

Comparison of clinical characteristics in adult patients under 65 years of age with and without Covid-19 pneumonia

Tugce Sahin Ozdemirel¹, Esmâ Sevil Akkurt¹, Ozlem Ertan¹, Mehmet Enes Gökler², Berna Akinci Ozyurek¹

¹Department of Chest Disease, University of Health Sciences Ankara Atatürk Chest Diseases and Chest Surgery Training and Research Hospital, Ankara, Turkey, ²Department of Public Health, Yıldırım Beyazıt University Faculty of Medicine, Ankara, Turkey

ABSTRACT

Background: Coronavirus disease 2019 (COVID-19) can cause asymptomatic, mild upper respiratory tract symptoms and pneumonia in young persons. How the disease will progress in each patient is still unknown. Therefore, we aimed to investigate the prognostic markers of the development of pneumonia and the clinical characteristics of patients under 65 years with COVID-19 confirmed by a positive reverse transcriptase polymerase chain reaction test. **Methods:** In this retrospective study, a total of 271 patients admitted in our unit were included. The patients were divided into two groups, those who did and those who did not develop pneumonia. Their clinical features, treatment protocols, and laboratory parameters were recorded retrospectively. **Results:** Pneumonia developed in 67.9% (n = 184) of the cases. The age in the pneumonia group was higher than that in the non-pneumonia group ($p < 0.001$). In the logistic regression analysis, the symptom and co-morbidity status were examined according to the presence of pneumonia; hypertension (HT) (OR: 4525, 95% CL: 1,494–13,708) was the most important risk factor for pneumonia. When age and laboratory values were examined according to the presence of pneumonia, advanced age (OR: 1.042, 95% CL: 1.01–1.073), low albumin (OR: 0.917, 95% CL: 0.854–0.986), and high troponin (OR: 1.291, 95% CL: 1.044–1.596) were identified as risk factors for pneumonia. **Conclusion:** In this article, HT (22.3%, $P < 0.001$) has been considered as an important risk factor, whereas association of diabetes mellitus (21.2%, $P 0.029$) and smoking (25.0%, $P 0.038$) was also significant. The median age of the group was 51 (41.5–58) in the group developing pneumonia and 41 (30–48) in the non-developing group. Young patients with these predictive factors should be more carefully evaluated by further diagnostic procedures, such as thoracic computed tomography.

KEY WORDS: COVID-19, pneumonia, young adults

Address for correspondence: Dr. Tugce Sahin Ozdemirel, Department of Chest Disease, University of Health Sciences Ankara Atatürk Chest Diseases and Chest Surgery Training and Research Hospital, Ankara, Turkey.
E-mail: drtugesahin@gmail.com

Submitted: 08-Jan-2022

Revised: 05-Mar-2022

Accepted: 23-Jun-2022

Published: 29-Aug-2022

INTRODUCTION

During the pneumonia epidemic that emerged in Wuhan, China, in December 2020, pneumonia because of the newly defined severe acute respiratory syndrome coronavirus 2, known as SARS-CoV-2, was defined as coronavirus disease 2019 (COVID-19). Patients presented with both

asymptomatic and flu-like symptoms and showed different clinical courses, from pneumonia to respiratory failure.^[1,2] Thorax computed tomography (thorax CT) is very sensitive to identifying viral pneumonia. In all age groups, patients with COVID-19 pneumonia generally have bilateral,

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: WKHLRPMedknow_reprints@wolterskluwer.com

Access this article online	
Quick Response Code: 	Website: www.lungindia.com
	DOI: 10.4103/lungindia.lungindia_20_22

How to cite this article: Sahin Ozdemirel T, Akkurt ES, Ertan O, Gökler ME, Ozyurek BA. Comparison of clinical characteristics in adult patients under 65 years of age with and without Covid-19 pneumonia. Lung India 2022;39:422-7.

peripheral, and multi-focal involvement in lung radiology, and ground-glass densities, consolidation, and vascular enlargements can be seen in thorax CT.^[3] COVID-19 generally affects entire populations, but older people with underlying diseases are more susceptible.^[4] COVID-19 can cause asymptomatic or mild upper respiratory tract symptoms in young persons, and diffuse lung involvement is observed in some cases. The majority of patients who develop moderate to severe disease are over 50 years old, although there has been a substantial minority of young people requiring hospitalisation and mechanical ventilation.^[5] However, how the disease will progress in each patient is still unknown. Therefore, we aimed to investigate the prognostic markers of the development of pneumonia and the clinical characteristics of patients under 65 years with COVID-19 infection confirmed by a positive reverse transcriptase polymerase chain reaction (RT-PCR) test.

