DOI: 10.4149/BLL_2022_053

Bratisl Med J 2022; 123 (5)
339 – 346

CLINICAL STUDY

Polymorbidity in seniors hospitalized for COVID-19

DUBRAVA Martin, JANOSIOVA Jarmila, BORUCKY Jakub, KOROMHAZOVA Anna, MAJEKOVA Jana, STUGELOVA Katarina, VALENTOVA Martina, SUBA Jan Jr.

1st Department of Geriatrics, Comenius University, Faculty of Medicine, Bratislava, Slovakia.
martin.dubrava@fmed.uniba.sk

ABSTRACT
BACKGROUND: The health of seniors is usually characterized by polymorbidity. With regard to *quoad vitam* prognosis, COVID-19 is extremely risky for seniors. The data on polymorbidity in seniors with COVID-19 are scarce.
OBJECTIVE: To investigate comorbidity in seniors diagnosed with COVID-19 and requiring hospitalization.
METHODS: In a retrospective observational study, we analyzed patients aged 65 years or older and hospitalized primarily for COVID-19 from November 1, 2020, to April 30, 2021 (n=155; mean age 82 years). We monitored the presence of 48 diseases accompanying COVID-19.
RESULTS: The mean (minimal - maximal) number of acute, chronic and all comorbidities were 1.8 (0–5), 11.3 (2–20) and 13.1 (4–22), respectively. Excessive comorbidity (>10 diseases) was present in 72.3 %. Comorbid arterial hypertension was diagnosed in 86 %, chronic kidney disease in 86 %, hepatopathy in 82 %, coronary artery disease in 79 %, dehydration in 46 %, and urinary infections in 30 %. Twenty-six chronic comorbidities had a prevalence of >10 %. Residents of social care facilities (SCF) had significantly higher polymorbidity than home-living seniors (on average by 3.5 more diseases, their OR for excessive polymorbidity was 11.8). The prevalence of overall, chronic and excess polymorbidity increased up to the age of 84 years. Nine out of ten seniors aged 80 years or older had 11 or more comorbidities.
CONCLUSION: The burden of accompanying diseases in seniors with severe COVID-19 is very high. Seniors living in SCF are particularly at risk *(Tab. 5, Fig. 8, Ref. 58)*. Text in PDF *www.elis.sk*
KEY WORDS: COVID-19, geriatrics, polymorbidity.

Introduction

Since December 2019, COVID-19 caused by the "new virus" SARS-CoV-2 (SARS = severe acute respiratory syndrome, CoV = corona virus) has fundamentally changed the functioning of the world, including Slovakia. It can be asymptomatic (mostly) or with mild symptoms (the affected individuals might be treated as outpatients, i.e., at home), but it also may have a severe course (requiring hospitalization) or a very severe course (with the need of high-flow oxygen therapy, mechanical ventilation, and even extracorporeal membrane oxygenation, etc.). COVID-19 is associated with high lethality/ mortality (1). Seniors are especially at high risk (2, 3, 4, 5). COVID-19 is presented mainly by the respiratory system injury, but other organ systems are also affected (6). Since the beginning of 2020, we have been literally flooded with information about COVID-19 (7, 8) appearing from everywhere (starting with governments and ending with medical information sources).

Literary data agree that seniors have a more severe course of COVID-19 as compared to younger people (9, 10). The usual polymorbidity in seniors is cited as the main cause of the increased risk of hospitalization (11, 12) and lethality (13, 14, 15, 16) for COVID-19, although this association may not be significant (17). If COVID-19 occurs in people without comorbidities, patients under 65 years of age are really rare (18). Among COVID-19 comorbidities, obesity, diabetes, arterial hypertension, and other chronic diseases pose a particular risk (19). Polymorbidity in association with COVID-19 has already been genetically studied (20) included in COVID-19 mathematical models (21) and found to affect the comparability of lethality risk (22). Original papers published in renowned medical sources on any aspect of COVID-19 in seniors usually also provide information about their polymorbidity. However, usually only a few COVID-19 comorbidities are presented, i.e., several "traditional, major, risky diseases" are reported, such as diabetes or arterial hypertension. Morbidity also varies geographically with COVID-19 (23). To our knowledge, more comprehensive data on the polymorbidity of seniors with COVID-19 have so far not been published in Slovakia. Therefore, we provide such data on hospitalized seniors in this article.

