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Original Article

Charlson Comorbidity Index in Predicting Poor Clinical Outcomes and Mortality in Patients with COVID-19

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Abstract

OBJECTIVE: As known, older age and comorbidities are associated with poor clinical outcomes in patients with coronavirus disease 19. The aim of this study was to investigate the effect of the Charlson Comorbidity Index in predicting poor clinical outcomes in coronavirus disease 19 patients.

MATERIAL AND METHODS: Demographic characteristics and poor clinical outcomes (presence of pneumonia, respiratory failure, intensive care unit admission, and mortality) of the patients were evaluated retrospectively. Classical and modified Charlson Comorbidity Index was calculated and adjusted according to age.

RESULTS: In this study, 106 women and 107 men were included. The comorbidity rate was 50.7% and the most common comorbidities were hypertension (21.6%) and diabetes mellitus (15%). The rates of respiratory failure, intensive care unit admission, and mortality were 15%, 2.3%, and 2.8%, respectively. Older age was a high risk for poor outcomes. Pneumonia (odds ratio: 6.6; 95% CI: 3.4-12.7), respiratory failure (odds ratio: 5.2; 95% CI: 2.03-13.2), and intensive care unit admission (odds ratio: 1.1; 95% CI: 1.01-1.1) were significantly higher in patients with comorbid diseases than patients without any comorbidity ($P < .05$). Both median-modified and classical Charlson Comorbidity Index and their age-adjusted scores were significantly higher in patients with poor outcomes.

CONCLUSIONS: It is suggested that evaluation of the Charlson Comorbidity Index might contribute to the management of the patients with coronavirus disease 19 by predicting risk group for poor clinical outcomes and mortality.

KEYWORDS: COVID-19, comorbidity, Charlson Comorbidity Index, mortality, clinical outcome
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INTRODUCTION

Severe acute respiratory syndrome coronavirus-2 is a novel virus that causes coronavirus disease 2019 (COVID-19) which has been responsible for the global pandemic since March 2020. According to World Health Organization (WHO) report, there have been 203 174 401 confirmed cases of COVID-19, including 4 304 114 deaths until August 08, 2021.[1] From March 2020, when the first case was identified in our country, to August 2021, 5 895 841 cases were diagnosed and 52 088 people died.[2]

Coronavirus disease has a wide clinical spectrum from asymptomatic to severe disease including acute respiratory distress syndrome (ARDS) and death.[3] Mortality is a major concern of all clinicians in all countries.[4] The pathogenesis of COVID-19 infection remains unclear and there is no specific treatment protocol. Therefore, the management of COVID-19 and its outcomes are based on supportive therapy. Clinicians have been fighting against this new and unknown virus since the first day and are seeking to improve survival and outcomes in severe diseases.[5] To know the risk factors of worse clinical outcomes and mortality can help us to define the patients with COVID-19 at higher risk and to plan specific approach for prevention of serious events.[4,5]

Older age and comorbidities are the main risk factors of severe COVID-19 disease.[1] Most of the previous studies have identified comorbidities such as hypertension (HT), diabetes mellitus (DM), coronary artery disease, congestive heart failure, chronic obstructive pulmonary disease (COPD), cerebrovascular disease (CVD), cancer, and chronic renal disease (CRD) as the high-risk factors.[6,7]

Charlson Comorbidity Index (CCI) is a validated index that calculates the comorbidities and predicts the risk of death within 1 year of hospitalization.[8] It is found that CCI score above 0 was associated with an increased risk of severe disease and death when controlled for age and sex.[9] The aim of this study was to investigate the effect of CCI in predicting poor clinical outcomes such as pneumonia, respiratory failure, intensive care unit (ICU) admission, and mortality in patients with COVID-19.

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MATERIAL AND METHODS

Medical records of all hospitalized patients who were diagnosed with COVID-19 between March and June 2020 were evaluated retrospectively. The definitions of the COVID-19 disease were based on the WHO COVID-19 case definition sheet. While the presence of a positive nasopharyngeal polymerase chain reaction (PCR) test was defined as a definite case, cases with similar clinical and radiological findings (multiple ground-glass opacities, with peripheral and lower lung distribution) were defined as high probable COVID-19 despite the negative nasopharyngeal PCR test result.[10] Thorax CT scans of all patients with COVID-19 (both definite and high probable) were examined by the same radiologist who is specialized in thoracic radiology.

