The factors predicting pneumonia in COVID-19 patients: preliminary results from a university hospital in Turkey

HASAN SELÇUK ÖZGER
PINAR AYSERT YILDIZ
ÜMMÜGÜLSÜM GAYGISIZ
ASİYE UĞRAŞ DİKMEN
ZEHRA DEMİRBAŞ GÜLMEZ

See next page for additional authors

Follow this and additional works at: https://journals.tubitak.gov.tr/medical

Part of the Medical Sciences Commons

Recommended Citation
ÖZGER, HASAN SELÇUK; YILDIZ, PINAR AYSERT; GAYGISIZ, ÜMMÜGÜLSÜM; DİKMEN, ASİYE UĞRAŞ; GÜLMEZ, ZEHRA DEMİRBAŞ; YILDIZ, MEHMET; ŞENOL, ESİN; HIZEL, KENAN; TUNÇCAN, ÖZLEM GÜZEL; ÇAĞLAR, KAYHAN; BOZDAYI, GÜLENDAM; KÖKTÜRK, NURDAN; ÇİFTÇİ, TANSU ULUKAVAK; BIKMAZ, ŞAHENDER GÜLBİN AYGENCEL; and TÜRKOĞLU, MELDA (2020) "The factors predicting pneumonia in COVID-19 patients: preliminary results from a university hospital in Turkey," Turkish Journal of Medical Sciences: Vol. 50: No. 8, Article 8. https://doi.org/10.3906/sag-2005-385
Available at: https://journals.tubitak.gov.tr/medical/vol50/iss8/8

This Article is brought to you for free and open access by TÜBİTAK Academic Journals. It has been accepted for inclusion in Turkish Journal of Medical Sciences by an authorized editor of TÜBİTAK Academic Journals. For more information, please contact academic.publications@tubitak.gov.tr.
The factors predicting pneumonia in COVID-19 patients: preliminary results from a university hospital in Turkey

Authors
HASAN SELÇUK ÖZGER, PINAR AYSERT YILDIZ, ÜMMÜGÜLSÜM GAYGISIZ, ASİYE UĞRAŞ DİKMEN, ZEHRA DEMIRBAŞ GÜLMEZ, MEHMET YILDIZ, ESİN ŞENOL, KENAN HIZEL, ÖzLEM GÜZEL TUNÇCAN, KAYHAN ÇAĞLAR, GÜLENDAM BOZDAYI, NURDAN KÖKTÜRK, TANSU ULUKAVAK ÇİFTÇİ, ŞAHENDER GÜLBİN AYGENCEL BIKMAZ, and MELDA TÜRKoğlu

This article is available in Turkish Journal of Medical Sciences: https://journals.tubitak.gov.tr/medical/vol50/iss8/8
The factors predicting pneumonia in COVID-19 patients: preliminary results from a university hospital in Turkey

H. Selçuk ÖZGER, Pınar AYSERT YILDIZ, Ümmügülşüm GAYGİSİZ, Asiya UĞRAŞ DİKME, Zehra DEMİRBAŞ, Mehmet YILDIZ, Esin ŞENOL, Kenan HIZEL, Özlem GÜZEL TUNÇCAN, Kayhan ÇAĞLAR, Gülendam BOZDAYI, Nurdan KÖKTÜR, Tansu ULUKAVAK ÇİFTÇİ, Ş. Gülbin AYGENCEL BİKMĂZ, Melda TÜRKOĞLU, Müge AYDOĞDU, Lale KARABIYIK, Abdurrahman TUFAN, Gonca ERBAS, Hüseyin Koray KILIÇ, Ayfer KELEŞ, Fikret BİLDİK, İsa KILIÇARSLAN, Mehmet Akif KARAMERÇAN, Mehmet Ali ASLANER, Ahmet DEMİRÇAN, Mustafa KAVUTCU, Özlem GÜLBAR, Mehmet ARHAN, Hasan BOSTANCI, Hakam TUTAR, Nazlıhan BOY ACI DÜNDAR, İpek Kivlicım OĞUZÜLGEN, Murat DİZBAY

Background/aim: Pneumonia is the most serious clinical presentation of COVID-19. This study aimed to determine the demographic, clinical, and laboratory findings that can properly predict COVID-19 pneumonia.

