Turk J Public Health
Available online at: http://dergipark.org.tr/tjph/
Doi: 10.20518/tjph.1293201

TURKISH JOURNAL OF PUBLIC HEALTH

ORIGINAL ARTICLE

Investigation of all-cause mortality and associated factors in patients diagnosed with COVID-19: A retrospective cohort study

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Received: 11.05.2023, **Accepted:** 13.11.2023

Abstract

Objective: This study aims to investigate the extent and associated factors of all-cause mortality in patients diagnosed with COVID-19 in a hospital for over a one-year follow-up period.

Methods: This retrospective cohort study was conducted on the patients who applied and tested positive for SARS-CoV-2 in the Dokuz Eylul University Hospital which is a large tertiary healthcare facility in Izmir, Turkey, between 19.03.2020 and 31.05.2021. The study included 8955 adult patients with a positive SARS-CoV-2 PCR test. Kaplan-Meier survival analysis and Cox regression models were used to examine the relationships between demographic and clinical characteristics and mortality.

Results: The cumulative all-cause mortality rate was 4.7% in COVID-19 patients. Patients over 80 years old had a significantly higher risk of death compared to those younger than 50 years old (aHR:22.3; 95% CI: 10.4-47.7). Current or ex-smokers had a higher risk of death compared to non-smokers (aHR: 1.6; 95% CI: 1.1-2.4). Patients without any complaints before diagnosis had a higher risk of death compared to those with three or more complaints (aHR: 1.7; 95% CI: 1.2-2.6). Patients hospitalized in the intensive care unit had a significantly higher risk of death compared to outpatients (aHR: 62.3; 95% CI: 37.6-101.9).

Conclusions: In COVID-19 patients, the risk of all-cause mortality is higher in the elderly, smokers, individuals admitted to medical or intensive care services, and those with a decreasing number of pre-diagnostic complaints. Monitoring patients with long follow-up periods and determining the course of illness and cause of death are important for understanding the natural course of COVID-19.

Keywords: COVID-19, Mortality, Follow-Up Study

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Cite This Article: Süner AF, Emecen AN, Keskin S, Şiyve N, Şensoy EB, Turunç Ö, Ünal B. Investigation of all-cause mortality and associated factors in patients diagnosed with COVID-19: A retrospective cohort study. Turk J Public Health 2023;21(3): 336-348.

INTRODUCTION

Since the emergence of COVID-19 up to October 8, 2023, there have been over 771 million confirmed cases and sadly, more than 6.9 million individuals have lost their lives to the disease [1]. Accurately measuring the number of deaths due to the COVID-19 pandemic is crucial to understand the magnitude of the pandemic's impact on public health for each country and region. COVID-19 poses a direct and indirect increased risk for all-cause mortality in patients [2]. All-cause mortality is considered to be higher than expected during the pandemic [3]defined as the increase in all-cause mortality relative to the expected mortality, is widely considered as a more objective indicator of the COVID-19 death toll. However, there has been no global, frequently updated repository of the all-cause mortality data across countries. To fill this gap, we have collected weekly, monthly, or quarterly all-cause mortality data from 103 countries and territories, openly available as the regularly updated World Mortality Dataset. This dataset was used to compute the excess mortality in each country during the COVID-19 pandemic. Data showed that several countries including Peru, Ecuador, Bolivia and Mexico were worst affected.

COVID-19 death is defined as, someone with positive PCR or antigen testing, who dies before full recovery and no alternative cause of death can be found [1]. Deaths in the first 28 days in COVID-19 patients have been studied extensively in the literature and reflect the acute situation [4,5]. The first 28 days mortality is defined as directly related to the COVID-19 disease and no other condition has intervened. Later deaths generally refer to a death of the person from any cause. Deaths over time may be from complications or long-term effects of COVID-19 but can also be caused by non-COVID-19 reasons.

The infection fatality rate refers to the probability of dying for an infected person and is one of the key features of the COVID-19 pandemic. The expected total death burden of COVID-19 is directly related to the infection fatality rate [6]. Initial data from China had a case fatality rate of 3.4%with the rapid progression of the epidemic after the first wave [7]. National health systems were regulated to reduce viral transmission and the number of cases. Over time, the number of hospitalized and deceased people has also decreased [8]. Later, mathematical models predicted that 40-81% of the world's population could be infected, and infection fatality rate of 1.0% or 0.9% [9].