Patients and methods

In a retrospective observational study, we analyzed patients aged 65 years or older and hospitalized primarily for COVID-19 from November 1, 2020, to April 30, 2021, at the Ist Department

1st Department of Geriatrics, Comenius University, Faculty of Medicine, Bratislava, Slovakia

Address for correspondence: Martin DUBRAVA, MD, PhD, Assoc Prof, 1st Department of Geriatrics, Comenius University, Faculty of Medicine, Limbova 5, SK-833 05 Bratislava, Slovakia.

Tab. 1. Incidence of acute comorbidities.

Comorbidity	n	Incidence (%)
Pneumonia SARS-CoV-2	128	82.6
Dehydration	71	45.8
Urinary tract infection	47	30.3
Acute renal failure	8	5.2
Sepsis	7	4.5
Pulmonary embolism	5	3.2
Gastroduodenal ulcer	5	3.2
Acute myocardial infarction	3	1.9
Instable angina pectoris	1	0.6
Transient ischemic attack	1	0.6
Stroke	1	0.6

Tab. 2. Prevalence of chronic comorbidities.

Comorbidity	n	Prevalence (%)
Arterial hypertension	133	85.8
Chronic renal disease	133	85.8
Hepatopathy	127	81.9
Coronary artery disease	123	79.4
Heart failure	96	61.9
Immobility	88	56.8
Dementia	86	55.5
Chronic venous disease	82	52.9
Anemia	76	49.0
Hyperlipoproteinemia	70	45.2
Atrial fibrillation	66	42.6
Hypoacusis	65	41.9
Urinary incontinence	61	39.4
Osteoporosis	53	34.2
Fecal incontinence	50	32.3
Diabetes mellitus	47	30.3
Obesity	44	28.4
Benign prostatic hyperplasia	17	25.0
Arthrosis	36	23.2
Overweight	35	22.6
Allergy	35	22.6
Valvular disease	33	21.3
Back pain	29	18.7
Decubitus	26	16.8
Hypothyroidism	22	14.2
Malnutrition	21	13.5
Obstipation	15	9.7
Polyneuropathy	13	8.4
Chronic obstructive lung disease	11	7.1
Chronic gastritis	10	6.5
Bronchial asthma	10	6.5
Depression	10	6.5
Hyperthyroidism	9	5.8
Parkinson´s disease / syndrome	6	3.9
Active malignancy	6	3.9
Chronic bronchitis	5	3.2
Lung emphysema	2	1.3

Tab. 3. Mean number of comorbidities by place of residence.

Comorbidities (n)	Residence		p
	Home	SCF	
Acute	1.7	2.0	0.0503
Chronic	10.4	13.6	< 0.001
All	12.1	15.6	< 0.001

SCF – social care facility

Tab. 4. Mean number of comorbidities by gender.

Comorbidities (n)	Gender		p
	Women	Men	
Acute	1.7	1.9	ns
Chronic	11.3	11.3	ns

ns – nonsignificant

of Geriatrics, Comenius University, Faculty of Medicine, Bratislava, Slovakia. There were 155 patients, of which 87 (56.1 %) were women and 43 (27.7 %) lived in social care facilities (SCF). Their age was 65 to 99 years, mean age was 81.97 years, and median age was 82 years. In the case of the need for artificial pulmonary ventilation, patients were transferred to the Department of Intensive Medicine. The average/median length of hospitalization (including the calendar day of commenced hospitalization as the day 1 of hospitalization) were 12.9 and 11 days, respectively. We monitored the presence of acute (n=11) and chronic (n=37) comorbidities of COVID-19 (Tabs 1 and 2). The data were retrieved from discharge hospitalization reports manually (Tab. 4).

