ORIGINAL ARTICLE

COVID-19–related risk of in-hospital death in Silesia, Poland

Małgorzata Kowalska, Kamil Barański, Grzegorz Brożek, Angelina Kaleta-Pilarska, Jan E. Zejda

Department of Epidemiology, School of Medical Sciences in Katowice, Medical University of Silesia in Katowice, Katowice, Poland

KEY WORDS

COVID-19, death, in-hospital fatality rate, risk factors

ABSTRACT

INTRODUCTION The situation regarding COVID-19 in Poland is rapidly evolving. Because of this, it is important to investigate COVID-19 mortality and its predictors in one of the most densely populated regions of the country, Silesia Province.

OBJECTIVES The goals of this study were to assess in-hospital mortality due to COVID-19 and the impact of sex, age, and coexisting diseases on the risk of death.

PATIENTS AND METHODS The data analysis was based on discharge reports of patients with COVID-19 hospitalized between March and June 2020 in all hospitals in the region. Age, sex, hospital discharge status, and the presence of coexisting diseases were abstracted from the charts.

RESULTS In a group of 2830 in-patients with COVID-19, 325 died during hospitalization. COVID-19 deaths were associated with male sex (odds ratio [OR], 1.52; 95% CI, 1.17–1.96), older age (OR, 6.11; 95% CI, 4.5–8.31), and the presence of 3 or more coexisting diseases (OR, 4.78; 95% CI, 3.52–6.49). The most prevalent comorbidities were chronic cardiovascular and respiratory diseases.

CONCLUSIONS The estimated in-hospital fatality rate for COVID-19 was 11.5%, which is lower than the average COVID-19 fatality rate in other European countries. The risk of in-hospital death was associated with sex, age, and the number of coexisting diseases, such as chronic cardiovascular and respiratory diseases.

INTRODUCTION By the end of 2020, the cumulative number of confirmed cases of COVID-19 was 79 232 555 globally. This resulted in 1 754 493 deaths and a 2.2% case-fatality rate (CFR).[1] In Europe, the CFR ranges from 1.8% in Ukraine and Russia to 3.5% in Italy and 3.6% in Bulgaria.[2] The vast majority of patients with COVID-19 do not require hospitalization because of a mild course of the disease.

Early clinical reports coming mostly from China showed that a severe course requiring hospitalization is associated with a substantial risk of mortality and, based on one report, can approach 30%.[3] A more recent large, retrospective cohort study of 6493 cases in New York reported a 25.9% CFR among hospitalized patients.[4] The New York study identified predictors of in-hospital mortality as older age, male sex, and clinical signs of impaired renal and respiratory function. However, the authors did not find an independent impact of coexisting medical conditions such as hypertension, diabetes, or cancer. Hospitalized patients with COVID-19 are predominantly adults and 70% are aged 50 years or older.[5] The age structure explains the high prevalence of comorbidities in this population; for example, among patients hospitalized with COVID-19, approximately 35% had coexisting cardiovascular disease, 20% had coexisting chronic lung disease, and 40% had coexisting metabolic disease.[5] Several studies have documented the role of coexisting diseases in COVID-19 mortality.[6,7] The results of a recent comprehensive review and meta-analysis showed that 70% of COVID-19 fatalities were associated with such comorbidities as hypertension (48%), diabetes (25%), and respiratory disease (11%).[8] However, cardiovascular diseases did not appear to relate to fatality, a finding that the authors explained as being due to the small sample size.

In Poland, by the end of 2020, the confirmed cumulative number of COVID-19 cases was 1 257 799 and the related overall fatality rate was 2.1%.[1] The results of molecular, antigen tests for

Correspondence to:
Prof. Grzegorz Brożek, MD, PhD, Department of Epidemiology, Medical University of Silesia, ul. Medyków 18, 40-752 Katowice, Poland, phone: +48 32 252 37 34, email: gbrozek@sum.edu.pl
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WHAT'S NEW?

The risk of death in patients hospitalized with COVID-19 is greater in men than in women (odds ratio [OR], 1.35; 95% CI, 1.07–1.7), increases with age (on average, survivors are 18 years younger than deceased patients), and increases with the number of coexisting diseases, mostly with chronic cardiovascular, respiratory, and metabolic diseases. Sex, age, and comorbidities are independent factors that influence the risk of death from COVID-19. Having 3 or more comorbidities increases the risk of death in all patients; however, its impact is greater in patients under the age of 65 years (OR, 13.32) than in older patients (OR, 6.48).