Inclusion criteria were as follows:

- to have definite COVID-19 infection (with positive nasopharyngeal PCR result),
- to have high probable COVID-19 infection (clinical and radiological findings are compatible with COVID-19, but at least 2 PCR tests performed 24-48 hours apart are negative), and
- hospitalization due to COVID-19 infection.

Exclusion criteria were as follows:

- to be followed up in outpatient clinic with the diagnosis of definite or high probable COVID-19 infection and
- hospitalization due to non-COVID-19 diseases.

Demographic characteristics including body mass index (BMI), smoking history and comorbidities, clinical outcomes such as the presence of pneumonia, respiratory failure, ICU admission, and mortality were recorded. Respiratory failure was defined as oxygen saturation (SO_2) less than 90% in room air at the time of admission or during follow-up.

The CCI is a simple, easy-to-perform, and valid method to estimate the risk of death related to comorbid diseases.[8] Classical CCI includes 19 medical conditions weighted 1-6 with total scores ranging from 0 to 33. Furthermore, age-adjusted CCI score can be calculated by adding 1 point for each decade of age over 40 years. Modified CCI, on the other hand, is a simpler form that includes 12 comorbid conditions with a total score weighted from 0 to 24. Age-adjusted score can also be calculated by adding 1 point per decade over the age of 50.[8,11-13] Definitions and items of classical and modified CCI are shown in Table 1.

Table 1. Calculation of Classical and Modified Charlson Comorbidity Index Scores and Age-Adjusted Scores

Comorbid Conditions	CCI Score	Modified CCI Score
Age		
<40	+0	–
<50	–	+0
41-50	+1	–
50-59	–	+1
51-60	+2	–
60-69	–	+2
61-70	+3	–
70-79	–	+3
≥71	+4	–
>80	–	+4
Myocardial infarction	1	0
Congestive heart failure	1	2
Peripheral vascular disease	1	0
Cerebrovascular disease	1	0
Dementia	1	2
Chronic pulmonary disease	1	1
Rheumatic disease	1	1
Peptic ulcer disease	1	0
Mild liver disease	1	2
Diabetes without chronic complication	1	0
Diabetes with chronic complication	2	1
Hemiplegia	2	2
Renal disease	2	1
Any malignancy without metastasis	2	2
Leukemia	2	
Lymphoma	2	
Moderate or severe liver disease*	3	4
Metastatic solid tumor	6	6
AIDS (exclude asymptomatic infection)**	6	4
Max. comorbidity score	33	24
Max. age-adjusted comorbidity score	37	28

*Liver disease: mild, chronic hepatitis or cirrhosis without portal hypertension; moderate, cirrhosis, portal hypertension; severe, portal hypertension, history of variceal bleeding.
**AIDS: current CD4 count <200, opportunistic infection in the last 1 month, active AIDS such as Kaposi sarcoma.
AIDS, acquired immunodeficiency syndrome.

MAIN POINTS

- Older age and comorbidities were associated with poor clinical outcomes in patients with coronavirus disease 19.
- Charlson Comorbidity Index (CCI) is a tool for calculating comorbidity scores using a predefined list of medical conditions and also it can be adjusted for age and was associated with mortality.
- It is thought that evaluating the CCI score during the initial admission will contribute to the identification of the risky group and the preparation of an early action plan.

In this study, comorbidities were recorded from medical data. Classical and Modified CCI (cCCI and mCCI) were calculated for each patient. In addition, both scores of the cCCI and mCCI were adjusted and re-calculated according to age. Furthermore, CCI scores were classified according to the total

score as follows: 0 point: no comorbidity, 1-2: mild, 3-4: moderate, and ≥5: severe.[9]

Our study was approved by the Ministry of Health Scientific Research Board and Kocaeli University Non-Interventional Research Ethics Committee with the number GOKAEK-2020/11.19. As informed consent from patients to review their medical records was not obtained, patient data were de-identified. The flowchart of the study is presented in Figure 1.

