 Characteristics of 25 mortality cases

Age	Sex	Diagnosis	Other hospital or healthcare center	Symptom	Co-morbidity	NEWS	HCoV subtype	Combined pathogen	Cause of death
51	Female	Pneumonia	Yes	Fever		3	OC43	*Pseudomonas aeruginosa*	Pneumonia
53	Male	Hepatic failure	No	Fever, general weakness	Diabetes, pancreatic cancer	2	OC43		Pancreatic cancer
55	Female	Cerebral infarction	No	Decreased mentality		2	229E		Cerebral infarction
60	Male	Pneumonia	Yes	Fever, dyspnea	Hypertension	2	OC43	*Acinetobacter baumannii*	Pneumonia
65	Male	Pneumonia	No	Cough, sputum, dyspnea	COPD, diabetes	13	OC43	*Streptococcus agalactiae*	Pneumonia
68	Male	Pharyngitis	No	General weakness	Lung cancer	8	OC43		Pneumonia
69	Male	Pneumonia	No	General weakness, cough, sputum, dyspnea	Diabetes, cancer	4	OC43	Rhinovirus; *E. coli*	Pneumonia
69	Male	Pneumonia	No	No	Lung cancer	10	OC43		Lung cancer
73	Female	Pneumonia	No	Dyspnea	Hypertension	4	229E		Pneumonia
75	Female	Pneumonia	No	Vomiting		1	229E		Pneumonia
77	Female	Pneumonia	Yes	Fever, general weakness	Old CI	2	OC43		Pneumonia
77	Male	Acute respiratory lung disease	No	Dyspnea		3	OC43		Pneumonia
77	Male	Pneumonia	No	General weakness	Diabetes, hypertension, old CI, chronic kidney disease	7	OC43		Brain hemorrhage
78	Male	Pneumonia	No	General weakness	Diabetes, hypertension	1	229E		Pneumonia
79	Female	Pneumonia	No	Fever, vomiting	Hypertension, lymphoma	2	OC43		Pneumonia
79	Female	Pneumonia	Yes	Fever, myalgia	Hypertension, old CI	6	OC43	Influenza, *Klebsiella pneumoniae*	Pneumonia
79	Male	Pneumonia	Yes	Fever, general weakness	Old CI	8	NL63	Adeno virus	Pneumonia
80	Female	Pneumonia	No	General weakness	Hypertension, chronic kidney disease	16	OC43	Influenza	Pneumonia
81	Female	Pneumonia	No	Fever, cough		8	229E		Pneumonia

Table 3 (*continued*)

Table 3 (*continued*)

Age	Sex	Diagnosis	Other hospital or healthcare center	Symptom	Co-morbidity	NEWS	HCoV subtype	Combined pathogen	Cause of death
82	Male	Pneumonia	No	Coryza, cough, sputum, dyspnea	Hypertension, heart failure	2	OC43	Respiratory syncytial virus A	Pneumonia
82	Female	Heart failure	No	Dyspnea		4	OC43		Pneumonia
83	Female	Pneumonia	Yes	Fever	Multiple myeloma	11	OC43	Influenza	Pneumonia
86	Female	Pneumonia	No	Cough, sputum, dyspnea	Diabetes, hypertension	3	229E		Pneumonia
91	Male	Pneumonia	Yes	General weakness, cough, dyspnea	Asthma, diabetes, hypertension	2	229E		Pneumonia
91	Female	Pneumonia	No	General weakness		2		Influenza	Pneumonia

CI, cerebral infarction.

in 49% of RSV cases and 32% of influenza cases (21). Another study of respiratory pathogen diversity and co-infections in rural Zambia (18) showed that respiratory viral co-infection was less in adults than in children, but it was not related to the difference with clinical severity.

In our study, coronavirus-infected patients with general weakness, higher NEWS, and HCoV OC43 had a poorer prognosis associated with mortality. Patients with severe COVID19 disease had more prominent laboratory abnormalities including lymphocytopenia and leukopenia than those with less severe disease (22). However, sex, age, and lymphocytopenia were not associated with mortality of coronavirus-infected patients in our study. Recent studies have shown that frailty and complaints general weakness, exhaustion, and low physical activity in elderly patients are related to the onset and prognosis of critical illness (23-25). NEWS has been reported to predict prognosis well in COVID 19 patients (26). Patients with OC43 had two-fold odds of requiring O_2 or intubation than those with other strains, while no difference in mortality or ICU admission was observed in a study of coronavirus-infected patients receiving acute care (8). In our study, mortality was higher in patients infected with HCoV OC43 compared to the other subtypes. The reason for HCoV OC43 has more virulent prognosis is still unclear and requires further study.

Our study had several limitations. We only included patients who were admitted to the hospital, thus representing a subset of the more critically ill patients with HCoV infection in the community. However, a study of hospitalized patients provides important information for prognosis and treatment, including the death of patients from severe disease. Another limitation of the study is that viral diseases have different local distributions and characteristics, which limits the generalization of our findings to other institutions. Data were collected and analyzed from five hospitals in administratively different regions. Another limitation of the study is that the subjective symptoms may have been underestimated because children under the age of 1. However, since mortality analysis was only conducted over the age of 18, symptoms could be analyzed for prognostic factor.