MATERIALS AND METHODS

The approval for the study was obtained from the Medical Specialty Education Board of our hospital (711-28/1/2021). We included 350 adult patients aged 18–65 years whose COVID-19 infection had been confirmed by RT-PCR positivity between August 2020 and January 2021 in our hospital's COVID-19 out-patient clinic and COVID-19 service. The patients' admission symptoms, clinical features, laboratory parameters, lung radiological imaging, and treatment regimens were retrospectively obtained from the hospital information system. Patients ($n = 79$) who did not have a thorax CT examination and were asymptomatic or had symptoms for less than 5 days were excluded from the study. According to the thorax CT images, the patients were divided into two groups, those who developed and those who did not develop pneumonia, and their clinical features, treatment protocols, and laboratory parameters, that is, D-dimer, troponin, C-reactive protein (CRP), albumin, ferritin, lymphocyte count and percentage, neutrophil count and percentage, neutrophil-to-lymphocyte ratio (NLR), aspartate aminotransferase (AST), alanine aminotransferase (ALT), and lactate dehydrogenase (LDH), were recorded retrospectively. The patients' informed consent was obtained.

Statistics

The obtained data were evaluated using the IBM-SPSS (Version 20.0) program in the computer environment. Number, percentage, and mean \pm standard deviation were used for the descriptive statistics. Chi-squared tests were used to compare categorical data, and the Mann-Whitney U test was used to compare continuous data. Logistic regression models were created with variables found to be significant by bivariate analysis ($p < 0.05$). Binary logistic regression (backward stepwise method) analysis was used in the model analysis. $P \leq 0.05$ was accepted for statistical significance.

RESULTS

Of the study group, 45.4% were female ($n = 123$), and the mean age was 46.48 ± 11.99 years. Pneumonia developed in 67.9% ($n = 184$) of the cases, with 54.9% ($n = 101$) of these being men, and 25.0% ($n = 46$) were smokers. For the pneumonia group, the hospitalisation rate was 52.2%, and 9.8% ($n = 18$) required intensive care. A history of smoking, the presence of dyspnoea, a need for intensive care, desaturation, and hospitalisation were more frequent in those with pneumonia ($p < 0.005$, respectively). The socio-demographic characteristics and COVID-19 symptoms of the study group according to the presence of pneumonia are presented in Table 1. Of those with pneumonia, 90.2% ($n = 166$) were using favipiravir, 53.3% ($n = 98$) were using hydroxychloroquine, 42.9% were using steroids, and 44.6% were using non-specific antibiotics. Also, 22.3% ($n = 41$) of the patients with pneumonia had hypertension (HT), 21.2% ($n = 39$) had diabetes mellitus (DM), 10.9% had cardiac disease ($n = 20$), 6.5% had chronic obstructive pulmonary disease ($n = 12$), and 8.2% ($n = 5$) had asthma. Favipiravir, steroid, and non-specific antibiotic use statuses and the presence of HT were detected more frequently in those with pneumonia ($p < 0.005$, respectively). The drug use and co-morbidities of the study group according to the presence of pneumonia are presented in Table 2. The age in the pneumonia group was higher than that in the non-pneumonia group ($p < 0.001$). When laboratory values were examined according to the presence of pneumonia in the study group, white blood cell count, neutrophil count, neutrophil percentage, LDH level and NLR and initial troponin, initial D-dimer, initial ferritin, and initial CRP values were higher in the pneumonia group, whereas lymphocyte count, lymphocyte percentage, and albumin values were higher in the non-pneumonia group ($p < 0.005$, respectively). The study groups' ages and laboratory values according to the presence of pneumonia are presented in Table 3. In the logistic regression analysis, when the symptom and co-morbidity status were examined according to the presence of pneumonia, dyspnoea (OR: 2370, 95% CL: 1187–4730), hospitalisation (OR: 3803, 95% CL: 1877–7705), and HT (OR: 4525, 95% CL: 1494–13,708) were the most important risk factors for pneumonia [Table 4]. In the logistic regression analysis of the study group, when age and laboratory values were examined according to the presence of pneumonia, advanced age (OR: 1.042, 95% CL: 1.01–1.073), low albumin (OR: 0.917, 95% CL: 0.854–0.986), and high troponin (OR: 1.291, 95% CL: 1.044–1.596) were identified as risk factors for pneumonia [see Table 5].