It is essential to understand the magnitude of death quantitatively and determine the factors that influence death. In studies, advanced age [10], male gender, and non-white ethnicity are cited as the main risk factors for severe or fatal COVID-19 [11,12]Asian and Minority Ethnic (BAME. In addition, several comorbidities were reported as important risk factors for COVID-19 mortality including hypertension [13], cardiovascular diseases [14], kidney disease [15,16] and diabetes [15–17].

The relationship of death with lifestyle and metabolic factors such as obesity [18], smoking [15,19], vitamin D level [20,21] and environmental factors such as air pollutants [22] has been reported. In a study conducted in a national cohort in England, demographic covariates, being a healthcare worker, current smoking, cardiovascular disease, autoimmune diseases and oral steroid use were independently associated with COVID-19 mortality [15].

The effect of certain risk factors on mortality is known. The literature on COVID-19 and mortality is increasing day by day, a better understanding of extent and determinants of all-cause mortality in COVID-19 patients may help to develop better strategies to identify and protect groups that may be badly affected by the pandemic. This study aims to investigate the factors associated with all-cause mortality with an over one year of the follow-up period in patients diagnosed with COVID-19.

METHODS

This retrospective cohort study was conducted on the patients who applied and tested positive for SARS-CoV-2 in the Dokuz Eylul University Hospital, which is a large tertiary healthcare facility in İzmir, Turkey between 19.03.2020 and 31.05.2021. Dokuz Eylul University Hospital has been a designated pandemic public hospital since the beginning of the pandemic and people could admit to outpatient COVID-19 policlinic or emergency care unit with or without a referral. The study included 8955 patients with a positive SARS-CoV-2 PCR test. The study was approved by the Dokuz Eylul University Ethics Committee (Date: 23.03.2022- Decision No: 2022/11-01).

The data were collected through the COVID-19 Monitoring Center (COVIMER) established in the Dokuz Eylul University Hospital. In January 2021, COVIMER was established with the aim of monitoring the health status of people with a positive COVID-19 by PCR test. The center was coordinated by a faculty member from the Department of Public Health. The center's information technology infrastructure, data collection, and monitoring tasks were managed by an Epidemiologist and five residents from the Department of Public Health. Patient follow-up calls were conducted by five secretaries [23].

Participants were interviewed using a structured questionnaire by telephone calls on the 1st, 3rd, and 6th months after diagnosis. Data were collected using electronic interview forms and stored in separate databases in each follow-up. Patients were electronically followed up for death status on March 1, 2022, by the Hospital Information System.

All-cause death was the dependent variable, and it refers to patients who died in the hospital or during follow-up periods after being diagnosed with COVID-19. All-cause 'in hospital' death was defined as the death during the initial hospitalization of the patient with the diagnosis of COVID-19 or in the emergency room. Hospital death does not encompass any specific time frame. In the hospital setting, the majority of patients who died during the acute phase of admission are attributed to COVID-19-related mortality. The data of COVID-19 patients who died in the hospital were transferred to COVIMER from the hospital information system. The mortality status of these patients was later verified on March 1, 2022, during a system scan. Out-of-hospital death from all causes was defined as death in those who are hospitalized after being diagnosed with COVID-19 or in people who have never been hospitalized. Out-of-hospital deaths refer to mortality that occur at any healthcare facility or at home after discharge from Dokuz Eylul University Hospital following an acute COVID-19 admission. Out-of-hospital deaths refer to patients identified during the hospital information system's death screening on March 1, 2022, who were determined not to have died in the hospital during the acute phase. The information on

cause of death whether due to the long-term effects of COVID-19 or for any other reason was not available from the hospital records therefore we used all cause of death as the outcome variable of the study.

Independent variables were age, gender, educational status, perceived economic status, marital status, smoking, alcohol, presence of / number of chronic disease, presence of / number of initial symptoms, and inpatient and intensive care admission. Information on age, gender were obtained from the hospital information system, the information on other independent variables were collected through telephone interviews.

