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What are the factors that affect post COVID 1st month's continuing symptoms?

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Abstract

Aim: The aim of our research was to investigate retrospectively the relationship between the symptoms and general characteristics, initial laboratory values and treatments in patients who had COVID-19 and who applied to the chest diseases outpatient clinic for control after 1 month.

Method: Three hundred fifteen patients who were diagnosed with COVID-19 and applied to the chest diseases outpatient clinic between May 2020 and August 2020 for control in the 1st month were included in the study. Patient information was collected from the hospital information system and the e-pulse system.

Results: Females accounted for 50.2% of our patients and their mean age was 47.9 ± 14.8 (19-88) years. About 14.3% (n: 45) of the individuals were 65 years of age and older, 20.6% (n: 65) of our patients were smoking and 70.2% (n: 221) of our patients were treated at home. A total of 133 patients had at least one comorbid disease. The patients most frequently reported cough, dyspnoea, weakness, myalgia and diarrhoea. The most common symptoms were cough, dyspnoea, weakness and myalgia in the 1st month. Initial D-dimer, initial CRP and the values of platelet, D dimer and CRP in the 1st month were detected to be higher in patients with persistent symptoms when the laboratory values of patients whose symptoms continue after 1 month were examined. It was determined that the symptoms had persisted in patients who had been hospitalised, had dual therapy, had comorbid diseases and had more common pathologies in their pulmonary imaging.

Conclusion: Symptoms may persist for a long time in hospitalised patients, in patients with COVID-19–related pneumonia and concomitant chronic diseases and in patients with high D-dimer and high CRP at the time of admission. Patients are informed that their symptoms may last for a long time, unnecessary hospital admissions can be avoided.

1 | INTRODUCTION

In studies conducted on reports of pneumonia cases with unknown aetiology in Wuhan, China's Hubei Province, on 31 December 2019, it was determined that a new coronavirus (2019-nCoV) had not been detected in humans before and that the name of the disease had been accepted as COVID-19. Patients can present with asymptomatic or flu-like symptoms. It may show a different clinical

course from pneumonia to respiratory failure and may have a fatal course.[1,2] Fever, cough, shortness of breath, myalgia and fatigue are most common; sputum, haemoptysis, loss of sense of smell and taste, sore throat, headache, chest pain, diarrhoea are also common symptoms of COVID-19 infection.[3,4] In mild cases, symptoms continue for 2 weeks. It goes on for up to 3-6 weeks in severe cases. Symptoms can get worse in a week or so. Approximately 2-8 weeks after the onset of symptoms, deaths were also seen. It was found that some symptoms also existed in the outpatient clinic controls. The aim of our research was to investigate retrospectively the relationship between the symptoms and general characteristics, initial laboratory values and treatments in patients who had Covid 19 and who applied to the chest diseases outpatient clinic for control after 1 month.

2 | MATERIALS AND METHODS

Three hundred fifteen patients who were diagnosed with COVID-19 and applied to the chest diseases outpatient clinic between May 2020 and August 2020 for control in the 1st month were included in the study. Patient information were collected from the hospital information system and the e-pulse system. Patients' general characteristics (age, gender, history of smoking, treatment regimen and additional diseases), initial symptoms and ongoing symptoms within the 1st month, radiological characteristics, laboratory parameters (haemogram values, inflammatory markers and D-dimer) and hospitalisation status were reported. All patients were diagnosed of COVID-19 by Reverse-Transcriptase Polymerase Chain Reaction (RT-PCR) test. The approval for the study was obtained from the Medical Specialty Education Board of our hospital (689-27/8/2020).

3 | STATISTICAL ANALYSIS

The data obtained were evaluated in a computer environment using the IBM-SPSS (Version 20.0) statistical package program. For descriptive statistics, mean, standard deviation, minimum-maximum, median and 25-75 quartile values were used. Categoric variables were compared with the Pearson Chi-Square test. The Shapiro-Wilk test was used to compare continuous results, and the Mann-Whitney U and Kruskal-Wallis tests were used because, as a result of the normality test, they did not comply with the normal distribution. McNemar and Wilcoxon tests were used for dependent group comparisons. For statistical significance, $P \leq .05$ has been accepted.