DISCUSSION

Our study included 271 patients aged 18–65 years with positive RT-PCR tests for COVID-19 who had symptoms for longer than 5 days at the time of admission. Smoking and the presence of HT were found to be statistically

Table 1: Socio-demographic characteristics and COVID-19 symptoms of the study group according to the presence of pneumonia

Total number of patients n- 271 (100%)	Subjects n=271				P
	Without Pneumonia n=87 (32.1%)		With Pneumonia n=184 (67.9%)		
	n	%	n	%	
Gender					
Male	47	54,0	101	54,9	0,893
Female	40	46,0	83	45,1	
Smoking					
Non-smoker	64	73,6	110	59,8	0,038
Ex smoker	5	5,7	28	15,2	
Smoker	18	20,7	46	25,0	
Intensive care unit need					
No	87	100,0	166	90,2	0,003
Yes	0	0,0	18	9,8	
Fever					
No	67	77,0	123	66,8	0,088
Yes	20	23,0	61	33,2	
Cough					
No	56	64,4	111	60,3	0,523
Yes	31	35,6	73	39,7	
Dyspnoea					
No	72	82,8	102	55,4	<0,001
Yes	15	17,2	82	44,6	
Chest pain					
No	85	97,7	177	96,2	0,518
Yes	2	2,3	7	3,8	
Flu symptoms					
No	77	88,5	165	89,7	0,771
Yes	10	11,5	19	10,3	
Loss of taste and smell					
No	80	92,0	178	96,7	0,085
Yes	7	8,0	6	3,3	
Headache					
No	78	89,7	172	93,5	0,272
Yes	9	10,3	12	6,5	
Joint pain					
No	80	92,0	174	94,6	0,408
Yes	7	8,0	10	5,4	
Myalgia					
No	76	87,4	170	92,4	0,181
Yes	11	12,6	14	7,6	
Weakness					
No	63	72,4	144	78,3	0,290
Yes	24	27,6	40	21,7	
Diarrhoea					
No	78	89,7	175	95,1	0,092
Yes	9	10,3	9	4,9	
Back pain					
No	83	95,4	172	93,5	0,530
Yes	4	4,6	12	6,5	
Desaturation					
No	76	87,4	106	57,6	<0,001
Yes	11	12,6	78	42,4	
Treatment					
Home	74	85,1	88	47,8	<0,001
Hospital	13	14,9	96	52,2	
Final					
Live	87	100,0	183	99,5	0,491
Exitus	0	0,0	1	0,5	

P values written in bold show statistically significance

significant in the group that developed pneumonia. Hospitalisation, the need for additional antibiotics, desaturation, and bilateral involvement of the lung

Table 2: Drug use and co-morbidity status of the study group according to the presence of pneumonia

Total number of patients n- 271 (100%)	Subjects n=271				P
	Without Pneumonia		With Pneumonia		
	n	%	n	%	
Favipiravir					
No	24	27,6	18	9,8	<0,001
Yes	63	72,4	166	90,2	
Hydroxychloroquine					
No	51	58,6	86	46,7	0,068
Yes	36	41,4	98	53,3	
Steroid need					
No	77	88,5	105	57,1	<0,001
Yes	10	11,5	79	42,9	
Non-specific antibiotic					
No	75	86,2	102	55,4	<0,001
Yes	12	13,8	82	44,6	
Use of low-molecular-weight heparin					
No	68	78,2	117	63,6	0,016
Yes	19	21,8	67	36,4	
COPD					
No	86	98,9	172	93,5	0,053
Yes	1	1,1	12	6,5	
Asthma					
No	83	95,4	169	91,8	0,285
Yes	4	4,6	15	8,2	
Hypertension					
No	83	95,4	143	77,7	<0,001
Yes	4	4,6	41	22,3	
Diabetes mellitus					
No	78	89,7	145	78,8	0,029
Yes	9	10,3	39	21,2	
Lung radiological involvement					
No	87	100,0	0	0,0	<0,001
Unilateral	0	0,0	13	7,1	
Bilateral	0	0,0	171	92,9	
Malignancy					
No	85	97,7	174	94,6	0,241
Yes	2	2,3	10	5,4	
Hypothyroidism					
No	84	96,6	179	97,3	0,740
Yes	3	3,4	5	2,7	
Cardiovascular disease					
No	85	97,7	164	89,1	0,016
Yes	2	2,3	20	10,9	
Neurological disease					
No	86	98,9	182	98,9	0,953
Yes	1	1,1	2	1,1	
Obesity					
No	86	98,9%	178	96,7	0,306
Yes	1	1,1%	6	3,3	