Statistical Analysis

Survival time for deceased patients was estimated as the duration between the date of diagnosis and the date of death; for surviving patients, from the date of diagnosis to March 1, 2022. Kaplan Meier analysis was used to investigate the association between the independent variables and all-cause mortality. Log-Rank test was used to compare survival functions calculated according to different factors. Predictive Cox Regression Models were created from the variables that were significant in the Log-Rank test. In the model obtained, crude and multivariable adjusted hazard ratios and %95 confidence intervals were determined separately for each variable. The statistical analyses were performed by Statistical Package for Social Sciences SPSS (version 26, Armonk, NY, USA). A two-sided $p < 0.05$ was considered statistically significant.

RESULTS

In total 8955 COVID-19 patients were included in the study. Mean age of the patients was 44.4 ± 16.5 years and 51.2% of the participants were women. Of the patients, 85.9% were treated as an outpatient, 10.2% were admitted to the hospital service only, and 3.9% were admitted to the intensive care unit. All-cause mortality was 0.8% in patients treated at home (outpatients), 12% in patients hospitalized in service, and 72.2% in intensive care admissions. During over one year follow-up period (mean: 426 days, min: 1 max: 713), 421 patients (4.7%) died; 261 (61.9%) deaths occurred in the initial admission to Dokuz Eylul University Hospital and 160 (39.1%) died after the discharge from the hospital. Overall, 259 (2.9%) patients died within 28 days (early), and 162 patients (1.8%) died after 28 days (late) (Table 1).

Table 1. Patient Characteristics and Mortality

Patient Characteristics	
Age (Mean ± SD)	44.4 ± 16.5
Gender (Women) (%)	51.2
Education level	
High education level (%)	63.6
Primary/secondary school level education (%)	32.0
Literate/Illiterate (%)	4.4
COVID-19 treatment	
Outpatient (%)	85.9
Hospitalized (Service) (%)	12.0
ICU Admission (%)	3.9
Mortality	
All-Cause Mortality	
Outpatients (%)	0.8
Hospitalized (Service) (%)	12
ICU Admission (%)	72.2
Mortality During Follow-up	
Total (%)	4.7
Initial Admission (%)	61.9
After Hospital Discharge (%)	39.1
Early (Within 28 days) (%)	2.9
Late (After 28 days) (%)	1.8
Follow-up Period (days) (Median (Min-Max))	426 (1-713)

The cumulative mortality rate was 6.0% in men and 3.5% in women (p<0.001). All-cause mortality in COVID-19 patients occurred mostly in the first 28 days and was more common in men (p<0.001) (Figure 1) The cumulative mortality rate increased with age; 0.2% under the age of 40, 0.7% aged 40-49, 3.1% aged 50-59, 9.2% aged 60-69, 25.0% aged 70-79, 47.9% aged 80-89 and 90 years above 59.1% (p<0.001).

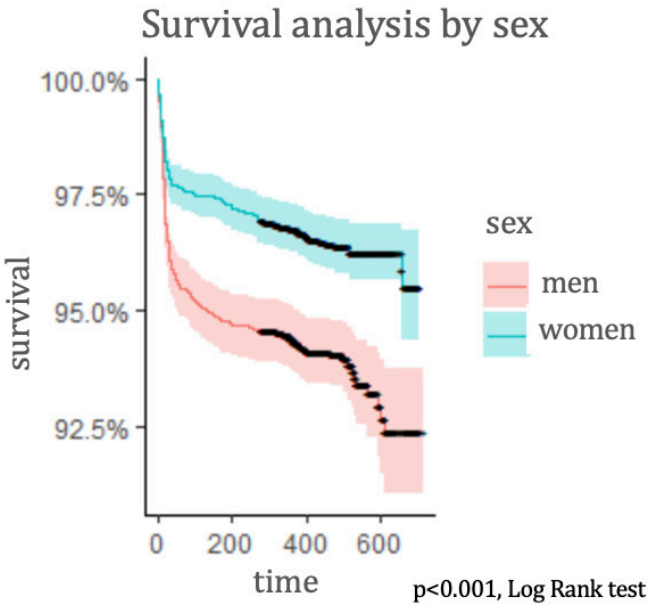

Figure 1. Survival curves of COVID- 19 patients by men and women

In Table 2, mean survival times were presented for men and women separately. Age, marital status, education, presence of chronic disease, number of chronic diseases, presence of pre-diagnosis complaints, number of pre-diagnosis complaints, admission status were associated with survival in both men and women (p<0.05 for all). Alcohol use made a difference in terms of survival in men (p<0.001). Perceived economic status was not associated with survival in either men (p=0.637) and women (p=0.223). Although smoking was associated with shorter survival in men (p<0.001), there was no association with survival in women (p=0.866).