SARS-CoV-2 in Silesia Province indicate that in the first half of 2020 (the first wave of the epidemic), the infection rate was approximately 5% and the symptomatic form of the disease made up approximately 20% of cases.[9] An analysis of the frequency of infection and mortality in the region revealed substantial variation in both; however, the authors emphasized that this difference could not be explained due to the analysis being descriptive and the epidemiological data being secondary.

However, the proportion of in-hospital mortality due to COVID-19 within the overall mortality due to COVID-19 remains unknown. Between-population variation in COVID-19 mortality may depend on many factors and coexisting chronic diseases are likely to contribute to this apparent variability. With this in mind, we analyzed available registry data to assess in-hospital mortality due to COVID-19 and the impact of coexisting diseases on the risk of COVID-19 death.

PATIENTS AND METHODS

The source of data for this study was hospital discharge reports available from March to June 2020. Data were obtained from the Department of Health's Department for Monitoring, Analyses, and Medical Statistics of the Silesia Province Office in Katowice, Poland, as part of routine reporting on "Analysis of Statistical Data." They covered all COVID-19–related hospital deaths (deaths due solely to COVID-19 and deaths due to comorbidity).[10] The reports were submitted from all hospitals (private and public) located in Silesia Province, Poland, though it should be pointed that all COVID-19–dedicated hospitals in Poland are public.

In this large administrative district (the population is 4.5 million and the population density is 366.3 people/km^2), the number of monthly COVID-19 hospitalizations significantly increased between March and June 2020. Over the same period, the absolute number of COVID-19 deaths also increased, reaching 122 fatalities in June, which resulted in an in-hospital CFR of 9.2% (FIGURE 1). According to the World Health Organization guidelines, a confirmed case of COVID-19 was defined as a positive result from a real-time reverse transcriptase–polymerase chain reaction assay of nasal or pharyngeal swab specimens.[11]

Statistical analysis The data analysis involved reports with a diagnosis of COVID-19 on discharge.[12] The available information included age, sex, hospital discharge status, and coexisting medical conditions. Comorbidities were grouped into categories based on the *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision* (*ICD-10*) codes and included cardiovascular diseases (I00–I99), respiratory diseases (J00–J99), and metabolic diseases (E00–E99). The age of the patients was presented as mean (SD) while categorical values were presented as absolute and relative frequencies. Differences between independent groups were tested by the Mann–Whitney test for continuous measures (non-normal distribution according to the Shapiro–Wilk test) or the χ^2 test for categorical measures. Statistical testing of a significant trend was assessed using the χ^2 test for trend. The associations between age, sex, and the number of comorbidities and death were calculated using raw odds ratios (ORs) and 95% CIs. Results of simple analyses were verified using multivariable logistic regression with survival status as the dependent variable and number of comorbidities, age, and sex as explanatory variables. A P value below 0.05 was considered significant throughout the analysis, which was performed with the Statistica 13.0 package (TIBCO Software, Inc., Palo Alto, California, United States). The study protocol was approved by the Ethics Committee of the Medical University of Silesia (PCN/0022/KB1/61/20). As we were working on secondary, anonymous data collected at the province level, written informed consent to participate in the study was not required.

We analyzed the data provided by the available hospital discharge records from all hospitals in Silesia Province. We extracted data on age, sex, diagnosis of COVID-19, coexisting diseases, and the outcome of hospitalization (death or survival). In particular, we aimed to examine the effect of the number of coexisting diseases and of major types of coexisting diseases, including cardiovascular, respiratory, and metabolic diseases.

RESULTS

The cumulative (March–June) in-hospital COVID-19 fatality rate was 11.5%. The mean (SD) age of all 2830 hospitalized patients was 58 (19.4) years. Women made up 48.4% of the study population. The age distribution of the study group by sex and death is presented in TABLE 1. Those who died were older on average than survivors.