COPD: chronic obstructive pulmonary disease. P values written in bold show statistical significance

parenchyma were more common in the pneumonia group. Of the laboratory parameters, initial D-dimer, troponin, neutrophil, NLR, CRP, LDH, and ferritin levels were higher in the pneumonia group, and lymphocyte, albumin, and hemoglobin values were lower. Older age, the presence of HT, dyspnoea at hospital admission, low albumin, and high troponin were found to be risk factors for the development of pneumonia. Studies have shown that the need for mechanical ventilators, intensive care hospitalisation, and

Table 3: Age and laboratory values of the study group according to the presence of pneumonia

	Subjects n=271						P
	Without Pneumonia			With Pneumonia			
	Ortanca	IQR 25	IQR 75	Ortanca	IQR 25	IQR 75	
Age	41,0	30,0	48,0	51,0	41,5	58,0	<0,001
White blood cell	5750,0	4800,0	7700,0	6500,0	5150,0	8560,0	0,023
Lymphocyte count	1640,0	1290,0	2170,0	1350,0	965,0	1915,0	0,005
Neutrophil count	3630,0	2800,0	4870,0	4295,0	3200,0	6150,0	0,005
Lymphocyte %	29,4	21,0	35,0	22,0	14,5	30,0	<0,001
Neutrophil %	60,5	56,0	69,0	68,0	60,4	78,6	<0,001
Haemoglobin	14,5	13,5	15,7	13,8	12,7	15,0	0,002
Albumin	42,7	38,3	45,8	38,8	34,1	41,9	<0,001
ALT	23,0	15,0	40,0	27,0	19,0	40,0	0,104
AST	24,0	19,0	31,0	27,0	19,0	40,0	0,071
LDH	198,0	162,0	238,0	242,0	185,0	315,0	<0,001
NLR	2,0	1,5	3,2	3,0	1,9	5,3	<0,001
Platelet	228,0	198,0	270,0	234,0	189,0	286,0	0,790
Initial Troponin	2,5	2,0	2,7	3,2	2,0	6,5	<0,001
Initial D-Dimer	,3	,2	,6	,6	,3	1,0	<0,001
Initial Ferritin	88,1	27,0	149,8	162,0	61,0	373,9	<0,001
Initial CRP	5,1	1,9	16,9	24,0	7,0	89,1	<0,001

CRP: C-reactive protein, ALT: Alanine transaminase, AST: Aspartate transaminase, NLR: neutrophil lymphocyte ratio, LDH: Lactate dehydrogenase. P values written in bold show statistically significance

Table 4: Symptom and co-morbidity status according to the presence of pneumonia in the logistic regression analysis (Step 4)

	B	S.E.	P	OR	%95 CI
Dyspnoea (Reference: None)	0,863	0,353	0,014	2,370	1,187-4,730
Treatment (Reference: Home)	1,336	0,360	<0,001	3,803	1,877-7,705
Favipiravir (Reference: No)	0,805	0,375	0,032	2,236	1,071-4,668
Hypertension (Reference: No)	1,510	0,566	0,008	4,525	1,494-13,708

CI, confidence interval; OR, odd's ratio; SE, standard error. The model dependent variable was the presence of pneumonia; Model content: Smoking, Dyspnoea, Treatment, Favipiravir, Steroid, Non-specific antibiotic, Hypertension

Table 5: Age and laboratory values according to the presence of pneumonia in the logistic regression analysis (Step 9)

	B	S.E.	P	OR	%95 CI
Age	0,041	0,015	0,008	1,042	1,011-1,073
Lymphocyte %	0,079	0,047	0,095	1,083	0,986-1,188
Neutrophil %	0,076	0,044	0,084	1,079	0,990-1,176
Albumin	-0,086	0,037	0,019	0,917	0,854-0,986
Initial Troponin	0,256	0,108	0,018	1,291	1,044-1,596