Materials and methods: This study was conducted in the Gazi University hospital. All hospitalized patients with confirmed and suspected SARS-CoV-2 infection between 16 March 2020 and 30 April 2020 were analyzed retrospectively. COVID-19 patients were separated into two groups, pneumonia and nonpneumonia, and then compared to determine predicting factors for COVID-19 pneumonia. Variables that had a P-value of less than 0.20 and were not correlated with each other were included in the logistic regression model.

Results: Of the 247 patients included in the study 58% were female, and the median age was 40. COVID-19 was confirmed in 70.9% of these patients. Among the confirmed COVID-19 cases, 21.4% had pneumonia. In the multivariate analysis male sex (P = 0.028), hypertension (P = 0.022), and shortness of breath on hospital admission (P = 0.025) were significant factors predicting COVID-19 pneumonia.

Conclusion: Shortness of breath, male sex, and hypertension were significant for predicting COVID-19 pneumonia on admission. Patients with these factors should be evaluated more carefully for diagnostic procedures, such as thorax CT.

Key words: COVID-19, pneumonia, predicting factors

1. Introduction

COVID-19 is an epidemic affecting nearly every country, with over 5.5 million confirmed cases and over 350,000 deaths [1]. About 80% of patients have mild disease, 20% require hospital admission, and approximately 5% require intensive care admission [2]. In Turkey to date, approximately 160,000 COVID-19 cases were identified and 4500 of these patients died [3].

Pneumonia is the most serious clinical presentation of COVID-19, although the majority of infected patients...
(80%) experience a mild disease without pneumonia or only mild pneumonia [4]. Several risk factors for severe COVID-19 pneumonia have been well-defined in the literature. However, the factors predicting COVID-19 pneumonia on hospital admission are not yet clear. Advanced radiological methods (CT and USG) are used in addition to chest X-ray [5]. Use of these methods increases labor and cost and causes additional radiation exposure. Therefore, it is important to evaluate all patients for pneumonia-predicting factors on hospital admission and then decide which tests to perform.

In this study we aimed to evaluate the demographic, clinical, laboratory, and imaging findings of our patients to see which factors are predictive of COVID-19 pneumonia on admission.

2. Methods

2.1. Patients and data extraction
This study was conducted in the Gazi University hospital. All patients with confirmed and suspected SARS-CoV-2 infection hospitalized between 16 March 2020 and 30 April 2020 were analyzed retrospectively. Suspected and confirmed cases were diagnosed according to the criteria of the COVID-19 national guidelines. A suspected case is defined as: (a) fever or at least one of the signs and symptoms of acute respiratory disease (cough and dyspnoea), in which the clinical condition cannot be explained by another cause/disease, and a history of travel abroad 14 days before the onset of symptoms; (b) fever or at least one of the signs and symptoms of acute respiratory disease (cough and dyspnoea) and close contact with a confirmed COVID-19 patient 14 days before the onset of symptoms; (c) fever and at least one of the signs and symptoms of acute respiratory disease (cough and dyspnoea) and close contact with a confirmed COVID-19 patient 14 days before the onset of symptoms; (d) a sudden onset of fever with cough or dyspnoea without rhinorrhea. A confirmed case is defined as any suspected case in which SARS-CoV-2 has been detected by molecular methods [PCR in nasopharyngeal or lower respiratory tract samples (sputum, endotracheal aspirate)] [6].

Patients under 18 years of age were excluded from the study.

This study was approved by the ethical committee of the Gazi University School of Medicine and was conducted according to the Declaration of Helsinki and Good Clinical Practice (25 April 2020, no.: 269).