All hospitalized patients were divided into 4 groups defined by the number of coexisting diseases with the principal diagnosis of COVID-19: "0 coexisting diseases" (n = 1750), "1 coexisting disease" (n = 504), "2 coexisting diseases" (n = 219), and "3 coexisting diseases" (n = 357). A clear association between the occurrence of COVID-19 death and the number of comorbidities is shown in FIGURE 2. This trend was significant (P <0.001).

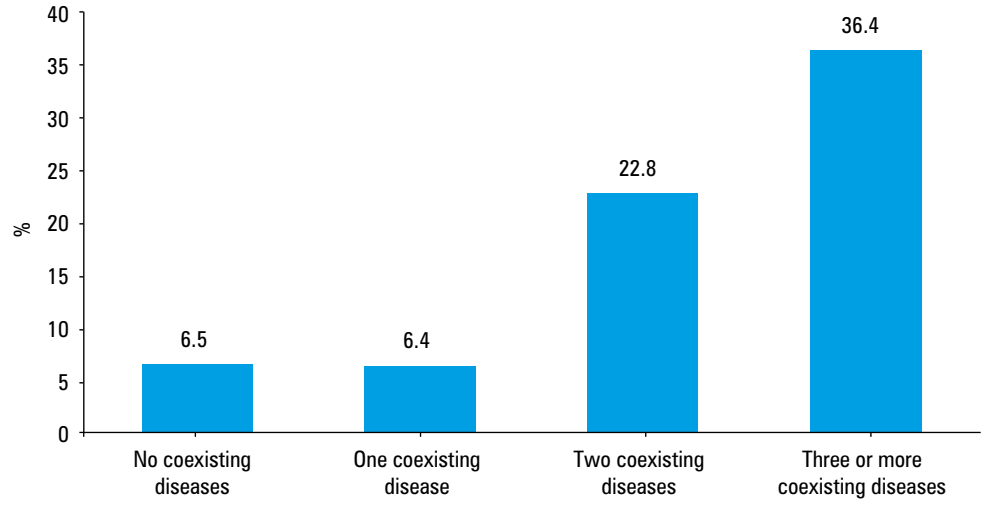

FIGURE 1 Frequency of COVID-19 deaths in groups of patients with COVID-19 hospitalized March–June 2020 in Silesia Province, Poland, according to the number of coexisting diseases

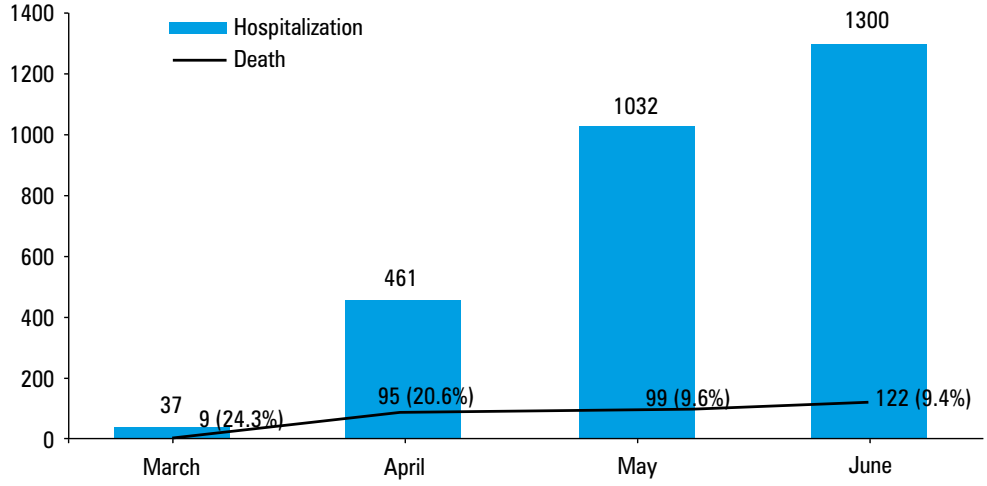

FIGURE 2 Number of daily hospitalizations and deaths due to COVID-19 in Silesia Province, Poland, from March 1 to June 30, 2020

TABLE 1 Mean age of patients hospitalized for COVID-19 in Silesia Province between March and June 2020 by sex and survival status

