One Year of Covid-19 Hospital at Croatia: Prevalence Cardio Comorbidities and Predictors of Health Outcomes - A Retrospective Study

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ABSTRACT

Backround: During the pandemic 2020 many hospitals became so-called Covid-19 Hospital. In Croatia our General County Hospital Nasice was the very first one with declared Covid-19 status. Our objective was to determine the clinical features of patients with severe COVID-19 disease considering of different cardiovascular risk factors and their health outcomes.

Materials and Methods: A retrospective study was conducted by analysing the medical records of 541 hospitalized COVID-19 patients in Croatian General County Hospital Nasice during one year in the period from March 1st 2020 to March 1st 2021. We examined collected individual data as gender, age, presence or absence of comorbidity, type of comorbidity, laboratory data, number of days at hospital and outcomes (discharge home, transfer to another hospital and death).

Results: Patients mean age was 72 years with range of 22 do 95 years. There were 408 (77%) discharged from the hospital, 23 (4%) transferred to another hospital, and 94 (18%) died. Hypertension had 325 (61%) of patients, coronary heart disease had 58 (11%) patients, cardiomyopathy had 98 (19%), arrhythmic disease had 88 (17%), valve disease had 24 (5%). Diabetes as risk factor had 151 patients (29%). Patients without any comorbidity were only 55 (10%). Total range of hospitalized days was 33 with 8 days mean. We found statistically significant differences in disease outcomes according to the gender and age of patients and whether patients suffer from cardiomyopathy and arrhythmic diseases. Age over 65, cardiomyopathy and valve disease were independent predictors of poor outcome for male. For female risk factors were cardiomyopathy, obesity and body mass index.

Conclusions: The prevalence of cardio comorbidity in Croatian Covid-19 hospitalized patients was analyzed and gender-different predictors of health have been identified.

Keywords: COVID-19 Disease, Comorbidity, Coronary Disease, Hypertension, Heart Disease Risk Factors

Introduction

The SARS-CoV-2 causing COVID-19 has reached pandemic levels since March 2020. The World Health Organisation on April 10th 2021 speaks of frightening 134 million persons infected with the SARS-COV-2 virus and nearly 3 million died worldwide. In Europe, slightly more than 47 million are infected, of which 1 million are dead. Citing World Health Organisation data in Croatia, on the day of writing the paper 290,899 people were infected, of which 6,269 died, the death rate is 54.67% of men versus 45.33%

of women. Case fatality ratio were 1,3 on March 1 2021. According to WHO at date February 2 2020 at 91 countries hospitalized were 46520 corona patients and on March 1 2021 hospitalized corona patients were 169 354. (Source: World Health Organisation). All these numbers strongly argue for all scientific efforts against pandemic endanger humanity.

The scientific community has focused on the well-being of humanity, so since the beginning of the pandemic, according to WHO, all global research of corona virus disease counting almost 298 thousands of papers (https://www.who.int/emergencies/diseases/novel-coronavirus-2019/global-research-on-novel-coronavirus-2019-ncov). Today is well known that SARS-CoV-2 not only causes viral pneumonia but has major implications for the cardiovascular system. Patients with cardiovascular risk factors including male gender advanced age, diabetes, hypertension and obesity as well as patients with established cardiovascular and cerebrovascular disease have been identified as particularly vulnerable populations with increased morbidity and mortality when suffering from COVID-19. (Cumming *et al.*, 2020; Du *et al.*, 2020; Guo *et al.*, 2020; Kumar *et al.*, 2020; Phelan *et al.*, 2020; Strozzi *et al.*, 2020; Zheng *et al.*, 2020; Zhou *et al.*, 2020).

The European Society of Cardiology 2020 in June proclaimed very important document for clinicans in which is notify that patients with cardiovascular risk factors and established cardiovascular disease represent a vulnerable population when suffering from COVID-19. (https://www.escardio.org/Education/COVID-19-and-Cardiology/ESC-COVID-19-Guidance).