2.2. Data extraction
A trained team of physicians reviewed and collected the data including patient demographics, comorbidities, home medications, contact history, vital signs, initial laboratory tests, initial electrocardiogram findings, radiological findings, inpatient medications, and outcomes.

Diagnosis of COVID-19 was confirmed by positive real-time reverse transcriptase polymerase chain reaction (RT-PCR) in samples obtained from oropharyngeal and nasopharyngeal sites. The PCR tests were performed in the molecular virology laboratory authorized by the Ministry of Health, General Directorate of Public Health. PCR tests were repeated within 24 h to 48 h in patients with a high suspicion of COVID-19 when the initial PCR test was negative. Patients with two consecutive negative PCR results were considered clinically diagnosed cases in the presence of typical radiological findings for COVID-19 in a thorax CT [7]. COVID-19 positive patients were separated into two groups: pneumonia and nonpneumonia. Pneumonia was diagnosed by clinical signs (dry cough, tachypnea, difficulty in breathing) and imaging findings from chest X-rays. Suspected pneumonia cases were confirmed by CT scan. These two groups were compared in terms of factors predicting COVID-19 pneumonia.

2.3. Statistical analysis
SPSS software for Windows (version 17, IBM, Armonk, NY, USA) was used to analyze the data. Categorical variables were described as frequency rates and percentages, and continuous variables were described using mean, median, and interquartile range (IQR) values. The fitness of the continuous variables to the normal distribution was evaluated with the Kolmogorov–Smirnov test. Means for continuous variables were compared using independent group t-tests when the data were normally distributed; otherwise, the Mann–Whitney U-test was used. Proportions for categorical variables were compared using the χ2 test, although the Fisher exact test was used when the data were limited. In the univariate analysis, variables that had a P-value of less than 0.20 and were not correlated with each other were included in the logistic regression model. Sex, diabetes mellitus, hypertension, fever, dry cough, shortness of breath, lymphopenia, and CRP, D-dimer, and ferritin levels were included in the logistic regression model. Values with a type-I error level of below 5% were considered statistically significant.

3. Results
A total of 247 patients were included in the study. The median age was 40 (IQR 30–52), and 58% were female. A diagnosis of COVID-19 was confirmed by PCR in 70.9% of these patients. Thirty percent of cases had at least one comorbidity. The most common comorbidities were hypertension (36, 14.6%), cardiovascular disease (22, 8.9%), malignancy (21, 8.5%), and diabetes mellitus (19, 7.7%) (Table 1).

Among the COVID-19 confirmed cases 21.4% had pneumonia. The predicting factors for pneumonia were evaluated between two groups (Table 2). In the multivariate
analysis, male sex [OR: 3.51 (95% CI 1.48–10.73), P = 0.028], hypertension [OR: 6.06 (95% CI 1.29–29.41), P = 0.022], and shortness of breath on hospital admission [OR: 4.92 (95% CI 1.22–19.8), P = 0.025] were significant factors predicting COVID-19 pneumonia (Table 3).

4. Discussion
In our study, pneumonia was detected in approximately one-fifth of COVID-19 cases. Male sex, hypertension, and shortness of breath on hospital admission were significant factors for predicting COVID-19 pneumonia.

Table 1. The baseline characteristics of patients on admission.