Statistical Analysis

Statistical Package for the Social Sciences Statistics 20.0 (SPSS Inc.; Chicago, IL, USA) package program was used for statistical analyses of the study. Categorical variables were expressed as counts (percentage). Continuous variables were expressed as median or mean ± standard deviation. Mann–Whitney *U* test was used for the comparison of continuous variables. Comparisons of categorical variables between the groups were performed using the chi-square test. The risk was calculated by the chi-square test. A 2-sided *P* value <.05 was considered statistically significant.

RESULTS

Totally 213 patients with COVID-19 were included in the study; 106 women (49.8%) and 107 men (50.2%). The median age and BMI of the study population were 46 years (min: 18, max: 93) and 25.5 kg/m^2 (min: 17, max: 47.2), respectively. Among the study population, 46.7% of the patients had a smoking history, 20.7% was current smoker, and 26% was former smoker. Coronavirus disease19 PCR test was positive in 69.5% of the patients. At initial admission, 5.3% of the patients had room air SO_2below 90%. Mean SO_2 was 95.98 ± 3.3% during first admission, and the mean duration of hospitalization was 4.99 ± 3.2 days. During follow-up, 15% of the patients had respiratory failure. The need for ICU rate was 2.3% and the mortality rate was 2.8%. Demographic characteristics, CCI scores of the study population, and clinical outcomes of the disease are shown in Table 2.

The comorbidity rate was 50.7% and the most common comorbidities were HT (21.6%), DM (15%), and malignancy (8.5%) (Figure 2). Although the presence of the comorbidity was significantly higher in men than women (57.9% vs. 43.4%, *P* = .03), clinical outcomes of the disease were similar between the gender.

The study population was categorized by age. Patients over 65 years old were defined as elderly and 26.8% of the study population were elderly. The frequency of comorbidities (37.2% vs. 87.7%, *P* = .001) and poor clinical outcomes such as pneumonia (58.3% vs. 87.7%, *P* = .001) and respiratory failure (9.7% vs. 29.8%, *P* = .001) were significantly higher in