Patients	N	Age, y, mean (SD)	*P* value[a]
Female patients with COVID-19	1371	58.6 (20.2)	0.057
Male patients with COVID-19	1459	57.4 (18.7)	
Patients who died of COVID-19	325	73.7 (12.1)	<0.001
Patients who died of causes other than COVID-19	2505	55.9 (19.2)	
Total	2830	58 (19.4)	–

a Result of the Mann–Whitney test

In total, the frequency of death was 9.9% in women and 12.9% in men. The difference was significant (P = 0.014) and the association showed an increased risk of death for men (OR, 1.35; 95% CI, 1.07–1.7). When comparing age groups, the respective proportions of those dying were 3.5% and 22.8% for those under 65 years of age and those 65 years or older, respectively (P <0.001; OR, 8.01; 95% CI, 5.97–10.75).

The association between the number of coexisting diseases and COVID-19 deaths for all patients as well as by sex and age is presented in TABLE 2. In all patients and all subgroups, the risk of death increased with an increasing number of comorbidities. The coexistence of 2 or more diseases was more strongly associated with the risk of COVID-19 death in younger hospitalized patients (<65 years) than in older ones.

The results from simple analyses were verified using a multivariable logistic regression model with the number of comorbidities, age category, and sex as explanatory variables. The results of the multivariable analysis are presented in TABLE 3.

The results of the multivariable analysis confirmed that after adjustment for age and sex, the risk of death due to COVID-19 was related to the number of coexisting diseases and that it followed an exposure-response pattern.

The second objective of the study was to investigate the impact of 3 major disease categories (cardiovascular, respiratory, and metabolic

TABLE 2 Risk of COVID-19 death by the number of coexisting diseases in all patients in Silesia Province, Poland, March–June 2020; subgroups were defined by sex and age

Hospitalized patients	OR (95% CI)		
	One coexisting disease	Two coexisting diseases	Three coexisting diseases
Women	1.12 (0.59–2.09)	5.83 (3.31–10.26)	9.19 (5.92–14.26)
Men	0.88 (0.52–1.49)	3.34 (2.05–5.44)	7.67 (5.23–11.26)
Age <65 y	1.25 (0.51–3.11)	6.48 (3.06–13.73)	13.32 (6.94–25.55)
Age ≥65 y	0.57 (0.36–0.91)	2.37 (1.52–3.7)	3.58 (2.56–4.99)
Overall	0.98 (0.65–1.47)	4.29 (2.97–6.2)	8.31 (6.23–11.08)

Abbreviations: OR, odds ratio

TABLE 3 Impact of the number of coexisting diseases on the risk of COVID-19 death, controlled for age and sex (results of multivariable logistic regression)

Independent variable	Class	OR (95% CI)
Number of comorbidities	1 vs 0 (ref.)	0.7 (0.46–1.06)
	2 vs 0 (ref.)	3.05 (2.07–4.51)
	3 vs 0 (ref.)	4.78 (3.52–6.49)
Age group	≥65 y vs <65 y (ref.)	6.11 (4.5–8.31)
Sex	Men vs women (ref.)	1.52 (1.17–1.96)

Abbreviations: ref., reference; others, see TABLE 2

diseases) on the risk of death due to COVID-19. Among patients with only 1 comorbidity, there were no cases of metabolic diseases, and among patients with 2 comorbidities, there were no cases with coexisting diagnoses of cardiovascular and metabolic diseases. Among 504 patients with a single comorbidity, the most prevalent diagnoses were cardiovascular (19.2%) and respiratory (28.3%) diseases. The respective COVID-19 fatality rates in these subgroups were 6.2% and 11.2%. The remaining 264 patients with a single comorbidity had other diagnoses and in this subgroup the COVID-19 fatality rate was 3.8%. Two coexisting diseases were found in 219 patients. The coexistence of cardiovascular and respiratory diseases (n = 38) was associated with a COVID-19 fatality rate of 31.6%. In the remaining 181 cases with 2 comorbidities, the COVID-19 fatality rate was 21%. The 3 abovementioned diseases were not found to coexist in the study group. Cardiovascular disease, either by itself or as one of the coexisting comorbidities, was found in 511 patients and was associated with a COVID-19 fatality rate of 25.6%. Respiratory disease was found in 431 patients and was associated with a COVID-19-fatality rate of 32.5%.