| Demographic information | No (%) |
|-------------------------|--------|
| Age, median (IQR)       | 40.0 (30–52) |
| Sex                     |        |
| Female                  | 116 (58.0) |
| Male                    | 84 (42.0)  |
| Comorbidities           |        |
| Cardiovascular disease  | 39 (15.8) |
| Hypertension            | 36 (14.6) |
| Coronary artery disease | 17 (6.9)  |
| Congestive heart failure| 5 (2.0)   |
| Malignancy              | 21 (8.5)  |
| Diabetes mellitus       | 19 (7.7)  |
| Chronic obstructive pulmonary disease (COPD) | 13 (5.3) |
| Chronic renal disease   | 4 (1.6)   |
| Active smoker           | 65 (26.3) |
| At least one comorbid disease | 73 (29.6) |
| At least two comorbid diseases | 29 (11.7) |
| Medications             |        |
| Anti-hypertensives      | 34 (13.8) |
| Angiotensin-converting enzyme (ACE) inhibitors | 16 (6.5) |
| Angiotensin receptor blockers (ARB) | 11 (4.5) |
| Others (beta-blocker, calcium channel blocker) | 10 (4.0) |
| Statins                 | 7 (3.5)  |
| NSAI drugs              | 5 (2.0)  |
| Steroids                | 9 (3.6)  |
| Immunosuppressive agents| 18 (7.3) |
| Distribution of cases   |        |
| Confirmed cases         | 175 (70.9) |
| Clinically diagnosed cases | 72 (29.1) |

1Percentages are calculated on the total number of patients.

Male gender and older age were identified as risk factors for COVID-19 disease and a severe clinical course [8–10], although in the current study median age and the percentage of male patients were lower compared to previous studies [8,11,12]. Male sex was found to be a significant factor for predicting COVID-19 pneumonia in this study.

Older age and comorbid diseases are associated with a severe clinical course in COVID-19 cases [10,13]. In a recent metaanalysis, 35.6% of COVID-19 cases had at least one comorbid disease [14]. Comorbidities which are most frequently detected in COVID-19 cases and are proven to be associated with poor prognosis are hypertension, cardiovascular diseases, diabetes, COPD, and active smoking, respectively [10,15,16]. In our study, the relationship between these comorbidities and COVID-19 pneumonia was evaluated, and hypertension was significantly more frequent in patients with pneumonia in the multivariate analysis. We should also take into consideration that two-thirds of cases with pneumonia had no comorbid disease.

In addition to hypertension, the potentially beneficial or harmful effects of ACE inhibitors and ARBs used as an antihypertensive at the onset and the severity of SARS-CoV-2 infection have been discussed [17,18]. These drugs may have a protective effect on disease-related lung injury, although they may increase the risk of SARS-CoV-2 infection. In our study, the use of ACE inhibitors and ARBs in patients with COVID-19 pneumonia was higher than in COVID 19 patients without pneumonia. However, ACE inhibitors or ARBs were not included in the multivariate analysis because of their high correlation with hypertension. Therefore, the role of these antihypertensives in predicting pneumonia was not evaluated in this study.

The most common symptoms in COVID-19 patients were fever, cough, fatigue, and myalgia [19,20]. In the first published data from China, fever was noted during hospital admission in more than 80% of cases, while recent data indicate that fever was detected in only half of the cases [12,13,19–22]. The frequency of fever was much lower in mild COVID-19 cases [23]. In our study, the most common symptoms were cough, fever, shortness of breath, myalgia, and fatigue, respectively. All of these symptoms were more common in patients with pneumonia, but only shortness of breath was predictive of COVID-19 pneumonia. Fever was detected in less than half of the cases of COVID-19 pneumonia on admission, and it was thought that fever is not reliable for predicting COVID-19 pneumonia.

In COVID-19 cases, low levels of oxygen saturation (<88%), lymphocytopenia, D-dimer, ferritin, and AST, LDH, and CRP elevations are shown to be poor prognostic factors at different cut-off values in different cohorts [19,24–26]. In our study these prognostic factors were compared
Table 2. Comparison of confirmed COVID-19 patients with and without pneumonia.