In the study group, the association between all chronic disease and all-cause mortality was also examined using Kaplan-Meier analysis. Survival was significantly associated with having history of diabetes mellitus, hypertension, coronary artery disease, heart failure, cancer, kidney disease, chronic lung disease, cirrhosis, cerebrovascular disease, dementia (p<0.05), except patients with asthma history in men and women. There was no significant association between survival and high cholesterol (p=0.056) in women. There was no significant difference in survival for men with thyroid disease (p=0.927), but there was a significant difference for survival for women with thyroid disease (p=0.047) (Table 3).

Variables that were significantly associated with all-cause mortality in the Kaplan Meier analysis were included in the Cox regression model to estimate crude and multivariate adjusted HRs for all-cause mortality. We considered variables age, sex, marital status, education, number of chronic diseases, alcohol, smoking, number of complaints before diagnosis and hospital admission status for the multivariate Cox regression model.

Cox regression model showed that being a man increased the risk of mortality (HR:1.7; 95% Cl:1.4-2.1). Patients with increasing age had a higher risk of death. The risk of death over the age of 80 was 175 times higher (HR: 175.7; 95% CI: 112.1-275.3) compared to under the age of 50. Having lower literacy or being illiterate was associated with a higher risk of death compared to individuals with higher education (HR: 7.1; 95% CI: 4.7-10.5). Death risk was higher for people with three or more chronic diseases than for people without any

Table 2. Mean survival times in the categories of independent variables in men and women COVID-19 patients

Men					Women				
	Number of deaths	(%)	Mean survival time (days)	Log-Rank (p)		Number of deaths	%	Mean survival time (days)	Log-Rank (p)
Age groups									
Under 50 (n=2838)	15	0.5	701.7		Under 50 (n=2975)	7	0.2	702.6	
50-59 (n=731)	31	4.2	684.8		50-59 (n=737)	15	2.0	691.9	
60-69 (n=429)	55	12.8	616.8	<0.001	60-69 (n=449)	26	5.8	667.3	<0.001
70-79 (n=251)	86	24.3	473.5		70-79 (n=260)	42	16.2	601.6	
Over 80 (n=120)	74	61.7	301.6		Over 80 (n=165)	70	42.4	437.4	
Marital status									
Married (n=2674)	196	7.3	655.9	0.002	Married (n=2573)	65	2.5	662.6	<0.001
Not married (n=1104)	50	4.5	669.3		Not married (n=1391)	86	6.2	688.2	
Educational categories									
Higher education (n=2467)	60	2.4	689.2		Higher education (n=2370)	16	0.7	699.4	
Primary / secondary level education (n=1178)	97	8.2	648.2	<0.001	Primary / secondary level education (n=1251)	45	3.6	681.5	<0.001
Literate / illiterate (n=53)	8	15.1	605.1		Literate / illiterate (n=279)	28	10.0	636.2	
Perceived economic situation									
Bad (n=495)	17	3.4	677.9		Bad (n=442)	6	1.4	695.7	
Medium (n=2432)	105	4.3	676.1	0.637	Medium (n=2666)	65	2.4	688.5	0.223
Good (n=735)	29	3.9	679.4		Good (n=760)	13	1.7	692.3	
Chronic disease									
Yes (n=1263)	211	16.7	590.9	<0.001	Yes (n=1704)	149	8.7	648.3	<0.001
No (n=3106)	50	1.6	702.2		No (n=2282)	11	0.4	702.4	
Number of chronic diseases									
0 (n=3106)	50	1.6	702.2		0 (n=2882)	11	0.4	702.4	
1-2 (n=1003)	133	13.3	613.8	<0.001	1-2 (n=1338)	83	6.2	664.6	<0.001
3> (n=260)	78	30.0	501.8		3> (n=366)	66	18.0	586.1	
Alcohol									
Never used (n=1574)	95	6	460.0	<0.001	Never used (n=2349)	69	2.9	-	-
Used before / Currently using (n=1240)	35	2.8	473.1		Used before / Currently using (n=633)	0	0.0	-	
Smoking									
Never used (n=1625)	65	4.0	467.9	<0.001	Never used (n=2200)	55	2.5	475.0	0.866
Used before / Currently using (n=622)	56	9.0	445.5		Used before / Currently using (n=383)	10	2.6	474.5	
Presence of pre-diagnosis complaints									
Yes (n=2484)	133	5.4	504.0	<0.001	Yes (n=2729)	90	3.3	640.0	0.007
No (n=1855)	128	6.8	669.4		No (n=1857)	70	5.8	681.3	
Number of complaints before diagnosis									
0 (n=1885)	128	6.8	669.4		0 (n=1857)	70	3.8	681.3	<0.001
1-2 (n=920)	84	9.1	444.2	<0.001	1-2 (n=740)	52	7.4	616.3	
3> (n=1564)	49	3.1	515.1		3> (n=2025)	38	1.9	477.7	
Admission status									
Outpatient (n=3672)	42	1.1	696.8		Outpatient (n=4024)	20	0.5	701.0	
Service admission (n=466)	51	11.9	641.1	<0.001	Service admission (n=448)	59	13.2	633.9	<0.001
Intensive care admission (n=231)	168	72.7	211.1		Intensive care admission (n=114)	81	71.1	221.0	