4 | RESULTS

Females accounted for 50.2% (n:158) of our patients and their mean age was 47.9 ± 14.8 (19-88) years. 14.3% (n: 45) of the individuals were 65 years of age and older, 34.3% (n: 108) had no findings in their lung computed tomography (CT) and chest X-rays, 20.6% (n:

What's known

- Long COVID is the name used by patients to identify symptoms of COVID-19 that persist after acute illness.
- The working definitions of "post-acute" (symptoms after 3-4 weeks) and "chronic" (symptoms after 12 weeks) COVID-19 have not yet been officially confirmed.
- The cause of persistent symptoms is unknown, but it probably involves several different mechanisms of disease, including an inflammatory reaction with a vasculitic component.

What's new

- If patients with D-dimer and CRP elevation at the time of COVİD-19 diagnosis with concomitant diseases and with widespread pneumonia in Thorax computed tomography are informed that their symptoms may last for a long time.
- Does this contribute to the reduction of unnecessary hospital admissions?

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65) of our patients were smoking and 70.2% (n: 221) of our patients were treated at home. A total of 133 (42.2%) patients had at least one comorbid disease. Hypertension (HT) was determined in 43 (32.3%) patients, asthma was determined in 29 (21.8%) patients, diabetes mellitus (DM) was determined in 25 (18.7%) patients, coronary artery disease (CAD) was determined in 15 (11.2%) patients, chronic obstructive pulmonary disease (COPD) was determined in 12 (9%) patients, neurological disease was determined in 7 (5%) patients, a history of malignancy was determined in 7 (5%) patients (two patients with lung cancer, three patients with thyroid cancer, one patient with brain cancer, one patient with osteosarcoma), hypothyroidism was determined in 5 (3.7%) patients, rheumatological disease was determined in 4 (3%) patients, renal failure 3 (2.2%) patients and bronchiectasis was determined in 3 (2.2%) patients. In addition to treatment with Favipiravir and/or Hydroxychloroquine, 47 (14.9%) patients received empiric antibiotic therapy, 33 (10.4%) patients received corticosteroid therapy and 23 (7%) patients received both antibiotic and corticosteroid therapy, 119 (37.7%) patients received prophylactic enoxaparin and 4 patients received enoxaparin at the therapeutic dose. The general characteristics of the study group are presented in Table 1. When the symptoms of the study group were evaluated, while 7% (n: 22) of the subjects were asymptomatic in the first part of the study, 27.3% (n: 86) of the subjects were found to be asymptomatic in the 1-month period ($P < .001$). It was found that the symptoms of fever myalgia, diarrhoea, dyspnoea, cough, loss of taste and smell and sore throat decreased within 1 month of the first period when the contrast of the two periods was examined (Table 2). The symptom distribution of the study group by period is shown in Table 2. The median lymphocyte percent was 26.0 (17.7-33.5) in the first part of the analysis, and 27.0 (21.2-34.2) in the calculation one

TABLE 1 General characteristics of the study group

	N	%
Gender		
Female	158	50.2
Male	157	49.8
Age		
<65	270	85.7
≤65	45	14.3
Thorax CT		
No	108	34.3
Ground-glass opacities	160	50.8
Ground-glass opacities and thrombus	4	1.3
Consolidation	30	9.5
Consolidation + ground-glass opacities	12	3.8
Nodular infiltration	1	0.3
Chest X-rays		
Normal	108	34.3
Infiltration	207	65.7
Treatment		
Favipiravir	185	58.7
Favipiravir and Hidroksiklorokin	52	16.5
Hidroksiklorokin	78	24.8
Smoking behavior		
Non smoker	197	62.5
Ex-smoker	53	16.8
current smoker	65	20.6
Treatment place		
Hospital	94	29.8
Home	221	70.2
Comorbidities		
No	182	57.7
Yes	133	42.2

Abbreviation: CT, computed tomography.

month later, when certain laboratory values of the study group were analysed, and there was no difference between the two times. In our study, no statistically significant difference was found between age, gender and smoking status (P > .005 for each) when the distribution of individuals with persistent symptoms was examined after 1 month. It was determined that the symptoms had persisted in patients who had been hospitalised, had dual therapy, had comorbid diseases and had more common pathologies in their pulmonary imaging (Table 3). A total of 182 (57.7%) patients had no comorbidities, 115 (63.1%) of those without comorbidity continued to have symptoms in the 1st month. 114 (75.4%) of those with comorbid diseases continued to have symptoms in the 1st month. Table 3 describes the distribution of general characteristics of the study group according to the occurrence of symptoms after 1 month. All patients