|                  | Pneumonia | Non-pneumonia | P-value |
|------------------|-----------|---------------|---------|
| **Total no = 175** |           |               |         |
| **Age, median (IQR)** | 50 (40–68) | 34 (28–42) | < 0.001 |
| **Sex**          |           |               | 0.046   |
| Female           | 16 (43.2) | 85 (61.6)     |         |
| Male             | 21 (56.8) | 53 (38.4)     |         |
| **Comorbidities**|           |               |         |
| Diabetes mellitus| 5 (13.5)  | 3 (2.2)       | 0.009   |
| Cardivascular disease | 13 (35.1) | 7 (5.1)   | < 0.001 |
| Hypertension     | 12 (32.4) | 6 (4.3)       | < 0.001 |
| Coronary artery disease | 4 (10.8)  | 3 (2.2)   | 0.033   |
| Congestive heart failure | 1 (2.7)   | 2 (1.4)   | 0.622   |
| COPD             | 2 (5.4)   | 2 (1.4)       | 0.197   |
| Asthma           | 4 (10.8)  | 5 (3.6)       | 0.107   |
| Malignancy       | 2 (5.4)   | 2 (1.4)       | 0.197   |
| Active Smoker    | 12 (32.4) | 20 (14.5)     | 0.012   |
| ≥ 1 comorbidities| 17 (45.9) | 13 (9.4)      | < 0.001 |
| ≥ 2 comorbidities| 6 (16.2)  | 5 (3.6)       | 0.005   |
| **Medications**  |           |               |         |
| Anti-hypertensives| 12 (32.4) | 6 (4.3)      | < 0.001 |
| ACE inhibitors or ARB| 8 (21.6) | 4 (2.9)  | < 0.001 |
| Statins          | 2 (5.4)   | 1 (0.7)       | 0.087   |
| NSAI drugs       | 1 (2.7)   | 0 (0.0)       | 0.077   |
| Steroids         | 1 (2.7)   | 1 (0.7)       | 0.365   |
| Immunsuppressive drugs | 2 (5.4)  | 2 (1.4)   | 0.481   |
| **Clinical characteristics** | | | |
| Fever, > 38 °C   | 15 (40.5) | 17 (12.3)     | < 0.001 |
| Dry cough        | 18 (48.6) | 24 (17.4)     | < 0.001 |
| Sore throat      | 4 (10.8)  | 11 (8.0)      | 0.593   |
| Nasal congestion | 5 (5.4)   | 3 (2.2)       | 0.332   |
| Myalgia or fatigue| 13 (35.1)| 10 (7.2)  | < 0.001 |
| Sputum production| 5 (13.5)  | 2 (1.4)       | 0.003   |
| Headache         | 5 (13.5)  | 6 (4.3)       | 0.041   |
| Shortness of breath| 16 (43.2)| 11 (8.0)  | < 0.001 |
| Diarrhea         | 5 (5.4)   | 3 (2.2)       | 0.332   |
| Duration of symptoms, median (IQR) | 3 (3–6.5) | 3 (2–4)   | < 0.085 |
| Tachypnea, > 24 breath/min | 7 (18.9) | 1 (0.7)  | < 0.001 |
| Oxygen saturation < 90% | 6 (16.2) | 0         | < 0.001 |
| Requirement of oxygen support at admission | 6 (16.2) | 0 | < 0.001 |
| **Laboratory Findings at hospital admission** | | | |
| Leukocytopenia < 4000 / mm³ | 20 (54.1) | 58 (42.6) | 0.216   |
| Lymphocytopenia < 800 / mm³ | 10 (27.0) | 4 (2.9)  | < 0.001 |
Table 2. (Continued).