Around the world studies have shown the importance of comorbidities in coping with covid-19 disease (Alemu, 2020; Azevedo *et al.*, 2020; Berenguer *et al.*, 2020; Cen *et al.*, 2020; Christensen *et al.*, 2020; Cummings *et al.*, 2020; Du *et al.*, 2020; Emami *et al.*, 2020; Galván-Tejada *et al.*, 2020; Guo *et al.*, 2020; Gupta *et al.*, 2021; Guzik *et al.*, 2020; Jordan *et al.*, 2020; Kumar *et al.*, 2020; Lang *et al.*, 2020; Liu *et al.*, 2020; Long *et al.*, 2020; Ruan *et al.*, 2020; Sun *et al.*, 2020; Wang *et al.*, 2020; Williamson *et al.*, 2020; Wu *et al.*, 2021; Zheng *et al.*, 2020; Zhou *et al.*, 2020). Most papers divided comorbidity factors into: diabetes mellitus, heart problems, obesity, high blood pressure, chronic kidney disease, COPD-asthma (Elezkurtaj *et al.*, 2021; Koya *et al.*, 2021; Phelps *et al.*, 2020; Petrilli *et al.*, 2020; Yang HJ *et al.*, 2020).

During the pandemic 2020 many hospitals became so-called Covid-19 Hospital. General County Hospital Nasice in Croatia was the very first one with declared Covid-19 status. The focus of our research is therefore to gain insight into the composition of corona patients who have been hospitalized in General County Hospital Nasice and determination of different cardiovascular risk factors and their health outcomes.

Materials and Methods

We conducted a retrospective study after approval from the Etic committee of General hospital Nasice on 03/25/2021. The sample consisted of SARS-COV-2 positive patients hospitalized in General Hospital Nasice during 03/01/2020 to 03/01/2021. The sample included the total 530 had severe respiratory problems with pneumonia of total 541 hospitalized persons with COVID-19 disease during the declared period. A total of 11 pediatric and / or gynecological patients had asymptomatic COVID-19 and were excluded from the sample. All analyzed data had collected by manual extraction from the medical records of hospitalized patients with a confirmed diagnosis of COVID-19 disease. According to the researchs available to us (Alemu, 2020; Azevedo *et al.*, 2021; Berenguer *et al.*, 2020; Cen *et al.*, 2020; Christensen *et al.*, 2020; Cummings *et al.*, 2020; Du *et al.*, 2020; Emami *et al.*, 2020; Galván-Tejada *et al.*, 2020; Guo *et al.*, 2020; Gupta *et al.*, 2021; Guzik *et al.*, 2020; Jordan *et al.*, 2020; Kumar *et al.*, 2020; Lang *et al.*, 2020; Liu *et al.*, 2020; Long *et al.*, 2020; Ruan *et al.*, 2020; Sun *et al.*, 2020; Wang *et al.*, 2020; Williamson *et al.*, 2020; Wu *et al.*, 2021; Zheng *et al.*, 2020; Zhou *et al.*, 2020), we decided to collect data about hospitalized patient: age, gender, laboratory characteristic CRP and D-dimer, presence or absence: coronary heart disease, cardiomyopathy, arrhythmic disease, valve disease, diabetes, psychiatry diagnoses, body mass index, number of hospitalized dvcays and health outcomes. Cardiovascular and other comorbidities were fully noted in the discharge letters we analyzed. Laboratory data (crp and d-dimers) and body mass index however were not been recorded at electronic form of medical records for each patients and the collected for these variables was less than the total numbers.

Statistical Analysis

Data analysis was performed using IBM SPSS Statistics for Windows (Version 25). Examination of the normality of the distribution showed that mostly the variables had asymmetric distributions, so we used the nonparametric Chi-square test or Fisher exact test when data are limited ($p<0.05$). Descriptive statistics for continuous variables as age, body mass index, days at hospital and laboratory dana are presented at Table 1. Categorical variables as gender and presence or absence of comorbidity are presented as number and percentage at Table 3.