We considered the presence of more than 10 observed diseases as excessive comorbidity. We investigated comorbidities in cohorts divided by 5-year age intervals (65–69 years (n=17), 70–74 years (n=19), 75–79 years (n=24), 80–84 years (n=27), 85–89 years (n=32), ≥90 years (n=36)). We also analyzed comorbidities according to gender and domicile (living at home or in social care facilities). The frequency of occurrence for acute diseases is reported as an incidence, for chronic diseases as prevalence (for benign prostatic hyperplasia it is counted only for men). For statistical analysis, we used routine statistical methods (descriptive statistics, CHI2 test, Fisher exact test, unpaired Student´s t-test, odds ratio (OR) and its 95% confidence interval (CI)), we considered the differences with $p \leq 0.05$ statistically significant.

Results

The mean (minimal – maximal) numbers of acute comorbidities, acute comorbidities excluding SARS-CoV-2 pneumonia, chronic and all investigated comorbidities (including SARS-CoV-2 pneumonia) were 1.8 (0–5), 1.0 (0–5), 11.3 (2–20) and 13.1 (4–22), respectively. The average numbers of acute and

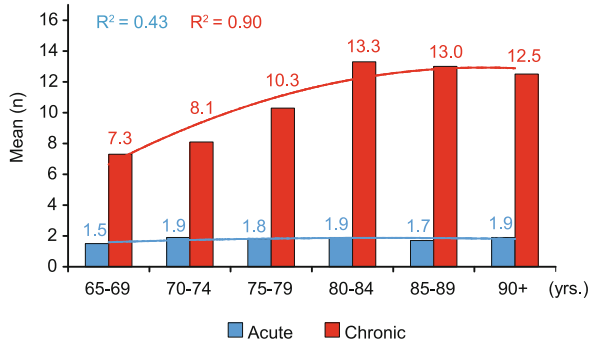

Fig. 1. Frequency of acute and chronic comorbidities by age.

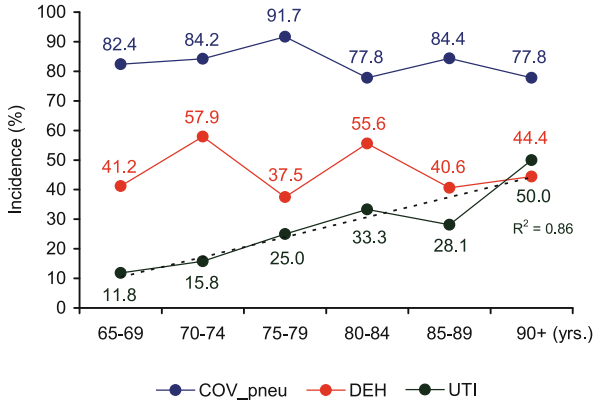

Fig. 2. Incidence of selected acute comorbidities by age. COV_pneu – SARS-CoV-2 pneumonia, DEH – dehydration, UTI – urinary tract infection; significance of prevalence differences in UTI at age 65–69 years and 90 years or older – p = 0.007