TABLE 2 Distribution of symptoms of the study group by periods

	First		After 1 mo		Test value
	N	%	N	%	P
Fever					
No	216	68.6	310	98.4	<.001
Yes	99	31.4	5	1.6	
Weakness					
No	248	78.7	246	78.1	.913
Yes	67	21.3	69	21.9	
Myalgia					
No	223	70.8	273	86.7	<.001
Yes	92	29.2	42	13.3	
Diarrhoea					
No	305	96.8	314	99.7	.004
Yes	10	3.2	1	0.3	
Dyspnoea					
No	223	70.8	242	76.8	.023
Yes	92	29.2	73	23.2	
Cough					
No	195	61.9	265	84.1	<.001
Yes	120	38.1	50	15.9	
Loss of taste and smell					
No	291	92.4	313	99.4	<.001
Yes	24	7.6	2	0.6	
Sore throat					
No	287	91.1	314	99.7	<.001
Yes	28	8.9	1	0.3	
Sputum					
No	304	96.5	312	99.0	.057
Yes	11	3.5	3	1.0	
Other					
No	275	87.3	288	91.4	.106
Yes	40	12.7	27	8.6	
At least one symptom					
No	22	7.0	86	27.3	<.001
Yes	293	93.0	229	72.7	

Note: McNemar Test was used.

received corticosteroid therapy had at least one symptom in the 1st month (P < .001). Initial D-dimer, initial CRP and the values of platelet, D dimer and CRP in the 1st month were detected to be higher in patients with persistent symptoms when the laboratory values of patients whose symptoms continue after 1 month were examined. No difference was found between the values of initial Neutrophil%, Lymphocyte% and NLR and the 1st month (Table 4). The distribution of laboratory values for the study group based on the presence of symptoms after 1 month is shown in Table 4. In the subgroup analysis, no statistical difference was found in the initial and 1st month

TABLE 3   Distribution of general characteristics of the study group according to the presence of symptoms 1 mo later

	After 1 mo				Test value
	No symptoms		Symptoms		
	N	%	N	%	P
Gender					
Female	41	47.7	117	51.1	.589
Male	45	52.3	112	48.9	
Age					
<65	78	90.7	192	83.8	.121
≤65	8	9.3	37	16.2	
Thorax CT					
No	48	55.8	60	26.2	<.001
Ground-glass opacities	31	36.0	129	56.3	
Ground-glass opacities and thrombus	—	—	4	1.7	
Consolidation	5	5.8	25	10.9	
Consolidation +ground-glass opacities	2	2.3	10	4.4	
nodular infiltration	—	—	1	0.4	
Chest X-rays					
Normal	48	55.8	60	26.2	<.001
Infiltration	38	44.2	169	73.8	
Treatment					
Favipiravir	45	52.3	140	61.1	.004
Favipiravir and Hydroxychloroquine	9	10.5	43	18.8	
Hydroxychloroquine	32	37.2	46	20.1	
Smoking behavior					
Non smoker	46	53.5	151	65.9	.117
Ex-smoker	17	19.8	36	15.7	
Current smoker	23	26.7	42	18.3	
Treatment place					
Hospital	8	9.3	86	37.6	.001
Home	78	90.7	143	62.4	
Comorbidities					
No	68	79	114	49	<.001
Yes	18	21	115	51	

Note: X^2 test was used.

Abbreviation: CT, computed tomography.

NLR values. The distribution of laboratory values by treatment received by the research group is shown in Table 5.

5 | DISCUSSION

In our study, the female-male ratio and the rate of comorbid diseases were similar to the literature. Cardiovascular diseases, chronic lung diseases and DM were the most common accompanying diseases. Our average age was 47.9 ± 14.8 years of age. The patients %70 were given treatment at home. In the 1st month, all our patients were alive due to mild to moderate cases and younger patients. The fact that we have a younger population compared with China and the USA explains this situation. The infection of COVID-19 can affect both men and women. However, its incidence and severity is higher in males than in females. A study of 138 hospitalised patients with COVID-19 showed that the median age was 56 years and 75 (54.3%) were male while 63 (45.7%) were female.[5] Almost half (46.4%) of patients had an underlying health condition in a retrospective analysis (n = 138) of patients with COVID-19.[5]