The Pearson correlation coefficients were calculated to determine the association between characteristics of patients and health outcomes also with significant level $p<0.05$. In order to examine how much of outcome variance can be explained by characteristics of patients we conduct logistic regression model (Table 5 and 6).

Results

The focus of our interest is one-year work with corona patients within the COVID-19 hospital with the aim of insight into patient characteristics and their health outcomes. During one year period total of 530 hospitalized with heavy COVID-19 illness participated in this study. Male hospitalized patients were 54.09% and female 45.91%. The mean patient age was 72 years (Table 1) with standard deviation 12 years. A majority of patients were in the range of 80 to 89 years (29.3%). The smallest number of patients (below 5%) were those younger than 49 years and over 90 years. We were found difference in mortality rates between male and female (Table 3). In our hospital during one year 14.08% (40/284) male and 22.41% (54/241) female died. Patients with 82+ years had twice more mortality (33.3%) from corona than patients 65 to 81 years old (15.1%).

Table 1: Descriptive statistics of patients observed characteristics

	N (%)	Mean	Median	Min	Max	SD
Age						
20-29 years	1 (0,2)					
30-39 years	5 (1,0)					
40- 49 years	16 (3,0)					
50-59 years	57 (10,9)	72,01	73,00	22	95	12,080
60-69 years	132 (25,1)					
70-79 years	142 (27,0)					
80-89 years	154 (29,3)					
> 90 years	18 (3,4)					
Days at hospital						
0 to 3 days	99 (18,9)					
4 to 9 days	278 (53)	7,6	6,51	0	33	5,204
10 to 33 days	148 (28,2)					
CRP	495 (92,4)	103,59	81,20	0,10	449	87,078
D-dimer	229 (43,2)	3075	1055	0,16	35200	66,65,825
Body mass index	472 (89,1)	28,37	27,55	12,40	61,64	5,549

N-number, %-percentage, Min-minimum value, Max –maximum value, SD- standard deviation

Even 157 (29.6%) hospitalized had body mass index over 30. The mean of body mass index was 28.37 kg/m2 which is considered overweigh, but no correlation with health outcomes was found. Non one observed laboratory data showed significance differences in health outcomes.

The presence of comorbidities, especially cardiac comorbidities in corona patients was as follows: hypertension had 325 (61.3%) of patients, coronary heart disease 58 (10.9%) patients, cardiomyopathy had 98 (18.5%), arrhythmic disease had 88 (16.6%), valve disease had 24 (4.5%) (Table 4).

Diabetes as risk factor had 151 patients (28.5%). Patients without any comorbidity were only 55

(10.4%). We also examined the interrelationships of comorbidities (Table 3).

Table 2: Patients characteristics and health outcomes (univariate analysis)

	Discharged from hospital	Transfer to another hospital	Died	p
Variables	N (%)	N (%)	N (%)	
Gender				
Male	228 (80,3)	16 (5,6)	40 (14,1)	
Female	180 (70,7)	7 (2,9)	54 (22,4)	0.02 **
Total	408 (77,7)	23 (4,4)	94 (17,9)	
Age				
22 to 64 years	112 (83)	13 (9,6)	10 (7,4)	
65 to 81 years	204 (81)	10 (4)	38 (15,1)	0.00***
82 and more	92 (66,7)	0 (0)	46 (33,3)	
Total	408 (77,7)	23 (4,4)	94 (17,9)	
Body mass index				
12,4 to 24,63	90 (76,3)	5 (4,2)	23 (19,5)	0.285
24,7 to 27,55	87 (89,8)	3 (5,8)	26 (20,4)	
27,56 to 31,25	93 (80,2)	9 (7,8)	14 (12,1)	
31,26 to 61,64	86 (78,2)	6 (5,5)	18 (16,4)	
CRP				
0,10 to 81	197 (80,70)	11 (4,5)	36 (14,8)	
81,20 to 449	188 (77)	9 (3,7)	47 (19,3)	0.393
D-dimer				
0,16 to 1051	93 (81,6)	2 (1,8)	19 (16,7)	
1052 to 35200	92 (80,7)	0 (0)	22 (19,3)	0.329