DISCUSSION The serious epidemiological situation of COVID-19 in Poland justifies the analysis of mortality in one of the most densely populated regions of the country, Silesia Province. Recent data (reported on December 31, 2020) revealed that the total mortality rate due to COVID-19 remains high in Poland (74.1/100 000 population) although somewhat lower than in Sweden (86.1/100 000) and significantly lower than in Czechia (108/100 000), the United Kingdom (106.6/100 000), Belgium (167.4/100 000), or Spain (108.4/100 000). The mortality rate is lower in Germany, where it stands at 39.5/100 000.[13] In our study, we focused not on general COVID-19 mortality but on in-hospital mortality, including the COVID-19 fatality rate.

The results of our study show that the unadjusted cumulative in-hospital COVID-19 fatality rate was 11.5% over the period from March to June 2020. A comprehensive review of evidence published in mid-2020 provided slightly higher in-hospital mortality figures across Europe and the United States, at 22.2% and 22.9%, respectively.[14] The lower value of the cumulative in-hospital COVID-19 fatality in our study, compared with foreign centers, may result from different eligibility criteria for hospital admissions. Polish rules are regulated by an ordinance of the Chief Sanitary Inspector.[15]

The figure obtained in our study is lower than expected, even considering differences in the clinical status of admitted patients and other unknown factors. Moreover, this figure does not reflect the dynamics of in-hospital mortality over time that have been seen by others.[16] As expected, the in-hospital COVID-19 fatality rate is larger than the population-based COVID-19 fatality rates because of the different denominators used in the calculations. In Poland, the fatality rate of COVID-19 observed in the general population (where the denominator represents all cases) is 2.2%, as compared with 2% in Germany or 3.5% in Italy.[17]

Our findings confirm that the risk of death among hospitalized male patients with COVID-19 is greater than for women. This observation is in line with evidence published in other reports.[4,18] Moreover, the risk of mortality increases with the increasing age of patients, a finding which is consistent with the results of the SARSTer study.[19] In our study, the mean ages of surviving and deceased patients were 55.9 and 73.7 years, respectively. The mean age at death of our patients with COVID-19 was similar to that reported in other studies.[6,7] The experience gained during the Italian epidemic points to age as being one of the most important risk factors for COVID-19 mortality,[20] and this conclusion is supported by findings from Spain.[21]

Regarding the second objective of our study, our findings confirm that the risk of death due to COVID-19 increases with the increasing number of coexisting diseases, reaching a peak when there are 3 or more comorbidities. Moreover, the results of our analysis suggest that sex, age, and occurrence of comorbidities are independent factors that influence the risk of COVID-19 death, and that the impact of the last factor (number of comorbidities) follows an exposure-response relationship.

Chronic coexisting cardiovascular, respiratory, and metabolic diseases appear to contribute to the risk of COVID-19 death. Such a constellation of diseases is similar to the published evidence

on the role of coronary artery disease, cerebrovascular disease, and dyspnea, all classified as independent risk factors for COVID-19 mortality.[6] Another disorder that has been confirmed to increase the risk of death is arterial hypertension.[7] The results of a meta-analysis suggest that hypertension may be associated with up to a 2.5-fold higher risk of severe or fatal COVID-19, especially in older individuals.[22]

A significant contribution from sex, age, and coexisting diseases to COVID-19 fatality has been reported in several studies. A report from the United Kingdom highlights the impact of male sex, greater age, and the presence of diabetes, severe asthma, and various other medical conditions.[18] Age, sex, and the presence of pneumonia, diabetes, arterial hypertension, obesity, immunosuppression, and end-stage kidney disease were identified as major independent risk factors for COVID-19 mortality in Mexico.[23]

An interesting observation provided by our study is the greater risk of death in younger (<65 years) than in older (65+ years) patients with comorbidities. In the younger age group, the occurrence of 3 or more comorbidities moved the risk of COVID-19 death to an OR of 13.32, whereas in the older age group it was 6.48. A similar between-group difference in ORs was found when the condition of 2 coexisting diseases was taken into account (3.58 vs 2.37, respectively). A resulting "mirror image" is difficult to explain given the lack of specific information concerning the clinical condition of the patients. It cannot be excluded, however, that the presence of multiple comorbidities in younger people has a larger overall impact on health status (and related susceptibility resulting in a more severe course of SARS--CoV-2 infection) compared with the impact of the more natural presence of multiple comorbidities among the elderly. The format and content of our source data hamper a deeper explanation of this finding. It cannot be excluded that other factors contribute to this gradient and sometimes the likely cause exceeds biological phenomena. For example, the higher COVID-19 mortality of patients younger than 19 years in Brazil was ascribed to insufficient provision of intensive care unit beds for this age group,[24] though such a cause is not likely in Poland.