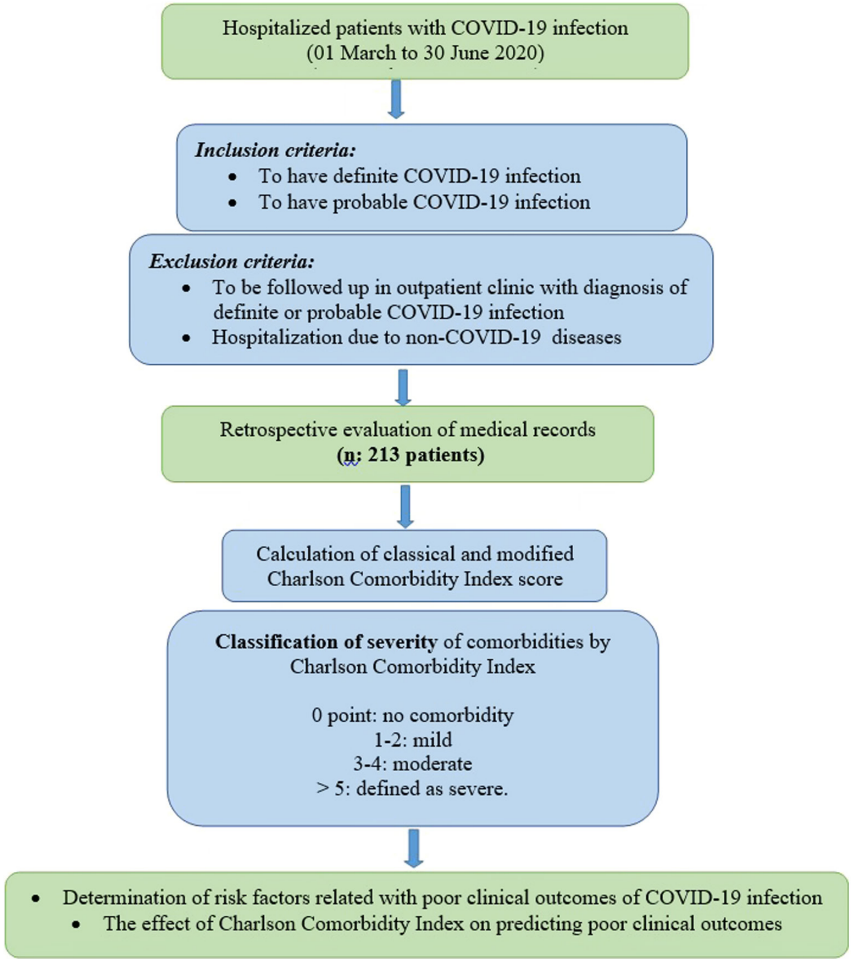

Figure 1. Flowchart of the study.

Table 2. Demographic Characteristics and CCI Scores of the Patients

	Variables	n(%)
Gender, n (%)		
Women		106 (49.8)
Men		107 (50.2)
Age category, years, n (%)		
<65		156 (73.2)
≥65		57 (26.8)
BMI category, kg/m^2, n (%)		
<18	Cachexia	2 (1.3)
18-25	Normal weight	66 (41.5)
25-30	Over weight	60 (37.7)
>30	Obese	24 (15.1)
>40	Morbid obese	7 (4.4)
Smoking history, n (%)		
Non-smoker		90 (53.3)
Current smoker		35 (20.7)
Former smoker		44 (26)
Presence of comorbidity, n (%)		108 (50.7)
Presence of pneumonia, n (%)		141 (66.2)
Respiratory failure, n (%)		32 (15)
Need for ICU, n (%)		5 (2.3)
Mortality, n (%)		6 (2.8)
Charlson Comorbidity Index		
Classical CCI	Median (25th-75th)	0 (0-1)
Classical CCI—age	Median (25th-75th)	1 (0-4)
Modified CCI	Median (25th-75th)	0 (0-1)
Modified CCI—age	Median (25th-75th)	1 (0-3.5)

BMI, body mass index; PCR, polymerase chain reaction; ICU, intensive care unit; CCI, Charlson Comorbidity Index.

elderly than younger ones. The ICU admission rate was also higher in older patients, but the difference was not statistically significant (5.3% vs. 1.3% $P = .09$).

Approximately 20% of the patients were obese (BMI ≥ 30 kg/m^2) in the study population. There was no significant difference in mortality rates between the obese and non-obese patients in this study. However, the rate of respiratory failure was significantly higher in obese patients ($P = .02$; odds ratio (OR): 3.1; 95% CI: 1.2-7.9).

Both median-modified and classical CCI scores and their age-adjusted scores were significantly higher in patients with pneumonia, respiratory failure, who required ICU, and who died (Tables 3 and 4). Furthermore, as the severity of comorbidity increased according to the classification of CCI, clinical outcomes such as pneumonia, respiratory failure, and mortality were increased. Clinical outcomes and mortality rates according to age-adjusted modified and classical CCI scores are shown in Figures 3 and 4.

Comparison of the patients according to the presence of pneumonia revealed that age ($P = .0001$), BMI ($P = .005$), and cigarette packs used in years ($P = .001$) were significantly higher in those with pneumonia. The rate of comorbidity was also higher in patients with pneumonia (65.2% vs. 22.2%, $P = .000$). Especially frequencies of HT, DM, COPD, and malignancy were found to be high in those with pneumonia, and these differences were statistically significant (Table 3). Coronavirus disease19 PCR test positivity was significantly lower in patients with pneumonia than cases without pneumonia (54.6% vs. 98.6%; $P = .000$).

Patients with respiratory failure were older ($P = .0001$), and they had higher comorbidity rates ($P = .000$). The presence of HT, DM, and malignancy was high in this group, and the differences were statistically significant (Table 3). The respiratory failure rate was significantly higher in patients with pneumonia ($P = .000$), and the presence of respiratory failure was significantly associated with mortality ($P = .000$).

Initial room air SO_2 was significantly lower in patients with pneumonia, respiratory failure, and mortality ($P = .0001$, $P = .0001$, $P = .03$, respectively).