Note: p= significance of hi2 tests *p<.05, ***p<.01

Table 3: Comorbidities and health outcomes (x2 test)

	Discharged from hospital	Transfer to another hospital	Died	p
Variables	N (%)	N (%)	N (%)	
Cardiac Comorbidity				
Coronary heart disease	44 (77,2)	1 (1,8)	12 (21,1)	0,113
Cardiomyopathy (all causes)	61 (62,9)	6 (6,2)	30 (30,9)	0,00***
Arrhythmic disease	58 (65,9)	6 (6,8)	24 (27,3)	0,014**
Valve disease	16 (69,6)	2 (8,7)	5 (21,7)	0,49
Hypertension	246 (76,4)	15 (4,7)	61 (18,9)	0,659
Diabetes	109 (73,6)	5 (3,4)	34 (23,0)	0,145
Hypertension + Diabetes	83 (75,5)	3 (2,7)	24 (21,8)	0,698
Obesity (BMI>30)	118 (75,2)	13 (8,3)	26 (16,6)	0,059
Psychiatric diagnoses	46 (74,2)	3 (4,8)	13 (21,0)	0,779
Any Comorbidity				
Absence	48 (88,9)	1 (1,9)	5 (9,3)	
Presence	360 (76,4)	22 (4,7)	89 (18,9)	0,113

Note: H = hypertension, D=diabetes; *p<.05, ***p<.01

Table 4: Total burden of heart disease and outcomes of covid-19 patients

	Total	Discharged from hospital	Transfer to another hospital	Died	p
Variables		N (%)	N (%)	N (%)	
No cardiac comorbidity	54	48 (88,9)	1 (1,9)	5 (9,3)	
1 cardiac comorbidity	216	173 (80,1)	10 (4,6)	33 (15,3)	
2 cardiac comorbidity	89	58 (65,2)	4 (4,5)	27 (30,3)	0.043*
3 and more cardiac comorbidity	58	41 (70,7)	4 (6,9)	13 (22,4)	

Note: *p<.05

Table 5: Pearsons correlation coefficients of comorbidity, gender and age with health outcomes

	CHV	Cardiomyopathy	Arrhythmic disease	Valve disease	Hypertension	Diabetes	BMI
Variables							
Gender	0.006	0.061	0.039	0.037	0.199**	0.009	0.014
Age	0.062	0.227**	0.252**	0.086*	0.0175**	0.048	-0.104*
Health outcomes	0.017	0.171*	0.123*	0.033	0.038	0.074	-0.014

Legend: CHV- coronary heart disease, **. Correlation is significant at the 0.01 level (2-tailed), *. Correlation is significant at the 0.05 level (2-tailed)

As seen at Table 5, patient age correlated with all cardiac comorbidity except cardio heart disease.

We performed series of regression analyses in order to examine how much of health outcomes can be explained by independent variables such as sex, age and all type of comorbidity mainly cardiovascular diseases. At male gender hospitalized persons (Table 6), significant predictors of health outcomes were age of patient, absence of valve disease and/or cardiomyopathia (R^2=0.146 with significance 0.018*). In women, however, cardiomyopathia, obesity and body mass index had a predictive value for the health outcome (R^2=0.102 with significance 0.041* (Table 7).