CI, confidence interval; OR, odd's ratio; SE, standard error. The model dependent variable was the presence of pneumonia; Model content: Age, White blood cell, Lymphocyte count, Neutrophil count, Lymphocyte %, Neutrophil%, Albumin, LDH, NLR, Initial Trop, Initial D-Dimer, Initial Ferritin, Initial CRP

death rates are significantly higher in COVID-19 patients over 65 years of age compared to younger patients.^[6,7] However, no specific data for the clinical features and treatment of young adult COVID-19 patients admitted to hospitals have been published. As far as we know, although studies on COVID-19 patients under the age of 65 have been published, no comparative studies between young adult patients with and without pneumonia have been published. In a study of patients under the age of 50 with a diagnosis of COVID-19, 56% of the patients were male, their mean age was 44.44 years, and 92.1% had CT

lung involvement.^[3] Our study found that pneumonia developed at a rate of 67.9%, with a mean age of 46.48 ± 11.99 years. In another study, where a median age of 50 years (IQR; 40–68) was found in a pneumonia group, it was stated that older age was a significant risk factor for the development of pneumonia.^[8] In Jung *et al.*'s^[9] study, the mean age of a group of patients who initially developed pneumonia or during a follow-up was significantly higher (51.5 and 54.9 years, respectively) compared to a group without pneumonia (38.5 years). In our study, in accordance with the literature, the median age was 51 years (IQR; 41.5–58) in the group that developed pneumonia, and older age was statistically significant for the development of pneumonia. In the literature, it has been stated that HT, CVD, DM, and smoking are associated with poor clinical outcomes of COVID-19 cases.^[10,11] In our study, the most common co-morbidities detected in the pneumonia group were HT, DM, and CVD, and there was a significant relationship between smoking and the development of pneumonia. The most commonly reported symptoms observed in COVID-19 patients are fever, cough, and myalgia.^[12,13] In our study, these symptoms were common in the pneumonia group, but only dyspnoea was statistically significantly associated with COVID-19 pneumonia. Fever, the most common COVID-19, was not found to be significant in our study, suggesting that it was not a predictor for pneumonia. In another study, approximately 63% of hospitalised COVID-19 patients under the age of 65 had desaturation, and the hospital stay was longer in this group.^[14] In our study, desaturation and hospitalisation were statistically more significant in the pneumonia group. To date, most studies on prognostic markers have shown an increase in D-dimer and LDH values and a decrease in lymphocyte levels,^[15,16] and Zhang *et al.*^[17] emphasised that D-dimer levels are an important marker for determining mortality in cases with COVID-19 pneumonia. Itelman *et al.*^[18] emphasised that

patients with severe COVID-19 have higher leukocyte and neutrophil counts and LDH levels. In our study, increased D-dimer and LDH and decreased lymphocyte levels were found to be statistically significantly higher in the pneumonia group. NLR, high CRP, and low albumin have high sensitivity and specificity for demonstrating inflammation. Studies have shown that the NLR and the CRP/lymphocyte ratio are independent prognostic markers for many diseases.^[19,20] In our study, although the NLR and initial CRP values were high in patients with pneumonia, albumin and lymphocyte values were lower. In a retrospective cohort study involving 191 patients with COVID-19 from Wuhan, China, high LDH and ferritin levels were associated with mortality,^[21] and Wang *et al.*^[22] reported that 40% of patients with COVID-19 had high LDH values at the time of admission. In a systematic review conducted by Taneri,^[23] including 189 studies and 57,563 patients, compared to patients with an intermediate or low risk of disease, high ferritin and low haemoglobin levels were found in patients with a high risk for severe disease.^[23] Cobre *et al.*^[24] also found that high ferritin and low haemoglobin levels were observed in both COVID-19 patient groups and patients with severe disease.^[24] In our study, although haemoglobin levels were lower in the group that developed pneumonia, ferritin and LDH levels were higher. In a systematic review of four studies, including 374 patients, troponin levels were observed to be significantly higher in patients with severe COVID-19 infection compared to non-serious patients.^[25] Zhu *et al.*'s^[15] study also found that troponin values were a prognostic marker for severe disease. In our study, troponin values were higher in the group with pneumonia, and they were found to be a statistically significant risk factor for the development of pneumonia. In various studies, increased liver function markers, particularly ALT, AST, gamma-glutamyl transferase, and total bilirubin levels, have been described in COVID-19 patients.^[26,27] However, no statistical difference was found in these values in our study. In one study, at the time of diagnosis, 203 patients had bilateral pneumonia, 39 patients had unilateral pneumonia, six patients had normal thorax CT scan results, and 163 (65.7%) had radiological progression of symptoms on the seventh day in repeated radiological imaging.^[28] In another study, patients with or without pneumonia at the time of diagnosis had negative or positive CT findings according to the duration of symptoms; it was stated that the presence of pneumonia varied depending on the time after symptom onset, and the non-pneumonia group was characterised by younger patients, normal laboratory findings, and less co-morbidity.^[9] In another study, it was stated that positive CT findings were associated with symptom duration, and 56% of patients showed normal CT findings in the early phase (0–2 days) after symptom onset.^[29] Patients with symptoms for more than 5 days were included in our study, and in accordance with the literature,^[30] bilateral involvement was more common in the group with pneumonia, and older age was considered a risk factor for the development of pneumonia.