Compared to the patients who died and survived, comorbidity was higher among those who died, but the difference was not significant (83.8% vs. 49.8%, $P = .12$). However, according to the subgroup analysis of comorbidities, CRD ($P = .04$) and malignancy ($P = .000$) were significantly higher in patients with mortality (Table 4).

DISCUSSION

Older age and comorbidities were found to be the risk factors for poor clinical outcomes in patients with COVID-19. There was a relationship between higher CCI scores and the rate of poor clinical outcomes and mortality.

In this study, there is a male predominance in COVID-19 patients.[14-17] In a meta-analysis, 53% of all COVID-19 cases were reported to be male.[14] In our study, 50.2% of the study population was male and there was no significant difference in gender distribution. Our study population was younger than reported in the previous studies and one-fifth of them were obese.[16,17]

Based on early data, it is estimated that in the USA and European Union, 80% of cases with COVID-19 result in mild illness, but 14% require hospitalization, and 6% require ICU admission.[18] Recently, it was shown that more than one-third of patients with COVID-19 were admitted to ICU globally.[19] In this study, the rate of the patients who were admitted to ICU was (2.3%) extremely lower than the literature.

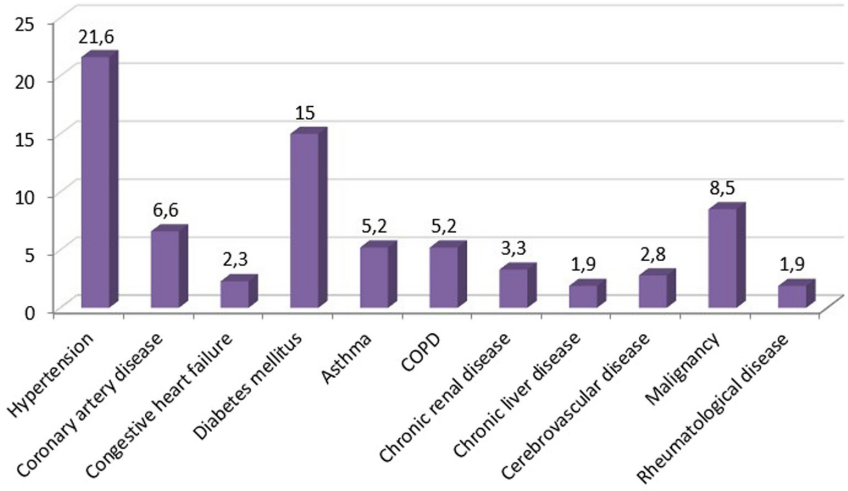

Figure 2. Most common comorbidities of the patients with COVID-19. COVID-19, coronavirus disease 19.

Table 3. Demographic and Clinical Characteristics and CCI Scores of the Patients According to the Presence of Pneumonia and Respiratory Failure

	Pneumonia (–)	Pneumonia (+)	*P*	Respiratory Failure (–)	Respiratory Failure (+)	*P*
Gender						
Women, %	55.6	46.8	.2	49.7	50	.9
Men, %	44.4	53.2		50.3	50	
Age, years, median	33.5	55	**.0001**	41	65	**.0001**
BMI, kg/m^2, median	24.6	26.9	**.005**	25.3	27.3	.95
Smoking pack of years, median	7.0	20.0	**.001**	11	30	**.002**
Comorbidity, %	22.2	65.2	**.000**	45.3	81.2	**.000**
HT	8.3	28.4	**.001**	18.8	37.5	**.02**
CAD	2.8	8.5	.1	7.7	0	.1
CHF	0.0	3.5	.1	1.7	6.2	.1
DM	2.8	21.3	**.000**	11.6	34.4	**.001**
Asthma	1.4	7.1	.08	4.4	9.4	.2
COPD	0.0	7.8	**.02**	5	6.2	.8
CRD	0.0	5	.06	2.8	6.2	.3
CLD	2.8	1.4	.5	2.2	0	.4
CVD	0.0	4.3	.08	2.2	6.2	.2
Malignancy	2.8	11.3	**.03**	5.5	25	**.000**
Modified CCI						
Median	0.0	0.0	**.001**	0.0	0.5	**.0001**
Modified CCI—age						
Median	0.0	2.0	**.0001**	0.0	3.5	**.0001**
Classical CCI						
Median	0.0	1.0	**.0001**	0.0	1.0	**.001**
Classical CCI—age						
Median	0.0	3.0	**.0001**	0.0	4.0	**.0001**