Table 6: The results of logistic regression model for prediction of health outcomes of male gender

	b	SE b	Beta	t	Significance
(Constant)	0.68	0,289		2,357	0,21
Age	0,213	0,109	0,193	1,954	0,05*
Valve disease	-0,691	0,342	-0,216	-2,019	0,046*
Cardiomyopathia	0,508	0,196	0,279	2,587	0,011*

Note: *p<.05

Table 7: The results of logistic regression model for prediction of health outcomes of female gender

	b	SE b	Beta	t	Significance
(Constant)	1,493	,352		4,240	,000
Cardiomyopathia	,508	,202	,258	2,517	,014
Diabetes	,271	,183	,149	1,483	,142
Obesity	,639	,281	,355	2,274	,025
Body mass index	-,038	,019	-,315	-2,002	,048

Note: *p<.05

Discussion

In our paper, we wanted to view all comorbidities within the category of cardiac disease separately as comorbidities. All the research whose findings we analyzed treated cardiac diseases as one entity and so we have no comparative data to refer to. In our one-year pandemic patient sample, we found a distribution of different comorbidities: hypertension had 61%, coronary heart disease 11%, cardiomyopathy 19%, arrhythmic disease 17%, valve disease 5%. Diabetes mellitus had 29%, obesity almost 30%. Age has been confirmed as a risk factor for serious corona disease outcomes. However, elevated blood pressure and elevated body mass index also laboratory data CRP and d-dimers did not have statistical significance as risk factors which contradicts some of the researchers findings (Berenguer *et al.*, 2020; Gupta *et al.*, 2021; Yang J *et al.*, 2020).

Heart disease and stroke statistics in 2020 declared a serious concern for the general state of health in the population (WHO). Unfortunately, the health status of the entire planet in 2020 received a new challenge: Covid-19 illness. The outcomes of the disease are related to the general physical and mental health of the person and the danger of the disease contributor. Almost at the beginning of the outbreak of pneumonia caused by coronavirus, scientists warned of comorbidities that significantly burden the carrying of SARS-COV-2 virus infection (Guo *et al.*, 2020; Du *et al.*, 2020; Petrilli *et al.*, 2020; Yang HJ *et al.*, 2020; Yang J *et al.*, 2020; Zheng *et al.*, 2020; Zhou *et al.*, 2020; Kumar *et al.*, 2020; Cummings *et al.*, 2020; Ruan *et al.*, 2020).

Comparing the presence of comorbidities in different parts of the world, we encounter different data in a series of papers. Unfortunately, we do not have comparative data for Eastern European countries and we compare the findings with large world nations. Chinese researchers find a range between 35% according to Guo, *et al.* 2020, 48% according to Zhou, *et al.* 2020 to 63% comorbidity for poor outcome according to Ruan, *et al.* 2020). Cardiac comorbidity at Chinese studies were from 8% (Zhou *et al.*, 2020), 8,4% (Yang HJ *et al.*, 2020) to 27,8% (Guo *et al.*, 2020). Comorbidity range in European studies is bigger and ranges from 22% in Denmark (Phelps *et al.*, 2021), 23,3% in Spain (Berenguer *et al.*, 2020) to 29% in UK. In an Indian study, 18% of patients had coronary artery disease (Koya *et al.*, 2021). Kumar, *et al.* (2020) in a meta-analysis of 79 studies cited 18.4% of patients with hypotension, 9.8% with diabetes, 8.8% with cardiovascular disease, 5.8% with endocrine disease, and 5% with gastrointestinal disease.

Various cardio comorbidities showed different outcomes in COVID-19 disease of which cardiomyopathies and arrhythmic disease had significantly more fatal outcomes.

There are several limitations to this research. The first relates to the incompleteness of laboratory data (CRP and D-dimer) and body mass index for each subject. The second objection relates to the retrospective study as a research method since all heart health indicators and others persons characteristics are not quantitatively equalized which limits the possibility of inference. We have not considered the contributions of partial correlations of some other data from the life habits of people that may contribute to the development of the disease (for example, high blood pressure if a person follows a doctor's advice may be a less risk factor).