| Anemia                              | 11 (29.7) | 17 (12.5) | 0.012 |
|-------------------------------------|-----------|-----------|-------|
| Female: Hgb < 12 g/dL               |           |           |       |
| Male: Hgb < 13 g/dL                 |           |           |       |
| Thrombocytopenia < 150×10³/mm³³    | 5 (13.5)  | 10 (7.4)  | 0.261 |
| ALT > 50 U/L                        | 7 (18.9)  | 4 (3.0)   | 0.002 |
| AST > 50 U/L                        | 5 (13.1)  | 2 (1.5)   | 0.004 |
| Creatinine > 1.1 mg/dL              | 4 (10.8)  | 3 (2.2)   | 0.036 |
| LDH > 248 U/L                       | 22 (59.5) | 22 (16.5) | < 0.001 |
| Troponin > 5 ng/L                   | 17 (49.5) | 15 (11.3) | < 0.001 |
| Prothrombin time (> 14.7 sec)       | 9 (24.3)  | 31 (24.0) | 0.971 |
| D-dimer > 1000 ng/mL                | 10 (27.0) | 5 (4.3)   | < 0.001 |
| Fibrinogen < 200                    | 1 (2.9)   | 5 (4.3)   | 0.730 |
| Ferritin > 800 ng/mL                | 4 (11.8)  | 2 (1.7)   | 0.019 |
| Creatine kinase > 170 U/L           | 11 (32.4) | 19 (14.6) | 0.017 |
| C-reactive protein > 40 mg/dL       | 12 (32.4) | 6 (4.5)   | < 0.001 |
| Procalcitonin > 0.5 ng/mL           | 1 (2.7)   | 5 (3.8)   | 0.751 |

**Outcomes**

| ICU care | 7 (18.9) | 0 (0.0) | < 0.001 |
|----------|----------|---------|---------|
| Mortality| 2 (5.4)  | 0 (0.0) | < 0.001 |
| Length of hospital stay, median (IQR) | 5.5 (4–8.5) | 1 (1–3) | < 0.001 |
| ICU care | 7 (18.9) | 0 (0.0) | < 0.001 |

COPD: Chronic Obstructive Pulmonary Disease, ACE: Angiotensin-converting enzyme, ARB: Angiotensin receptor blockers, NSA: Non-steroidal anti-inflammatory, AST: Aspartate aminotransferase, ALT: Alanine aminotransferase, ICU: intensive care unit

1Percentages are calculated on the total number of patients.

2Asymptomatic patients were excluded.

Table 3. Multivariate analysis of predicting factors for COVID-19 pneumonia.

|                        | B     | S.E.  | Wald   | Sig.   | Exp(B) | 95% CI           |
|------------------------|-------|-------|--------|--------|--------|------------------|
|                        |       |       |        |        |        | Lower            | Upper             |
| Male Sex               | 1.256 | 0.570 | 4.849  | 0.028  | 3.511  | 1.148            | 10.738            |
| Diabetes mellitus      | 1.007 | 1.050 | 0.920  | 0.337  | 2.737  | 0.350            | 21.416            |
| Hypertension           | 1.802 | 0.788 | 5.224  | 0.022  | 6.060  | 1.293            | 28.410            |
| CAD                    | −1.457| 1.428 | 1.041  | 0.308  | 0.233  | 0.014            | 3.824             |
| Fever                  | 0.836 | 0.696 | 1.442  | 0.230  | 2.306  | 0.590            | 9.021             |
| Dry cough              | 0.650 | 0.633 | 1.053  | 0.305  | 1.915  | 0.554            | 6.627             |
| Shortness of breath    | 1.594 | 0.711 | 5.024  | 0.025  | 4.926  | 1.222            | 19.859            |
| Lymphocytopenia < 800 ×10³/L | 0.489 | 1.092 | 0.201  | 0.654  | 1.631  | 0.192            | 13.870            |
| CRP > 40 mg/dL         | 0.617 | 0.893 | 0.477  | 0.490  | 1.852  | 0.322            | 10.654            |
| D-dimer > 1000 ng/mL   | 1.444 | 0.875 | 2.723  | 0.099  | 4.237  | 0.763            | 23.541            |
| Ferritin > 800 ng/mL   | 0.670 | 1.471 | 0.208  | 0.648  | 1.955  | 0.109            | 34.923            |

Hosmer and Lemeshow Test: P = 0.682

B: unstandardized regression weight, CI: confidence interval, OR: odds ratio, SE: standard error, CAD: Coronary artery disease, CRP: C-reactive protein
between pneumonia and nonpneumonia groups. In spite of a low level of oxygen saturation, lymphocytopenia, AST/ALT, creatinine, LDH, ferritin, CRP, and D-dimer levels were high in the pneumonia group; no significant relationship was found in multivariate analysis. This might be due to the low number of patients who required intensive care support among COVID-19 pneumonia cases in our study.