The most COVID-19 cases (>70%) show ground-glass opacities with consolidation and interstitial and/or interlobular septal thickening in Thorax CT.[12] COVID-19 predominant CT findings are

TABLE 4 Distribution of laboratory values of the study group according to the presence of symptoms after 1 mo

	After 1 mo						Test value
	No symptoms			Symptoms			
	Median	25 th percent	75 th percent	Median	25 th percent	75 th percent	P
First neutrophil %	58.80	50.40	67.55	62.55	55.75	70.25	.092
First lymphocyte %	26.70	21.00	35.65	24.90	17.40	32.15	.110
First NLR	2.25	1.47	3.24	2.48	1.76	3.78	.084
First platelet	228.00	188.50	270.50	237.50	191.50	279.00	.558
First D-dimer	0.32	0.21	0.53	0.46	0.26	0.90	.009
First ferritin	73.00	18.40	188.00	86.00	25.00	211.00	.586
First CRP	4.44	1.42	14.36	12.00	3.90	41.00	<.001
After 1 mo neutrophil %	58.10	49.20	63.40	59.10	52.00	66.00	.219
After 1 mo lymphocyte %	28.70	22.00	36.00	26.70	19.80	33.70	.194
After 1 mo NLR	2.10	1.56	2.67	2.21	1.57	3.09	.185
After 1 mo platelet	247.50	215.00	282.00	280.00	233.00	343.00	.011
After 1 mo D-dimer	0.37	0.20	0.53	0.44	0.27	0.74	.021
After 1 mo ferritin	47.00	13.00	138.00	65.30	23.00	235.00	.106
After 1 mo CRP	0.00	0.00	2.00	62.55	55.75	70.25	<.001

Note: Mann-Whitney *U* test was used.

Abbreviations: CRP, C-reactive protein; NLR, neutrophil/lymphocyte ratio.

bilateral, peripheral and basal predominant ground-glass opacity, consolidation or both.[6] Air bubble signs and nodules are rare findings.[7,8] In 3%-13% of COVID-19 pneumonia patients. nodules were identified,[9,10] which was lower than that seen in other types of viral pneumonia.[11] All but one of the patients had at least one ground-glass or consolidation on their CT scans. Nodular infiltration has been observed in one patient. Ground-glass opacity with or without consolidation is the main feature of the disease. The most common symptoms were fever (98%) followed by cough (76%) with more than half (55%) of patients developing dyspnoea in a study (n = 41) conducted by Huang et al in patients with confirmed COVID-19 infection.[3] In a large study (n = 1.099) from China. Guan et al reported that 67.8% of COVID-19 patients had cough while 33% had sputum production and 18.7% had shortness of breath.[12] In a retrospective study (n = 138) of hospitalised COVID-19 patients, 10% of patients reported nausea and diarrhoea.[5] A variety of studies have recorded a wide incidence rate of asymptomatic infections ranging from 1.6% to 56.6%.[13-19] Asymptomatic patients typically experience none of the aforementioned clinical signs and/or symptoms. according to these studies. Furthermore, this subgroup of patients has few to no radiological imaging anomalies. While some with asymptomatic infection may develop into symptomatic cases, most progress is without clinical deterioration. The most common symptoms recorded in our research were fever, cough, shortness of breath, weakness and myalgia. Seven percent of our patients were initially asymptomatic.

It has been accepted that smoking raises the risk of viral infections and influenza. Similar knowledge has been accepted for the COVID-19 pandemic. Smoking has been reported to be correlated with the incidence of the disease and the seriousness of the clinical course.[20] Of our patients 20.6 per cent (n: 65) have been smoked.