such diseases (HR: 25.3; 95% CI: 18.8-34.2). The risk of death was higher in people who never used alcohol compared to those who used before / currently using (HR: 2.1; 95% CI: 1.4-3.0). The risk of death in ex-smokers or current smokers was higher than in non-smokers (HR: 2.1; 95% CI: 1.5-2.9). Death risk was higher for people without any symptoms than for people with three or more symptoms (HR:3.5; 95% Cl:2.7-4.6). The risk of death in patients hospitalized in the intensive care unit was (HR:170.8; 95% Cl: 128.9-226.2) higher than in outpatients (Table 3).

In the multivariate Cox regression model, the risk of death in patients over 80 years of age (aHR:22.3; 95% CI: 10.4-47.7) was higher than in patients younger than 50 years of age. The risk of death (aHR:1.6; 95% CI: 1.1-2.4) was higher in ex-smokers or current smokers compared to non-smokers. The risk of death in patients who had no complaints before diagnosis was (aHR:1.7; 95% Cl: 1.2-2.6) higher than those with 3 or more complaints. The risk of death in patients hospitalized in the intensive care unit was (aHR:62.3; %95 Cl: 37.6-101.9) higher than in outpatients (Table 4).

Table 3. Mean survival times in the categories of independent variables in men and women COVID-19 patients

Men					**Women**				
	Number of deaths	**%**	**Mean survival time (days)**	**Log-Rank (p)**		**Number of deaths**	**%**	**Mean survival time (days)**	**Log-Rank (p)**
Diabetes Mellitus									
No (n=3397)	190	5.6	667.5	<0.001	No (n=3517)	98	2.8	686.4	<0.001
Yes (n=421)	70	16.6	587.9		Yes (n=477)	61	12.8	617.7	
Hypertension									
No (n=3236)	159	4.9	672.2	<0.001	No (n=3272)	72	2.2	690.0	<0.001
Yes (n=582)	101	17.4	583.7		Yes (n=732)	87	12.0	627.0	
Coronary Artery Disease									
No (n=3501)	175	5.0	671.1	<0.001	No (n=3751)	123	3.3	683.1	<0.001
Yes (n=317)	85	26.8	524.0		Yes (n=243)	36	14.8	601.0	
Heart Failure									
No (n=3751)	227	6.1	664.0	<0.001	No (n=3940)	137	3.5	681.9	<0.001
Yes (n=67)	33	49.3	304.4		Yes (n=54)	22	40.7	372.3	
Cancer									
No (n=3718)	211	5.7	666.5	<0.001	No (n=3880)	120	3.1	683.9	<0.001
Yes (n=100)	49	49.9	397.0		Yes (n=114)	39	34.2	491.7	
High Cholesterol									
No (n=3675)	242	6.7	660.5	<0.05	No (n=3832)	148	3.9	679.4	0.056
Yes (n=143)	18	12.6	614.1		Yes (n=162)	11	6.8	656.5	