CONCLUSION

The presence of dyspnoea and HT, older age, low albumin, high troponin, and hospitalisation, which are indicators of mortality in elderly patients, were also important factors for predicting COVID-19-related pneumonia in patients under 65 years of age. Young patients with these predictive factors should be more carefully evaluated by further diagnostic procedures, such as thoracic CT.

Ethics committee approval

The approval for the study was obtained from the Medical Specialty Education Board of our hospital (711-28/1/2021)

Informed consent

Written informed consent was obtained from all participants who participated in this study.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

- Zhou P, Yang XL, Wang XG, Hu B, Zhang L, Zhang W, *et al.* A pneumonia outbreak associated with a new coronavirus of probable bat origin. *Nature* 2020;579:270-3.
- Guo YR, Cao QD, Hong ZS, Tan YY, Chen SD, Jin HJ, *et al.* The origin, transmission and clinical therapies on coronavirus disease 2019 (COVID-19) outbreak – An update on the status. *Mil Med Res* 2020;7:11.
- Zhao W, Zhong Z, Xie X, Yu Q, Liu J. Relation between chest CT findings and clinical conditions of coronavirus disease (COVID-19) pneumonia: A multicenter study. *AJR Am J Roentgenol* 2020;214:1072-7.
- Liu K, Chen Y, Lin R, Han K. Clinical features of COVID-19 in elderly patients: A comparison with young and middle-aged patients. *J Infect* 2020;80:e14-8.
- Bonifazi M, Mei F, Skrami E, Latini LL, Amico D, Balestro E, *et al.* Predictors of worse prognosis in young and middle-aged adults hospitalized with COVID-19 pneumonia: A multi-center Italian study (COVID-UNDER50). *J Clin Med* 2021;10:1218.
- Zhou F, Yu T, Du R, Fan G, Liu Y, Liu Z, *et al.* Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: A retrospective cohort study. *Lancet* 2020;395:1054-62.
- Grasselli G, Zangrillo A, Zanella A, Antonelli M, Cabrini L, Castelli A, *et al.* Baseline characteristics and outcomes of 1591 patients infected with SARS-CoV-2 admitted to ICUs of the Lombardy region, Italy. *JAMA* 2020;323:1574-81.
- Özger HS, Aysert Yıldız P, Gaygısız Ü, Uğraş Dikmen A, Demirbaş Gülmez Z, Yıldız M, *et al.* The factors predicting pneumonia in COVID-19 patients: Preliminary results from a university hospital in Turkey. *Turk J Med Sci* 2020;50:1810-6.
- Jung HK, Kim JY, Lee MS, Lee JY, Park JS, Hyun M, *et al.* Characteristics of COVID-19 patients who progress to pneumonia on follow-up chest radiograph: 236 patients from a single isolated cohort in Daegu, South Korea. *Korean J Radiol* 2020;21:1265-72.
- Zheng Z, Peng F, Xu B, Zhao J, Liu H, Peng J, *et al.* Risk factors of critical & mortal COVID-19 cases: A systematic literature review and meta-analysis. *J Infect* 2020;81:e16-25.
- Zuin M, Rigatelli G, Zuliani G, Rigatelli A, Mazza A, Roncon L. Arterial hypertension and risk of death in patients with COVID-19 infection: Systematic review and meta-analysis. *J Infect* 2020;81:e84-6.
- Tian S, Hu N, Lou J, Chen K, Kang X, Xiang Z, *et al.* Characteristics of COVID-19 infection in Beijing. *J Infect* 2020;80:401-6.
- Kim GU, Kim MJ, Ra SH, Lee J, Bae S, Jung J, *et al.* Clinical characteristics