This study has several limitations. Our data was collected retrospectively from a single center, and the number of cases was limited. Therefore, patients with COVID-19 pneumonia have not been evaluated according to disease severity. In addition, we could not assess the risk factors for poor outcome, because the number of critically ill patients was low.

In conclusion, shortness of breath, male sex, and hypertension were significant factors for predicting COVID-19 related pneumonia on admission. Patients who have these predicting factors should be evaluated more carefully for further diagnostic procedures, such as thorax CT.

Acknowledgments/disclaimers/conflicts of interest
None to declare.

References
1. World Health Organization (2020). Coronavirus disease (COVID-19) situation report – 126 [online]. Website https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports [accessed 15 May 2020].
2. Wu C, Chen X, Cai Y, Xia J, Zhou X et al. Risk factors associated with acute respiratory distress syndrome and death in patients with coronavirus disease 2019 pneumonia in Wuhan, China. Journal of Medical Association Internal Medicine 2020; e200994. [Online ahead of print] doi: 10.1001/jama.2020.6775
3. T.C. Sağlık Bakanlığı (2020). Tükiye günlük koronavirüs tablosu [online]. Website https://covid19.saglik.gov.tr/ [accessed 28 May 2020].
4. Yuki K, Fujiogi M, Koutsogiannaki S. COVID-19 pathophysiology: a review. Clinical Immunology 2020; 215: 108427. doi: 10.1016/j.clim.2020.108427
5. World Health Organisation (2020). Clinical management of COVID-19 interim guidance [online]. Website https://www.who.int/publications/i/item/clinical-management-of-covid-19 [accessed 28 May 2020].
6. T.C. Sağlık Bakanlığı (2020). COVID-19 (SARS-CoV-2 enfeksiyonu) rehberi. Website https://covid19bilgi.saglik.gov.tr/tr/covid-19-rehberi.html [accessed 14 May 2020].
7. Simpson S, Kay FU, Abbara S, Bhalla S, Chung JH et al. Radiological society of North America expert consensus statement on reporting chest ct findings related to COVID-19. Endorsed by the society of thoracic radiology, the American college of radiology, and RSNA. Journal of Thoracic Imaging 2020. [Online ahead of print] doi: 10.1097/RTI.0000000000000524
8. Myers LC, Parodi SM, Escobar GJ, Liu VX. Characteristics of hospitalized adults with COVID-19 in an integrated health care system in California. Journal of the American Medical Association 2020; 323 (21): 2195-2198. doi: 10.1001/jama.2020.7202
9. Xie J, Tong Z, Guan X, Du B, Qiu H. clinical characteristics of patients who died of coronavirus disease 2019 in China. Journal of the American Medical Association Network Open 2020; 3 (4): e205619. doi: 10.1001/jamanetworkopen.2020.5619
10. Zheng Z, Peng F, Xu B, Zhao J, Liu H et al. Risk factors of critical & mortal COVID-19 cases: a systematic literature review and meta-analysis. The Journal of Infection 2020. [Online ahead of print] doi: 10.1016/j.jinf.2020.04.021
11. Richardson S, Hirsch JS, Narasimhan M, Crawford JM, McGinn T et al. Presenting characteristics, comorbidities, and outcomes among 5700 patients hospitalized with COVID-19 in the New York City area. Journal of the American Medical Association 2020; 323 (20): 2052-2059. doi: 10.1001/jama.2020.6775
12. Fu L, Wang B, Yuan T, Chen X, Ao Y et al. Clinical characteristics of coronavirus disease 2019 (COVID-19) in China: a systematic review and meta-analysis. Journal of Infection 2020; 80 (6): 656-665. doi: 10.1016/j.jinf.2020.03.041
13. Yang J, Zheng Y, Gou X, Pu K, Chen Z et al. Prevalence of comorbidities and its effects in coronavirus disease 2019 patients: a systematic review and meta-analysis. International Journal of Infectious Diseases 2020; 94: 91-95. doi: 10.1016/j.ijid.2020.03.017
14. Cao Y, Liu X, Xiong L, Cai K. Imaging and clinical features of patients with 2019 novel coronavirus SARS-CoV-2: a systematic review and meta-analysis. Journal of Medical Virology 2020; 1-11. [Online ahead of print] doi: 10.1002/jmv.25822
15. Zhao Q, Meng M, Kumar R, Wu Y, Huang J et al. The impact of COPD and smoking history on the severity of Covid-19: a systematic review and meta-analysis. Journal of Medical Virology 2020; 1-7. [Online ahead of print] doi: 10.1002/jmv.25889
16. Zuin M, Rigatelli G, Zuliani G, Rigatelli A, Mazza A et al. Arterial hypertension and risk of death in patients with COVID-19 infection: systematic review and meta-analysis. Journal of Infection 2020; 81 (1): e84-86. doi: 10.1016/j.jinf.2020.03.059.
17. Guo J, Huang Z, Lin L, Ly J. Coronavirus disease 2019 (COVID-19) and cardiovascular disease: a viewpoint on the potential influence of angiotensin-converting enzyme inhibitors/angiotensin receptor blockers on onset and severity of severe acute respiratory syndrome coronavirus 2 infection. Journal of the American Heart Association 2020; 9 (7): e016219. doi: 10.1161/JAHA.120.016219
18. Clerkin KJ, Fried JA, Raikhelkar J, Sayer G, Griffin JM et al. COVID-19 and cardiovascular disease. Circulation 2020; 141 (20): 1648-1655. doi: 10.1161/CIRCULATIONAHA.120.046941