Conclusion

In our study, we analyzed covid-19 patients in a one-year pandemic period with special reference to the cardiac diseases underlying poor health. Cardiac conditions such as cardiomyopathy and vulvar disease with age over 65 in male patients are burdensome for health, while in women they are cardiomyopathies, body mass index and pathological obesity. All the efforts of cardiologists as well as other different professions that advocate for better cardiovascular health of people are invaluable for human society in general.

References

Alemu Y. Predictors Associated with COVID-19 Deaths in Ethiopia. *Risk management and healthcare policy* 2020; 13: 2769.

Azevedo RB, Botelho BG, de Hollanda JV, Ferreira LV, de Andrade LZ, Oei SS, de Souza Mello T, Muxfeldt ES. Covid-19 and the cardiovascular system: a comprehensive review. *Journal of human hypertension* 2021; 35: 4-11.

Benjamin EJ, Virani SS, Callaway CW, Chamberlain AM, Chang AR, Cheng S, Chiuve SE, Cushman M, Delling FN, Deo R, de Ferranti SD. Heart disease and stroke statistics—2018 update: a report from the American Heart Association. *Circulation* 2018; 137: e67-492.

Berenguer J, Ryan P, Rodríguez-Baño J, Jarrín I, Carratalà J, Pachón J, Yllescas M, Arriba JR, Muñoz EA, Divasson PG, Muñiz PG. Characteristics and predictors of death among 4035 consecutively hospitalized patients with COVID-19 in Spain. Clinical Microbiology and Infection 2020; 26: 1525-1536.

Birkmeyer JD, Barnato A, Birkmeyer N, Bessler R, Skinner J. The Impact Of The COVID-19 Pandemic On Hospital Admissions In The United States: Study examines trends in US hospital admissions during the COVID-19 pandemic. *Health Affairs* 2020; 39: 2010-2017.

Bonow RO, O'Gara PT, Yancy CW. Cardiology and COVID-19. *JAMA* 2020; 324: 1131-1132.

Cen Y, Chen X, Shen Y, Zhang XH, Lei Y, Xu C, Jiang WR, Xu HT, Chen Y, Zhu J, Zhang LL. Risk factors for disease progression in patients with mild to moderate coronavirus disease 2019—a multi-centre observational study. *Clinical Microbiology and Infection* 2020; 26: 1242-1247.

Christensen DM, Strange JE, Gislason G, Torp-Pedersen C, Gerds T, Fosbøl E, Phelps M. Charlson comorbidity index score and risk of severe outcome and death in Danish COVID-19 patients. *Journal of General Internal Medicine* 2020; 35: 2801-2803.

Cummings MJ, Baldwin MR, Abrams D, Jacobson SD, Meyer BJ, Balough EM, Aaron JG, Claassen J, Rabbani LE, Hastie J, Hochman BR. Epidemiology, clinical course, and outcomes of critically ill adults with COVID-19 in New York City: a prospective cohort study. *The Lancet* 2020; 395: 1763-1770.

Dalmazzo LF, de Almendra Freitas AF, Alves BE, Cardoso DK, de Carvalho EF, Akil F, da Cunha Vieira Perini F, Pires KT, de Aguiar LC, Moraes MC, Madeira MI. Transfusion profile, clinical characteristics, comorbidities and outcomes of 3014 hospitalized patients diagnosed with COVID-19 in Brazil. *Vox Sanguinis* 2021.

Du RH, Liang LR, Yang CQ, Wang W, Cao TZ, Li M, Guo GY, Du J, Zheng CL, Zhu Q, Hu M. Predictors of mortality for patients with COVID-19 pneumonia caused by SARS-CoV-2: a prospective cohort study. *European Respiratory Journal* 2020; 55(5).

Elezkurtaj S, Greuel S, Ihlow J, Michaelis EG, Bischoff P, Kunze CA, Sinn BV, Gerhold M, Hauptmann K, Ingold-Heppner B, Miller F. Causes of death and comorbidities in hospitalized patients with COVID-19. *Scientific Reports* 2021; 11: 1-9.