BMI, body mass index; HT, hypertension; CAD, coronary artery disease; CHF, chronic heart failure; DM, diabetes mellitus; COPD, chronic obstructive pulmonary disease; CLD, chronic liver disease; CRD, chronic renal disease; CVD, cerebrovascular disease; CCI, Charlson Comorbidity Index; SD, standard deviation.
P value <.05 was considered statistically significant.

Table 4. Demographic and Clinical Characteristics and CCI Scores of the Patients According to the Presence of ICU Stay and Mortality

	ICU (–)	ICU (+)	*P*	Mortality (–)	Mortality (+)	*P*
Gender						
Women, %	50.5	20	.2	49.8	50	.9
Men, %	49.5	80		50.2	50	
Age, years, median	46	67	.06	46	65	**.04**
BMI, kg/m^2, median	25.5	28.1	.6	25.4	26.6	.6
Smoking pack of years, median	15	30	.2	15	115	.053
Comorbidity, %	49.5	100	**.03**	49.8	83.3	.12
HT	21.6	20	.9	22.2	0	.2
CAD	6.7	0	.6	6.8	0	.5
CHF	2.4	0	.7	2.4	0	.7
DM	15.4	0	.3	15.5	0	.3
Asthma	4.8	20	.13	5.3	0	.6
COPD	4.3	40	**.000**	4.8	16.7	.2
CRD	3.4	0	.7	3.4	0	.7
CLD	1.9	0	.8	1.9	0	.7
CVD	2.9	0	.7	2.4	16.7	**.04**
Malignancy	7.2	60	**.000**	6.8	66.7	**.000**
Modified CCI						
Median	0.0	2.0	**.005**	0.0	2.5	**.007**
Modified CCI—age						
Median	1.0	4.0	**.01**	1.0	5.0	**.005**
Classical CCI						
Median	0.0	2.0	**.03**	0.0	2.5	**.005**
Classical CCI—age						
Median	1.0	4.0	**.02**	1.0	5.0	**.006**

BMI, body mass index; HT, hypertension; CAD, coronary artery disease; CHF, chronic heart failure; DM, diabetes mellitus; COPD, chronic obstructive pulmonary disease; CLD, chronic liver disease; CRD, chronic renal disease; CVD, cerebrovascular disease; CCI, Charlson Comorbidity Index; SD, standard deviation; ICU, intensive care unit.
P value <.05 was considered statistically significant.

Mortality data may vary by country and demographic features of the patients and range from 3.1% to 18%.[6,9,15-17] While the rate is as high as 15%-16% in the USA and Sweden,[15,16] it is 3.1% in China.[6] The mortality rate of our study was 2.8% In this study, the need for ICU and mortality rates were found to be lower than in the literature. These

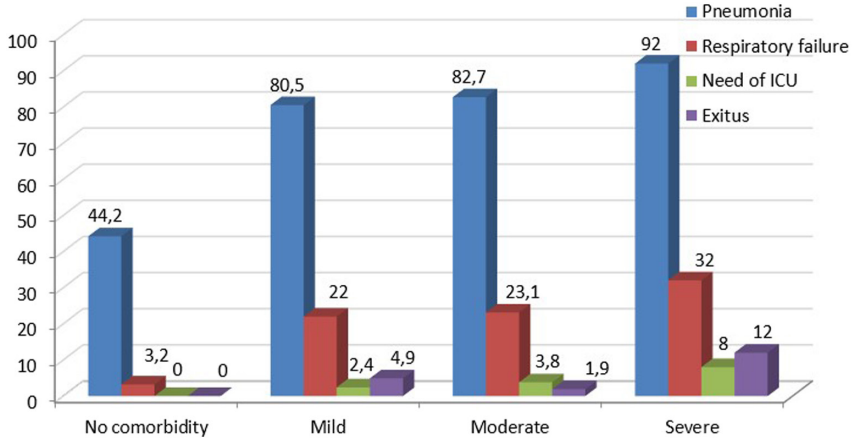

Figure 3. Clinical outcomes and mortality rates according to the classification of age-adjusted, modified CCI scores. CCI, Charlson Comorbidity Index.