19. Cevik M, Bamford C, Ho A. COVID-19 pandemic - a focused review for clinicians. Clinical Microbiology and Infection 2020. [Online ahead of print] doi: 10.1016/j.cmi.2020.04.023

20. Li LQ, Huang T, Wang YQ, Wang ZP, Liang Y et al. COVID-19 patients' clinical characteristics, discharge rate, and fatality rate of meta-analysis. Journal of Medical Virology 2020. [Online ahead of print] doi: 10.1002/jmv.25757

21. Guan WJ, Ni ZY, Hu Y, Liang WH, Ou CQ et al. Clinical characteristics of coronavirus disease 2019 in China. New England Journal of Medicine 2020; 382 (18): 1708-1720. doi: 10.1056/NEJMoia2002032

22. Tian S, Hu N, Lou J, Chen K, Kang X et al. Characteristics of COVID-19 infection in Beijing. Journal of Infection 2020; 80 (4): 401-406. doi: 10.1056/NEJMoia2002032

23. Kim GU, Kim MJ, Ra SH, Lee J, Bae S et al. Clinical characteristics of asymptomatic and symptomatic patients with mild COVID-19. Clinical Microbiology and Infection 2020. [Online ahead of print] doi: 10.1016/j.cmi.2020.04.040

24. Zhou F, Yu T, Du R, Fan G, Liu Y 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 (10229): 1054-1062. doi: 10.1016/S0140-6736(20)30566-3

25. Wang D, Hu B, Hu C, Zhu F, Liu X et al. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. Journal of American Medical Association 2020; 323 (11): 1061-1069. doi: 10.1001/jama.2020.1585

26. Zhao Q, Meng M, Kumar R, Wu Y, Huang J et al. Lymphopenia is associated with severe coronavirus disease 2019 (COVID-19) infections: a systematic review and meta-analysis. International Journal of Infectious Diseases 2020; 96: 131-135. doi: 10.1016/j.ijid.2020.04.086