- of asymptomatic and symptomatic patients with mild COVID-19. *Clin Microbiol Infect* 2020;26:948.e1-3.
14. Ni YN, Wang T, Liang BM, Liang ZA. The independent factors associated with oxygen therapy in COVID-19 patients under 65 years old. *PLoS One* 2021;16:e0245690.
 15. Zhu YC, Tan L, Liu L, Li KZ, Qi WY, Hu X. Comparative analysis of characteristics and medications between coronavirus disease 2019 and severe acute respiratory syndrome. *Clin Med J* 2020;18:15-23.
 16. Ming J, Hong W, Chunli S, Kun W. Literature review and research overview of novel coronavirus pneumonia. *Shanxi Med J* 2020;49:259-63.
 17. Zhang L, Yan X, Fan Q, Liu H, Liu X, Liu Z, *et al.* D-dimer levels on admission to predict in-hospital mortality in patients with Covid-19. *J Thromb Haemost* 2020;18:1324-9.
 18. Itelman E, Wasserstrum Y, Segev A, Avaky C, Negru L, Cohen D, *et al.* Clinical characterization of 162 COVID-19 patients in Israel: Preliminary report from a large tertiary center. *Isr Med Assoc J* 2020;22:271-4.
 19. Yodying H, Matsuda A, Miyashita M, Matsumoto S, Sakurazawa N, Yamada M, *et al.* Prognostic significance of neutrophil-to-lymphocyte ratio and platelet-to-lymphocyte ratio in oncologic outcomes of esophageal cancer: A systematic review and meta-analysis. *Ann Surg Oncol* 2016;23:646-54.
 20. Tanriverdi Z, Gungoren F, Tascanov MB, Besli F, Altiparmak IH. Comparing the diagnostic value of the C-reactive protein to albumin ratio with other inflammatory markers in patients with stable angina pectoris. *Angiology* 2020;71:360-5.
 21. Deng Y, Liu W, Liu K, Fang YY, Shang J, Zhou L, *et al.* Clinical characteristics of fatal and recovered cases of coronavirus disease 2019 in Wuhan, China: A retrospective study. *Chin Med J (Engl)* 2020;133:1261-7.
 22. Wang D, Hu B, Hu C, Zhu F, Liu X, Zhang J, *et al.* Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. *JAMA* 2020;323:1061-9.
 23. Taneri PE, Gómez-Ochoa SA, Llanaj E, Raguindin PF, Rojas LZ, Roa-Díaz ZM, *et al.* Anemia and iron metabolism in COVID-19: A systematic review and meta-analysis. *Eur J Epidemiol* 2020;35:763-73.
 24. Cobre AF, Stremel DP, Noleto GR, Fachi MM, Surek M, Wiens A, *et al.* Diagnosis and prediction of COVID-19 severity: Can biochemical tests and machine learning be used as prognostic indicators? *Comput Biol Med* 2021;134:104531.
 25. Lippi G, Lavie CJ, Sanchis-Gomar F. Cardiac troponin I in patients with coronavirus disease 2019 (COVID-19): Evidence from a meta-analysis. *Prog Cardiovasc Dis* 2020;63:390-1.
 26. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, *et al.* Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet* 2020;395:497-506.
 27. Paliogiannis P, Zinellu A. Bilirubin levels in patients with mild and severe Covid-19: A pooled analysis. *Liver Int* 2020;40:1787-8.
 28. Chen J, Qi T, Liu L, Ling Y, Qian Z, Li T, *et al.* Clinical progression of patients with COVID-19 in Shanghai, China. *J Infect* 2020;80:e1-6.
 29. Bernheim A, Mei X, Huang M, Yang Y, Fayad ZA, Zhang N, *et al.* Chest CT findings in coronavirus disease-19 (COVID-19): Relationship to duration of infection. *Radiology* 2020;295:200463.
 30. Yoon SH, Lee KH, Kim JY, Lee YK, Ko H, Kim KH, *et al.* Chest radiographic and CT findings of the 2019 novel coronavirus disease (covid-19): Analysis of nine patients treated in Korea. *Korean J Radiol* 2020;21:494-500.