Our study has several important limitations. The protocol covers a relatively short follow-up (from March to June 2020) and current patterns remain unknown. However, this is unavoidable due to delays in data releases; likewise, other published reports dealing with hospital records also have a limited follow-up. Another limitation stems from the fact that we used secondary epidemiological data. Despite this, the hospital discharge reports came from all hospitals in a large administrative district. A sample of this size justifies extrapolating the findings to the full national population. The format of the discharge files was restricted to basic information, so it was not possible to extract any information regarding clinical severity, treatment, and duration of COVID-19 and coexisting chronic diseases. In addition, there may be residual confounding due to the lack of additional sociodemographic information. The last unknown factor potentially affecting our findings is the possibility of the reported diagnoses being misclassified, which has also been discussed by others.[25-27] However, given the very high public health concern and the availability of all necessary diagnostic procedures in the hospitals of Silesia Province, such confounding seems very unlikely.

Conclusions In conclusion, the estimated unadjusted in-hospital fatality rate of COVID-19 in Silesia Province (Poland) is 11.5%. This value is lower than the mean COVID-19 fatality rate in other European countries and this finding deserves more specific investigation. In-hospital mortality was associated independently with sex, age, and the number of coexisting chronic diseases, in an exposure-effect manner concerning the latter factor. The increased risk of death in patients with COVID-19 is associated with the presence of chronic cardiovascular and respiratory diseases.

ARTICLE INFORMATION

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CONTRIBUTION STATEMENT MK and JEZ created the concept of the study. MK and JEZ contributed to the design of the research. MK and KB analyzed the data. JEZ coordinated funding for the project. All authors were involved in data collection, made substantial contributions to the concept and design of the study, or acquisition of data, or analysis and interpretation of data, drafting the article and revising it critically for important intellectual content, and all approved the final version of the manuscript.

CONFLICT OF INTEREST None declared.

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REFERENCES

1 WHO Coronavirus Disease (COVID-19) Dashboard. https://covid19.who.in. Accessed December 28, 2020.

2 Johns Hopkins Coronavirus Resource Center. https://coronavirus.jhu.edu/data/mortality. Accessed December 28, 2020.

3 Fei Z, Ting Y, Ronghui D, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. Lancet. 2020; 395: 1054-1062.

4 Mikami T, Miyashita H, Yamada T, et al. Risk factors for mortality in patients with COVID-19 in New York City. J Gen Intern Med. 2020.; 36: 17-26.

5 CDC COVID-Net. https://gis.cdc.gov/grasp/COVIDNet/COVID19-5.html. Accessed December 28, 2020.

6 Chen R, Liang W, Jiang M, et al. Risk factors of fatal outcome in hospitalized subjects with coronavirus disease 2019 from a nationwide analysis in China. Chest. 2020; 158: 97-105.

7 Biaggi A, Rossi L, Malagoli A, et al. Clinical and epidemiological characteristics of 320 deceased Covid-19 patients in an Italian province: a retrospective observational study. J Med Virol. 2020; 92: 2718-2724.

8 Gold MS, Sehayek D, Gabrielli S, et al. COVID-19 and comorbidities: a systematic review and meta-analysis. Postgrad Med. 2020; 132: 749-755.

9 Kowalska M, Hudzik G, Wodzisławska-Czapla D, et al. Spatial variability of SARS-CoV-2 infections in the Silesian Voivodeship, Poland. Przegl Epidemiol. 2020; 74: 432-440.

10 "Statistical Card Analysis" IT system. Silesian Voivodship Office in Katowice, Department of Health. Department for Monitoring, Analysis and Medical Statistics. Accessed November 18, 2020.

11 Nowak B, Szymański P, Pańkowski I, et al. Clinical characteristics and short-term outcomes of patients with coronavirus disease 2019: a retrospective single-center experience of a designated hospital in Poland. Pol Arch Intern Med. 2020; 130: 407-411.