No drugs for effective treatment of COVID-19 have been approved to date.[21,22] Treatment is tailored to the severity of the condition and individual heterogeneity. Updated periodically from the beginning of the pandemic in our country, according to TC The Scientific Advisory Board of the Ministry of Health Adult Patient Management Guidelines, if there are no contraindications, hydroxychloroquine and/or favipiravir treatment is recommended for patients with COVID-19. 58.7% of our patients received favipiravir, 24.8% received hydroxychloroquine and 16.5% received favipiravir and hydroxychloroquine. The symptoms of patients who received dual therapy at the beginning of treatment were observed to continue in the 1st month. This situation can be explained by the fact that these patients are heavier than other patients at the time of diagnosis and require more hospitalisation. Long COVID is the name used by patients to identify symptoms of COVID-19 that persist after acute illness.[23] The working definitions of "post-acute" (symptoms after 3-4 weeks) and "chronic" (symptoms after 12 weeks) COVID-19 have not yet been officially confirmed.[24,25] People with long COVID experience a confounding variety of recurrent and fluctuating symptoms, including cough, dyspnoea, fever, sore throat, chest pain, palpitations, cognitive deficiencies, myalgia, neurological symptoms, skin rashes and diarrhoea[24,26-30]; some of which also have persistent or intermittent low oxygen saturation.[31] In our study, cough, dyspnoea, weakness and myalgia were the most common in the 1st month. It was determined that the symptoms had persisted in patients who had been hospitalised, had dual therapy, had comorbid

TABLE 5 Distribution of laboratory values according to the treatment received by the study group

Treatment	Favipiravir[1]			Favipiravir and Hydroxychloroquine[2]			Hydroxychloroquine[3]			Test value
	Median	25 th percent	75 th percent	Median	25 th percent	75 th percent	Median	25 th percent	75 th percent	P
First neutrophil %	62.15	54.80	70.20	63.75	57.35	71.20	57.50	49.00	68.20	.179
First lymphocyte %	26.55	17.50	33.30	23.25	16.75	31.95	26.35	19.30	34.90	.487
First NLR	2.45	1.69	3.65	3.02	1.91	3.80	2.24	1.57	3.58	.286
First platelet	224.00	191.00	283.00	221.50	182.00	255.00	250.00	212.00	290.00	.066
First D-dimer	0.45	0.26	0.83	0.54	0.35	0.99	0.26	0.19	0.45	<.001
First ferritin	62.90	19.10	211.00	120.40	41.20	262.00	104.50	27.35	182.50	.389
First CRP	13.00	4.00	44.33	9.20	3.19	23.20	3.31	1.44	7.77	<.001
After 1 month neutrophil %	57.40	52.50	65.80	60.00	49.50	65.85	59.80	52.70	64.70	.964
After 1 month lymphocyte %	25.85	17.95	32.70	24.55	18.75	33.35	31.40	26.00	36.20	.005
After 1 month NLR	2.29	1.62	3.21	2.28	1.54	3.38	1.96	1.46	2.47	.053
After 1 month platelet	282.00	232.50	343.50	267.00	229.00	337.00	244.00	221.00	291.50	.058
After 1 month D-dimer	0.42	0.30	0.80	0.46	0.31	0.68	0.30	0.19	0.55	.014
After 1 month ferritin	73.00	22.00	265.00	57.00	29.10	194.00	48.55	11.00	157.35	.382
After 1 month CRP	0.40	0.00	4.50	3.29	0.87	7.00	0.54	0.00	2.27	<.001

Note: Kruskal-Wallis Test was used. First D-dimer 1-2:0.357 1-3:<0.001 2-3:<0.001, First CRP 1-2:0.422 1-3: <0.001 2-3:0.058, After 1 mo D-dimer 1-2:1.000 1-3:0.024 2-3:0.033, After 1 mo CRP 1-2:<0.001 1-3:1.000 2-3: <0.001.

Abbreviations: CRP, C-reactive protein; NLR, neutrophil/lymphocyte ratio.

diseases and had more common pathologies in their pulmonary imaging. Also, all patients who started corticosteroid therapy at the beginning had at least one symptom in the 1st month. Corticosteroid therapy was thought to be related to the initiation of patients with severe pneumonia. The cause of persistent symptoms is unknown, but it probably involves several different mechanisms of disease, including an inflammatory reaction with a vasculitic component.[32] Recent studies estimated that 10%-20% of people are still ill after 3 weeks and 1-3% are still severely ill after 12 weeks.[25,33] In individuals with conditions such as asthma, diabetes and autoimmune disorders, mainstream medical opinion considers them more common (though they are also known to occur in those with no pre-existing conditions),[26,27,33,34] in those who have been admitted to hospital.[27,28,33] This study found that 87.4% reported persistence with at least 1 symptom, particularly fatigue and dyspnoea, in patients who had recovered from COVID-19.[27] They subsequently complained of a relapse of chronic symptoms, in particular myalgia, extreme weakness, fever, dyspnoea, tightness of the chest, tachycardia, headaches and anxiety.[35] Interestingly few of them show biological anomalies (no lymphocytopenia or elevated C-reactive protein in particular) and in rare cases, chest computed tomographic scan traces of infection.[35] COVID-19 laboratory markers are not specific and are of minimal clinical benefit.[36] Lymphocytopenia and an increase in CRP values are the most commonly reported laboratory anomalies in the literature.[37,38] In our study, when the laboratory values of individuals whose symptoms continued after 1 month were examined both the initial and 1 month later D-dimer and CRP values were found to be higher for those with symptoms. D-dimer levels are commonly increased in patients infected with COVID-19. Significantly higher levels are found in those with critical illness and can be used as a prognostic marker for in-hospital mortality.[39]