Emami A, Javanmardi F, Pirbonyeh N, Akbari A. Prevalence of underlying diseases in hospitalized patients with COVID-19: a systematic review and meta-analysis. Archives of Academic Emergency Medicine 2020; 8(1).

Europian Society C Guidance for the Diagnosis and Management of CV Disease during the COVID-19 Pandemic, https://www.escardio.org/Education/COVID-19-and-Cardiology/ESC-COVID-19-Guidance

Galván-Tejada CE, Zanella-Calzada LA, Villagrana-Bañuelos KE, Moreno-Báez A, Luna-García H, Celaya-Padilla JM, Galván-Tejada JI, Gamboa-Rosales H. Demographic and comorbidities data description of population in mexico with SARS-CoV-2 infected patients (COVID19): An online tool analysis. *International Journal of Environmental Research and Public Health* 2020; 17: 5173.

Gebhard C, Regitz-Zagrosek V, Neuhauser HK, Morgan R, Klein SL. Impact of sex and gender on COVID-19 outcomes in Europe. *Biology of sex differences* 2020; 11: 1-3.

Guo T, Fan Y, Chen M, Wu X, Zhang L, He T, Wang H, Wan J, Wang X, Lu Z. Cardiovascular implications of fatal outcomes of patients with coronavirus disease 2019 (COVID-19). *JAMA cardiology* 2020; 5: 811-818.

Gupta R, Agrawal R, Bukhari Z, Jabbar A, Wang D, Diks J, Alshal M, Emechebe DY, Brunicardi FC, Lazar JM, Chamberlain R. Higher comorbidities and early death in hospitalized African-American patients with Covid-19. *BMC Infectious Diseases* 2021; 21: 1.

Guzik TJ, Mohiddin SA, Dimarco A, Patel V, Savvatis K, Marelli-Berg FM, Madhur MS, Tomaszewski M, Maffia P, D'acquisto F, Nicklin SA. COVID-19 and the cardiovascular system: implications for risk assessment, diagnosis, and treatment options. *Cardiovascular research* 2020; 116: 1666-1687.

Jordan RE, Adab P, Cheng K. Covid-19: Risk factors for severe disease and death. *British Medical Journal Publishing Group* 2020.

Koya SF, Ebrahim SH, Bhat LD, Vijayan B, Khan S, Jose SD, Pilakkadavath Z, Rajeev P, Azariah JL. COVID-19 and

Comorbidities: Audit of 2,000 COVID-19 Deaths in India. *Journal of Epidemiology and Global Health* 2021; 11: 230-232.

Kumar A, Arora A, Sharma P, Anikhindi SA, Bansal N, Singla V, Khare S, Srivastava A. Clinical features of COVID-19 and factors associated with severe clinical course: a systematic review and meta-analysis. *Social Science Research Network* 2020.

Lang JP, Wang X, Moura FA, Siddiqi HK, Morrow DA, Bohula EA. A current review of COVID-19 for the cardiovascular specialist. *American heart journal* 2020; 226: 29-44.

Liu PP, Blet A, Smyth D, Li H. The science underlying COVID-19: implications for the cardiovascular system. *Circulation* 2020; 142: 68-78.

Long B, Brady WJ, Koyfman A, Gottlieb M. Cardiovascular complications in COVID-19. *The American journal of emergency medicine* 2020; 38: 1504-1507.

Lu H, Stratton CW, Tang YW. Outbreak of pneumonia of unknown etiology in Wuhan China: the mystery and the miracle. *J Med Virol* 2020; 92: 401-402

Petrilli CM, Jones SA, Yang J, Rajagopalan H, O'Donnell L, Chernyak Y, Tobin KA, Cerfolio RJ, Francois F, Horwitz LI. Factors associated with hospital admission and critical illness among 5279 people with coronavirus disease 2019 in New York City: prospective cohort study. *BMJ* 2020; 369.