Table 3. Mean survival times in the categories of independent variables in men and women COVID-19 patients

Men					Women				
	Number of deaths	%	Mean survival time (days)	Log-Rank (p)		Number of deaths	%	Mean survival time (days)	Log-Rank (p)
Cirrhosis									
No (n=3787)	255	6.7	659.7	<0.05	No (n=3985)	157 (3.9)		678.8	<0.05
Yes (n=20)	5	25.0	536.2		Yes (n=9)	2 (22.2)		440.4	
Cerebrovascular Disease									
No (n=3787)	247	6.5	661.0	<0.001	No (n=3965)	151	3.8	670.5	<0.001
Yes (n=31)	13	41.9	420.0		Yes (n=29)	8	27.6	546.3	
Dementia									
No (n=3791)	243	6.4	661.9	<0.001	No (n=3942)	125	3.2	683.8	<0.001
Yes (n=27)	17	63.0	232.3		Yes (n=52)	34	63.4	296.8	

Table 4. Crude and adjusted hazard ratios for all cause mortality in patients with COVID-19

		HR (%95CI)	aHR (%95CI)
Gender	Women	Ref.	-
	Men	1.7 (1.4-2.1)	-
Age groups	Under 50	Ref.	Ref.
	50-59	8.4 (5.0-13.9)	3.3 (1.5-7.2)
	60-69	25.5 (15.9-41.0)	7.2 (3.5-14.7)
	70-79	75.8 (48.2-119.1)	11.8 (5.9-23.0)
	Over 80	175.7 (112.1-275.3)	20.9 (10.1-43.0)
Marital status	Married	Ref.	-
	Not married	0.9 (0.7-1.1.1)	-
Educational categories	Higher education	Ref.	-
	Primary / secondary level education	3.7 (2.8-5.0)	-
	Literate / illiterate	7.1 (4.7-10.5)	-
Number of chronic diseases	0	Ref.	-
	1-2	9.4 (7.1-12.6)	-
	3>	25.3 (18.8-34.2)	-
Alcohol	Used before / Currently using	Ref.	-
	Never used	2.1 (1.4-3.0)	-
Smoking	Never used	Ref.	Ref.
	Used before / Currently using	2.1 (1.5-2.9)	1.6 (1.2-2.3)
Number of complaints before diagnosis	3>	Ref.	Ref.
	1-2	2.0 (1.5-2.6)	2.5 (1.7-3.7)
	0	3.5 (2.7-4.6)	1.5 (1.1-2.2)
Admission status	Outpatient	Ref.	Ref.
	Service admission	14.5 (10.6-19.9)	5.5 (3.3-9.3)
	Intensive care admission	170.8 (128.9-226.2)	58.0 (36.5-92.1)

Note: aHR adjusted for gender, age, marital status, education, number of chronic diseases, alcohol, smoking, number of complaints before diagnosis, admission status.

DISCUSSION

In this retrospective cohort study, we investigated the magnitude and the predictors of all-cause mortality in COVID-19 patients over more than one year follow up. Age, smoking, number of pre-diagnostic complaints and admission status significantly increased the risk of death from all causes in COVID-19 patients.

In our study, the cumulative all-cause mortality rate was found to be 4.7%. Of the confirmed cases, 2.9% of the patients died due to the acute effects of COVID-19. When evaluating the total deaths in confirmed cases, the Case Fatality Rate (CFR) was 1.089 in the United States, which had the highest number of cases as of October 8, 2023, and 0.5 in Turkey [1]. The higher number of acute-phase deaths observed in our study may be attributed to our hospital's service area being specific to a certain region and its proximity to areas with a predominantly elderly population. Furthermore, the 4.7% cumulative all-cause mortality rate observed in our study encompasses all deaths without attributing them to any specific cause and results from a long-term follow-up. Therefore, deaths unrelated to the effects of COVID-19, occurring as a natural course in patients, may account for this difference.