6 | CONCLUSION

Symptoms may persist for a long time in hospitalised patients, in patients with COVID-19-related pneumonia and concomitant chronic diseases and in patients with high d-dimer and high CRP at the time of admission. Patients are informed that their symptoms may last for a long time, unnecessary hospital admissions can be avoided.

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REFERENCES

1. Zhou P, Yang XL, Wang XG, et al. A pneumonia outbreak associated with a new coronavirus of probable bat origin. *Nature*. 2020;579:270-273.
2. Cao YR, Cao Q-D, Hong Z-S, 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.
3. Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet*. 2020;395:497-506.
4. Zhu W, Xie K, Lu H, et al. in two emergency departments outside of Hubei, China. *J Med Virol*. 2020;92:1525–1532. doi:10.1002/jmv.25763
5. Wang D, Hu B, Hu C, et al. Clinical characteristics of 138 hospitalized patients with 2019, novel coronavirus-infected pneumonia in Wuhan, China. *JAMA*. 2020;323:1061-1069.
6. Akcay S, Ozlu T, Yilmaz A. Radiological approaches to COVID-19 pneumonia. *Turk J Med Sci*. 2020;50:604-610.
7. 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;1-6.
8. Shi H, Han X, Jiang N, et al. Radiological findings from 81 patients with COVID-19 pneumonia in Wuhan, China: a descriptive study. *Lancet Infect Dis*. 2020;20:425-434.
9. Ai T, Yang Z, Hou H, et al. Correlation of chest CT and RT-PCR testing in coronavirus disease 2019 (COVID-19) in China: a report of 1014 cases. *Radiology*. 2020;296:E32-E40.
10. Li X, Zeng X, Liu B, Yu Y. COVID-19 infection presenting with CT halo sign. *Radiology*. 2020;2:e200026.
11. Franquet T. Imaging of pulmonary viral pneumonia. *Radiology*. 2011;260:18-39.
12. Guan WJ, Ni ZY, Hu Y, et al. Clinical characteristics of coronavirus disease 2019 in China. *N Engl J Med*. 2020;382:1708-1720.
13. Recalcati S. Cutaneous manifestations in COVID-19: a first perspective. *J Eur Acad Dermatol Venereol*. 2020;34:e212-e213.
14. Zhonghua LX, Bing X, Za Z; Epidemiology Working Group for Ncip Epidemic Response CCfDC. Prevention. [The epidemiological characteristics of an outbreak of 2019 novel coronavirus diseases (COVID19) in China]. *Zhonghua Liu Xing Bing Xue Za Zhi*. 2020;41:145-151.
15. Nishiura H, Kobayashi T, Miyama T, et al. Estimation of the asymptomatic ratio of novel coronavirus infections (COVID-19). *Int J Infect Dis*. 2020;94:154-155.
16. Mizumoto K, Kagaya K, Zarebski A, Chowell G. Estimating the asymptomatic proportion of coronavirus disease 2019. (COVID-19) cases on board the Diamond Princess cruise ship, Yokohama, Japan, 2020. *Eurosurveillance*. 2020;25:2000180.
17. Ki M; Task Force for -nCo V. Epidemiologic characteristics of early cases with 2019 novel coronavirus (2019-nCoV) disease in Korea. *Epidemiol Health*. 2019;2020:e2020007.
18. Lu X, Zhang L, Du H, et al. SARS-CoV-2 infection in children. *N Engl J Med*. 2020;382:1663-1665.
19. Kimball A, Hatfield KM, Arons M, et al. Asymptomatic and presymptomatic SARS-CoV-2 infections in residents of a long-term care skilled nursing facility-King County, Washington, March 2020. *MMWR Morb Mortal Wkly Rep*. 2020;69:377-381.
20. Sonmez O, Tasdemir ZA, Kara HV, Akcay S. Tobacco and COVİD-19. *Eurasian J Pulmonol*. 2020;22:12-15.
21. Morse JS, Lalonde T, Xu S, Liu W. Learning from the past: possible urgent prevention and treatment options for severe acute respiratory infections Li et al. BMC Infectious Diseases (2020) 20:567 Page 13 of 14 caused by 2019-nCoV. *Chembiochem*. 2020;21:730-738.
22. Lu H. Drug treatment options for the 2019-new coronavirus (2019-nCoV). *Biosci Trends*. 2020;14:69-71.