Phelan AL, Katz R, Gostin LO. The novel coronavirus originating in Wuhan, China: challenges for global health governance. *JAMA* 2020; 323: 709-710.

Phelps M, Christensen DM, Gerds T, Fosbøl E, Torp-Pedersen C, Schou M, Køber L, Kragholm K, Andersson C, Biering-Sørensen T, Christensen HC. Cardiovascular comorbidities as predictors for severe COVID-19 infection or death. *European Heart Journal-Quality of Care and Clinical Outcomes* 2021; 7: 172-180.

Puškarić F, Čikeš M. COVID-19 i bolesnici sa zatajivanjem srca. *Medicus* 2020; 29(2 COVID-19): 205-210.

Ruan Q, Yang K, Wang W, Jiang L, Song J. Clinical predictors of mortality due to COVID-19 based on an analysis of data of 150 patients from Wuhan, China. *Intensive care medicine* 2020; 46: 846-848.

Strozzi M, Brida M, Došen D, Lovrić D, Anić D, Ivanac Vranešić I, Marić Bešić K, Planinc M, Međimurec G, Hrabak Paar M. Izvještaj sa sastanka multidisciplinarnog tima za priređene srčane bolesti odraslih održanog u vrijeme pandemije COVID-a 19. *Cardiologia Croatica* 2020;15: 296-305.

Sun K, Chen J, Viboud C. Early epidemiological analysis of the coronavirus disease 2019 outbreak based on crowdsourced data: a population-level observational study. *The Lancet Digital Health* 2020; 2: e201-e208.

Veer M, Kumar AM, Ivanova V. COVID-19 and the Cardiovascular System. *Critical Care Nursing Quarterly* 2020; 43: 381-389.

Virani SS, Alonso A, Benjamin EJ, Bittencourt MS, Callaway CW, Carson AP, Chamberlain AM, Chang AR, Cheng S, Delling FN, Djousse L. Heart disease and stroke statistics—2020 update: a report from the American Heart Association. *Circulation* 2020; 141: e139-596.

Wang L, He W, Yu X, Hu D, Bao M, Liu H, Zhou J, Jiang H. Coronavirus disease 2019 in elderly patients: characteristics and prognostic factors based on 4-week follow-up. *Journal of Infection* 2020; 80: 639-645.

Williamson E, Walker AJ, Bhaskaran K, Bacon S, Bates C, Morton CE, Curtis HJ, Mehrkar A, Evans D, Inglesby P, Cockburn J. OpenSAFELY: factors associated with COVID-19-related hospital death in the linked electronic health records of 17 million adult NHS patients. *MedRxiv* 2020.

World Health Organisation; https://covid19.who.int/ on 11/04/2021

Wu J, Mafham M, Mamas MA, Rashid M, Kontopantelis E, Deanfield JE, de Belder MA, Gale CP. Place and underlying cause of death during the COVID-19 pandemic: retrospective cohort study of 3.5 million deaths in England and Wales, 2014 to 2020. *In Mayo Clinic Proceedings* 2021; 96: 952-963.

Yang HJ, Zhang YM, Yang M, Huang X. Predictors of mortality for patients with COVID-19 pneumonia caused by SARS-CoV-2. *European Respiratory Journal* 2020; 56.

Yang J, Zheng Y, Gou X, Pu K, Chen Z, Guo Q, Ji R, Wang H, Wang Y, Zhou Y. Prevalence of comorbidities and its effects in patients infected with SARS-CoV-2: a systematic review and meta-analysis. *International Journal of Infectious Diseases* 2020; 94: 91-95.

Zheng YY, Ma YT, Zhang JY, Xie X. COVID-19 and the cardiovascular system. *Nature Reviews Cardiology* 2020; 17: 259-260.

Zhou F, Yu T, Du R, Fan G, Liu Y, Liu Z, Xiang J, Wang Y, Song B, Gu X, Guan L. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. *The lancet* 2020; 395: 1054-1062.