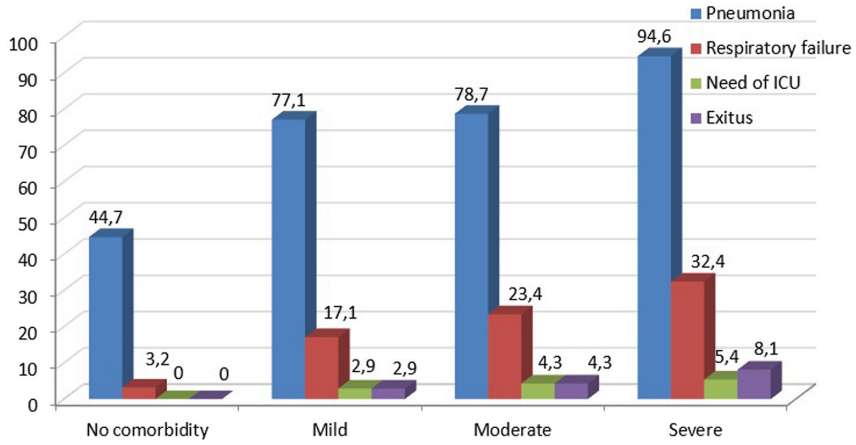

Figure 4. Clinical outcomes and mortality rates according to the classification of age-adjusted classical CCI scores. CCI, Charlson Comorbidity Index.

differences may be related to the heterogeneity of our study population, as it was younger and all patients were hospitalized and isolated in the early stages of the pandemic, regardless of disease severity.

There are multiple risk factors associated with mortality and severity of disease in COVID-19 patients. Studies had shown that age, male gender, and comorbidities are predictors of mortality.[15,19-23] Grasselli et al[20] reported that male gender was an independent risk factor of mortality.[20] Furthermore it was shown that there was an association between male gender and severity of the disease.[14,21] Age ≥ 65 years were associated with a higher risk of death during the hospital stay for COVID-19.[17] In contrast to these studies, poor clinical outcomes of the disease were similar between the genders in our study. However, older age was significantly a risk factor for pneumonia and respiratory failure.

The comorbidity rate of COVID-19 patients varies between 57.7% and 83%.[15,16,19,20,24] This broad range may be due to demographic differences of the study population, such as age. Also, it may differ depending on whether the study population includes all COVID-19 patients or only severe patients. In a review, among the 22 753 COVID-19 patients, 57.7% had one or more comorbidity.[24] There was a high rate of comorbidities (83%) at Pellaud et al's study.[16] The rate of comorbidity was 50.7% in our study. This rate, which is lower than the literature, may be related to the younger study population and not include intensive care patients.

Major comorbidities of COVID-19 patients are HT, DM, CVD, cancer, CRD, and COPD. Hypertension has the highest rate in all studies and its rate varies between 17% and 60%.[4,5,15-17,24,25] As similar to the literature, the most common comorbidities were HT, DM, and malignancy in our study.

Previous studies reported a correlation between the presence of comorbidity and mortality in patients with COVID-19.[4,5,19,21,26] The risk of death was increased in patients with DM, renal failure, and cardiovascular diseases such as heart failure and myocardial infarction.[4,5,26] The presence of comorbidity in COVID-19 was also related to severe disease and poor outcomes.[5,7,21] In a meta-analysis including 3994 COVID-19 patients reported that 13.16% of the patients had serious events (ICU admission, pneumonia, mechanical ventilation, ARDS, and death), and the presence of comorbidities increased the risk of developing serious events.[5] A systematic review revealed that comorbidities including HT, DM, cardiovascular disease, CVD, COPD, CRD, and malignancy had strong associations with the severity and prognosis of COVID-19.[21] Liang et al[25] reported that patients with cancer had a higher risk of COVID-19 with a poorer prognosis than those without cancer.[25]

In this study, pneumonia, respiratory failure, and ICU admission rates were significantly higher in patients with comorbid diseases than patients without any comorbidity. The rate of HT and DM was significantly higher in patients with pneumonia and respiratory failure. Chronic obstructive pulmonary disease rate was significantly higher in patients with pneumonia and who needed to stay in ICU. Comparison of the patients according to mortality revealed that the presence of comorbidity was higher among those who died, but the difference was not significant (83.8% vs. 49.8%, P = .12). However, according to the subgroup analysis of comorbidities, CRD (P = .04) and malignancy (P = .000) were significantly higher in patients with mortality.