Our study analyzed the clinical features and prognosis of patients admitted with coronavirus. In our study, the mortality rate of all admitted patients with coronavirus was 3.1% and 10.8% in adults. In an aging society, mortalities from various respiratory viruses including coronavirus could be inevitably increased. Therefore, it will be further needed studies on the clinical features, prognosis, and risk factors of respiratory viruses, which were known to cause upper respiratory tract infections with benign course in the past. Additionally, patients admitted by coronavirus should be treated carefully if they have general weakness symptoms,

Table 4 Prognostic factors for coronavirus infected patients in elder group

Characteristics	Univariate analysis			Multivariate analysis		
	HR	CI	P value	HR	CI	P value
Age ≥72 years	2.26	0.974–5.244	0.058			
Male	1.579	0.719–3.464	0.255			
Body mass index ≤22.1 kg/m^2	1.289	0.569–2.920	0.543			
Smoker	1.075	0.369–3.134	0.894			
Pneumonia	2.936	1.101–7.832	0.031	1.881	0.683–5.179	0.221
Comorbidity						
Diabetes	1.139	0.476–2.727	0.77			
Chronic airway disease	2.959	0.697–12.559	0.141			
Cancer	1.787	0.771–4.141	0.176			
Chronic kidney disease	2	0.471–8.490	0.347			
Hospital and health care center	2.86	1.225–6.676	0.015	1.858	0.769–4.490	0.169
Symptoms						
Fever	1.027	0.466–2.261	0.948			
General weakness	3.586	1.610–7.990	0.002	2.651	1.147–6.125	0.023
Cough	2.472	0.987–6.191	0.053			
Sputum	2.83	0.971–8.244	0.057			
Dyspnea	1.76	0.799–3.877	0.161			
NEWS ≥2	8.741	2.060–37.086	0.003	5.485	1.261–23.858	0.023
Antiviral agent	2.127	0.798–5.667	0.131			
Antibacterial agent	2.834	0.383–20.951	0.308			
Laboratory finding						
White cell count ≥9.4, 10^3/μL	1.881	0.831–4.258	0.129			
Lymphocyte count ≥1.44, 10^3/μL	1.345	0.611–2.865	0.462			
Platelet count ≤245, 10^3/μL	2.055	0.887–4.762	0.093			
Hemoglobin ≤12.0, g/dL	2.11	0.910–4.893	0.082			
C-reactive protein ≥74, mg/dL	3.929	1.566–9.857	0.004	1.918	0.717–5.135	0.195
Coronavirus subtype						
OC43	3.452	1.488–8.005	0.004	2.500	1.060–5.897	0.036
NL63	0.108	0.015–0.797	0.029			
229E	0.755	0.315–1.808	0.528			
Co-infecting influenza	0.046	0.000–197.997	0.261			
Co-infecting bacteria						
Klebsiella pneumonia	1.013	0.137–7.490	0.99			
Pseudomonas aeruginosa	0.961	0.130–7.103	0.969			

HR, hazard ratio; CI, confidence interval.

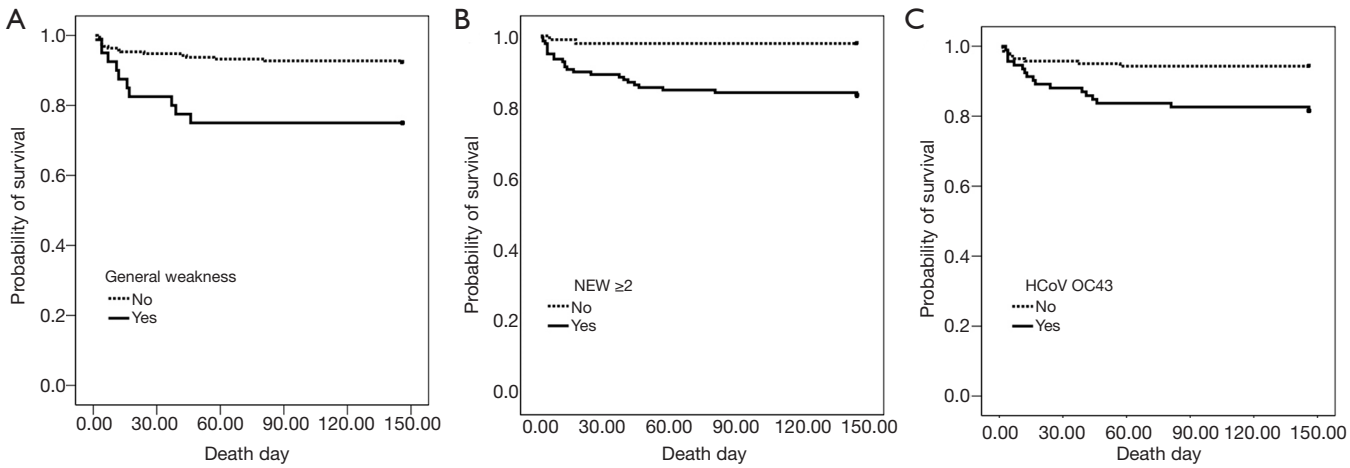

Figure 2 Kaplan-Meier survival curves showing the effects of (A) general weakness, (B) NEWS ≥2, (C) HCoV OC43 of 232 hospitalized patients with coronavirus infection.

NEWS higher than 2, or the OC43 subtype.

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Footnote

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