In our study, mortality was found to be high in the elderly similar to other studies in the literature [24,25]. Mahendra et al. reported that being over 50 years of age and prolonged duration of symptoms were independent predictors of death [26]. In our study, the risk of death in individuals over the age of 80 was more than 20 times higher than in individuals under the age of 50. As comorbidity increases with age in the elderly, mortality may also be on the rise. In addition, the elderly have a high vulnerability and low immunity to infection. This may explain the disproportionate death toll from COVID-19 in older age groups [27].

Studies have confirmed that male gender is a major risk factor for all-cause mortality in COVID-19 patients [24,28]. In our study, men were 1.7 times more likely to die from COVID-19 compared to women, but this association disappeared when adjusted to other variables. In a study conducted in Mexico, both gender and old age increased the risk of death. The risk was 16 times higher for men in the oldest group in the same study [29].

Chronic diseases also have a significant impact on mortality outcomes. In our study, diabetes mellitus, hypertension, coroner artery disease, heart failure, cancer, kidney disease, chronic lung disease, cirrhosis, cerebrovascular disease, dementia in men and women were significantly associated with all cause. High cholesterol only in women and thyroid disease only in men was associated with death. These findings are similar in terms of mortality for diabetes mellitus [30], hypertension, cardiovascular and cerebrovascular diseases [31,32], chronic liver disease [33], chronic lung disease [34], chronic kidney disease [35] in the literature. On the other hand, there was no significant between all cause of death and asthma, as also reported in the study of Matsumoto et al [36].

Mild symptoms occur in 81% of COVID-19 cases [37] and the mortality rate in these cases is low. However, mortality rates increase in hospitalized cases [38]. In our study, the highest mortality rates were found in patients admitted to the intensive care unit. Most of the patients admitted to the intensive care unit died within the first 28 days. Only 17.6%

of the patients admitted to the intensive care unit died after 28 days. These findings are also compatible with the literature [29,39,40].

Some lifestyle factors may also be risk factors for all-cause mortality. In the study of Zheng et al., smoking was found to be one of the important risk factors for death [41]. In our study, smoking was associated approximately 2-time increased risk of death after multivariate adjustments. However, this relationship was not found in some studies [24]. In our study, this risk was not found in women either (p=0.866). Alcohol use is also an important behavioral condition, but alcohol was not a significant factor for all cause of death in our study.

Our study has several strengths. This study has a large sample size from a single center that serves a population of around half a million living mostly urban and rural communities. Our findings are more generalizable because this hospital was designated as a public pandemic hospital that serves the general population. In our study, patients were followed up in average more than a year, and death due to all causes suggested by WHO was investigated. However, the study has some limitations. Missing data in the questionnaire because of recall bias is a problem in self-reported disease history or symptoms. If the patient died in the early days of COVID-19 some of the data on the independent variables could not be obtained from the relatives. In such cases hospital records were checked. The mortality data of our study are only related to whether the person died or not. The causes of death of the persons could not be reached. The identification of mortality rates exceeding those observed in all-time COVID-19 data may potentially be attributed to the inclusion of deaths due to causes unrelated to the disease, such as accidents, without any specific underlying reasons.

CONCLUSIONS

In this retrospective cohort study, in COVID-19 patients, the risk of all-cause mortality is higher in the elderly, smokers, individuals admitted to medical or intensive care services, and those with a decreasing number of pre-diagnostic complaints. Having a chronic disease was a significant risk factor for all-cause mortality. Monitoring patients with long follow-up periods and determining the course of illness and cause of death are important for understanding the natural course of COVID-19.

ACKNOWLEDGEMENTS

We thank all DEU-COVIMER staff and all of the participating individuals in the study.

Conflict of Interest: We declare no competing interests.

Financial Support: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Ethical Declaration: The study was approved by the Dokuz Eylul University Non-Interventional Research Ethics Committee (Date: 23.03.2022- Decision No: 2022/11-01).

Authorship Contributions: Concept: AFS, ANE, BÜ, Design: SK, ANE, Supervising: AFS, BÜ, ANE, Data collection and entry: ANE, AFS, SK, ÖT, NŞ, EBS, Analysis and interpretation: AFS, ANE, SK, BÜ, Literature search: AFS, BÜ, Writing: AFS, BÜ, Critical review: ANE, ÖT, BÜ.

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