23. Perego E, Callard F, Stras L, Melville-Jûhannesson B, Pope R, Alwan N. Why the Patient-Made Term 'Long Covid' is needed [version 1; peer review: awaiting peer review]. *Wellcome Open Res*. 2020;5:224.

24. Greenhalgh T, Knight M, Buxton M, Husain L. Management of post-acute covid-19 in primary care. *BMJ*. 2020;370:m3026. 3.

25. COVID Symptom Study. *How long does COVID-19 last? (blog).* Kings College London; 2020. https://covid.joinzoe.com/post/covid-long-term. Accessed October 1, 2020.

26. Assaf G, Davis H, McCorkell L.; on behalf of the COVID-19 Body Politic Slack Group. An analysis of the prolonged COVID-19 symptoms survey by patient-led research team. *Patient Led Res*; 2020. https://patientresearchcovid19.com/

27. Carfì A, Bernabei R, Landi F. Persistent symptoms in patients after acute COVID-19. *JAMA*. 2020;324:603-605.

28. Arnold DT, Hamilton FW, Milne A, et al. Patient outcomes after hospitalisation with COVID-19 and implications for follow-up; results from a prospective UK cohort. *medRxiv*. 2020.

29. Goërtz YM, Van Herck M, Delbressine JM, et al. Persistent symptoms 3 months after a SARS-CoV-2 infection: the post-COVID-19 syndrome? *ERJ Open Res*. 2020;6:00542-2020.

30. Vaes AW, Machado FV, Meys R, et al. Care dependency in nonhospitalized patients with COVID-19. *J Clin Med*. 2020;9:2946.

31. Dhont S, Derom E, Van Braeckel E, Depuydt P, Lambrecht BN. The pathophysiology of 'happy' hypoxemia in COVID-19. *Respir Res*. 2020;21:198.

32. Ladds E, Rushforth A, Wieringa S, et al. Persistent symptoms after Covid-19: qualitative study of 114 "long Covid" patients and draft quality principles for services. *BMC Health Serv Res*. 2020;20:1144.

33. Tenforde M, Kim S, Lindsell C, et al. Symptom duration and risk factors for delayed return to usual health among outpatients with COVID-19 in a multistate health care systems network — United States, March–June 2020. *MMWR Morb Mortal Wkly Rep*. 69:993, ePub.

34. Halpin SJ, McIvor C, Whyatt G, et al. Postdischarge symptoms and rehabilitation needs in survivors of COVID-19 infection: a cross-sectional evaluation. *J Med Virol*. 2021;93:1013–1022.

35. Davido B, Seang S, Tubiana R, de Truchis P. Post-COVID-19 chronic symptoms: a postinfectious entity? *Clin Microbiol Infect*. 2020;26:1448-1449.

36. Guneysu F, Yurumez Y, Guclu E, et al. The diagnostic process of COVID-19 in the emergency department: laboratory and ımaging methods. *Revista da Associação Médica Brasileira*. 2020;66:58-64.

37. Nikpouraghdam M, Jalali Farahani A, Alishiri G, et al. Epidemiological characteristics of coronavirus disease 2019 (COVID-19) patients in Iran: a single center study. *J Clin Virol*. 2020;127:104378.

38. Jaillon S, Berthenet K, Garlanda C. Sexual dimorphism in innate immunity. *Clin Rev Allergy Immunol*. 2019;56:308-321.

39. Yao Y, Cao J, Wang Q, et al. D-dimer as a biomarker for disease severity and mortality in COVID-19 patients: a case control study. *J Intensive Care*. 2020;8:49.