12 World Health Organization. International guidelines for certification and classification (coding) of COVID-19 as cause of death. Based on ICD International Statistical Classification of Diseases (16 April 2020). https://www.who.int/classifications/icd/Guidelines_Cause_of_Death_COVID-19.pdf?ua=1. Accessed December 15, 2020.

13 Worldometers website. Reported cases and deaths by country, territory, or conveyance. https://www.worldometers.info/coronavirus/#countries. Accessed December 31, 2020.

14 Goel S, Jain T, Hooda A, et al. Clinical characteristics and in-hospital mortality for COVID-19 across the globe. Cardiol Ther. 2020; 9: 553-559.

15 Information of the Chief Sanitary Inspector for hospitals due to the dynamically developing epidemiological situation related to the spread of the new SARS-CoV-2 coronavirus. Warsaw, 27.02.2020 [in Polish]. https://www.nfz-szczecin.pl/swiadczeniodawcy_news_2838_informacja_glownego_inspektora_sanitarnego_dla_szpitali_w_zwiazku_z_dynamicznie_rozwijajaca_sie_sytuacja_epidemiologiczna_zwiazana_z_szerzeniem_sie_nowego_koronawirusa_sars_cov_2.htm. Accessed February 25, 2021.

16 Docherty AB, Mulholland RH, Lone LI, et al. Changes in UK hospital mortality in the first wave of COVID-19: the ISARIC WHO Clinical Characterisation Protocol prospective multicentre observational cohort study. medRxiv. 2020. [Epub ahead of print]. doi:https://doi.org/10.1101/2020.12.19.20248559

17 Johns Hopkins Coronavirus Resource Center. Mortality analyses. https://coronavirus.jhu.edu/data/mortality. Accessed January 5, 2021.

18 Williamson EJ, Walker AJ, Bhaskaran K, et al. Factors associated with COVID-19-related death using OpenSAFELY. Nature. 2020; 584: 430-436.

19 Flisiak R. COVID-19 mortality data from the SARSTer database, January 26, 2021. Polish Society of Epidemiologists and Physicians of Infectious Diseases Department of Infectious Diseases and Hepatology, Medical University of Białystok [in Polish]. http://www.pteilchz.org.pl/wp-content/uploads/2021/01/%C5%9Bmiertelno%C5%9B%C4%87-w-Polsce-26-01-2021.pdf. Accessed February 24, 2021.

20 Onder G, Rezza G, Brusaferro S. Case-fatality rate and characteristics of patients dying in relation to COVID-19 in Italy. JAMA. 2020; 323: 1775-1776.

21 Vázquez NM, Manrique-Arija S, Cabezudo-García P, et al. Incidence and case fatality rate of COVID-19 in patients with inflammatory articular diseases. Int J Clin Pract. 2021; 75: e13707.

22 Lippi G, Wong J, Henry BM. Hypertension in patients with coronavirus disease 2019 (COVID-19): a pooled analysis. Pol Arch Intern Med. 2020; 130: 304-309.

23 Peña JE, Rascón-Pacheco RA, Ascencio-Montiel IJ, et al. Hypertension, diabetes and obesity, major risk factors for death in patients with COVID-19 in Mexico. Arch Med Res. 2020; 16: S0188-4409: 32243-32248.

24 de Siqueira Alves Lopes A, Fontes Vieira SC, Lima Santos Porto R, et al. Coronavirus disease-19 deaths among children and adolescents in an area of Northeast, Brazil: why so many? Trop Med Int Health. 2020; 26: 115-119.

25 Centers for Disease Control and Prevention. National Centre for Health Statistics. Excess deaths associated with COVID-19. provisional death counts for coronavirus disease (COVID-19). https://www.cdc.gov/nchs/nvss/vsrr/covid19/excess_deaths.htm. Accessed January 4, 2021.

26 Brown RB. Public health lessons learned from biases in coronavirus mortality overestimation. Disaster Med Public Health Prep. 2020; 14: 364-371.

27 Michelozzi P, de'Donato F, Scortichini M, et al. Temporal dynamics in total excess mortality and COVID-19 deaths in Italian cities. BMC Public Health. 2020; 20: 1238.