Charlson Comorbidity Index is a tool for calculating comorbidity scores using a predefined list of medical conditions and also it can be adjusted for age. It is an easy-to-perform and validated index estimating the risk of mortality related to comorbid disease and has been studied in many diseases.[8,11-13] Coronavirus disease 19 is also one of these diseases, and studies evaluating the effect of CCI on mortality in COVID-19 patients have been increased in the literature.[9,27-29] A recent systematic review and meta-analysis revealed that a higher CCI score was associated with increased mortality and severity of the disease in patients with COVID-19. There was a 16% increase in mortality for each increase in CCI score.[28] The CCI score >3 (OR: 2.71; 95% CI: 1.85-3.97) was found to be associated with mortality.[15] Gregoriano et al[30] reported that patients had a high burden of comorbidities, with a median CCI of 3 points.[30] It is found that CCI score above 0 was associated with an increased risk of severe COVID-19 and death when controlled for age and sex.[9] There was also an increasing trend in the length of stay in the hospital related to increasing CCI scores.[29]

In some studies, categorized CCI score[9,27] was used, while in others, both the median CCI score and the categorized CCI were evaluated together.[28,29] In our study, both median scores and categorized CCI were evaluated to improve the power of the study. The median scores of CCI and age-adjusted CCI were 0.00 and 1.00, respectively, in all study populations. These scores were relatively lower than the literature, but it is thought that it might be explained by the younger study population. Despite the relatively low CCI score in all patients with COVID-19, both median-modified and classical CCI scores and their age-adjusted scores were significantly higher in patients with poor clinical outcomes including pneumonia, respiratory failure, the need for a stay in ICU, and mortality. In addition, it was observed that as the severity of comorbidity increased according to the classification of CCI scores, poor clinical outcomes were also increased. These results were similar to the literature.

Modified CCI is a shorter and simpler form of CCI.[13] Unlike CCI, comorbidities do not include myocardial infarction, peripheral vascular disease, CVD, peptic ulcer, and uncomplicated diabetes. However, thromboembolic complications are frequent in patients with COVID-19. In addition, DM is one of the most common comorbidities. In order not to ignore the effect of these comorbidities, both classical CCI and modified CCI were evaluated in our study. However, the effects of both classical and modified CCI scores on poor clinical course and mortality were similar.

There are some limitations of this study. At first, it was a retrospective study and it was carried out in a single center (a university hospital). Second, the study population included a limited number of patients, with a median age of 46 years. Approximately one-quarter of the population is 65 years old or older. Especially, the relatively small number of the elderly population, where comorbidities are common, may not reflect the real effect of the severity of comorbidity. Third, retrospective screening of comorbidities from the database and calculating CCI seems problematic. However, since the first day of the pandemic in our clinic, medical information and comorbidities of inpatients have been recorded in detail in order to reduce unknowns about COVID-19. Therefore, we believe that this issue can be ignored.

In conclusion, older age and comorbidities were associated with poor clinical outcomes in patients with COVID-19. Charlson Comorbidity Index was significantly higher in patients with poor clinical outcomes including pneumonia, respiratory failure, intensive care, and death. There was a relationship between higher CCI scores and the rate of poor clinical outcomes and mortality. It is thought that evaluating the CCI score during the initial admission will contribute to the identification of the risky group and the preparation of an early action plan.

Ethics Committee Approval: This study was approved by Ethics committee of Kocaeli University, (Approval No: GOKAEK-2020/11.19).

Informed Consent: As informed consent from patients to review their medical records was not obtained, patient data were de-identified.

Peer-review: Externally peer-reviewed.

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