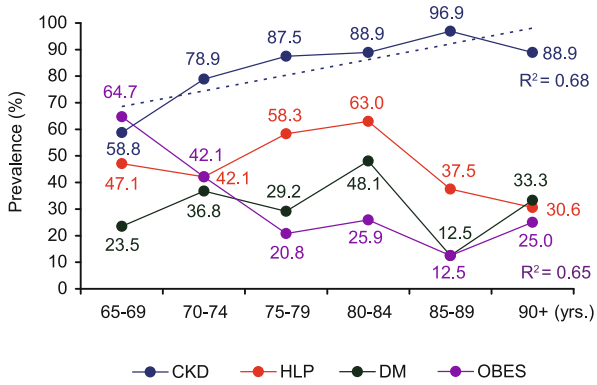

Fig. 4. Prevalence of selected chronic comorbidities by age. CKD – chronic kidney disease, DM – diabetes mellitus, HLP – hyperlipoproteinemia, OBES – obesity; the significance of prevalence differences in CKD at age 65–69 years and 85–89 years – p < 0.001, in hyperlipoproteinemia at age 80–84 years and 90 years or older – p = 0.01, in obesity at age 65–69 years and 85–89 years – p = 0.01

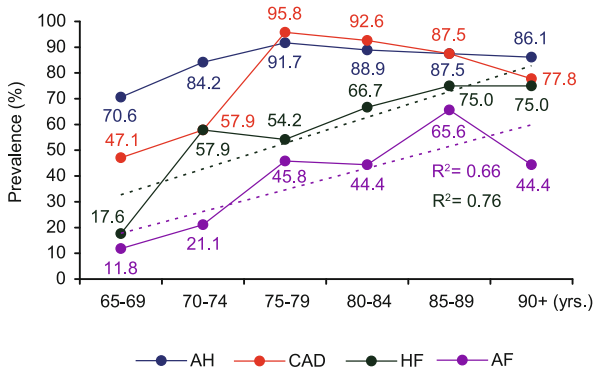

Fig. 3. Prevalence of selected chronic comorbidities by age. AF – atrial fibrillation, AH – arterial hypertension, CAD – coronary artery disease, HF – heart failure; significance of prevalence differences in AF at age 65–69 years and 90 years or older – p = 0.02, in HF at age 65–69 years and 90 years or older – p < 0.001, in CAD at age 65–69 years and 75–79 years – p < 0.001, in AH at age 65–69 years and 75–79 years – p = 0.08 and at age 65–74 years and 75 years or older – p = 0.06

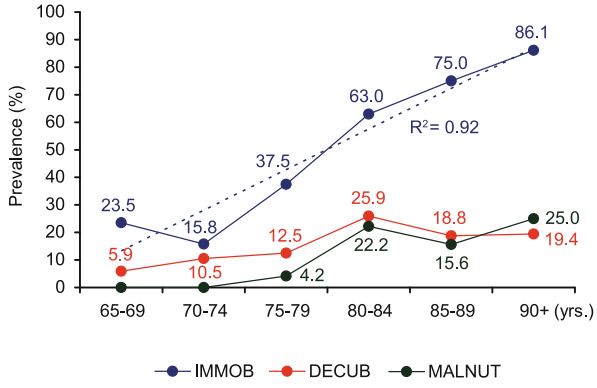

Fig. 5. Prevalence of selected chronic comorbidities by age. DECUB – decubitus, IMMOB – immobility, MALNUT – malnutrition; the significance of prevalence differences in malnutrition at age 65–79 years, and 80 years, or older – p < 0.001, in decubitus at age 65–79 years, and 80 years or older – p = 0.053, in immobility at age 65–69 years and 90 years or older – p < 0.001

chronic comorbidities observed in five-year age interval groups are presented in Figure 1. The average numbers of selected acute and chronic comorbidities in five-year age interval groups are presented in Figures 2–7. The mean numbers of acute comorbidities in age intervals of 65 to 69 years and ≥ 70 years were 1.5 and 1.8 (p > 0.05), respectively. The mean numbers of chronic comorbidities in age intervals of 65 to 79 years and ≥ 80 years were 8.7 and 12.9 (p < 0.001), respectively. The excessive comorbidity (> 10 diseases) was diagnosed in 72.3 % of patients, while in home-living patients and those living in SCF, it was 63.4 % and 95.3 %, respectively (p < 0.001, OR = 11.8, CI = 2.72–51.51). The relationship of excessive comorbidity to age is documented by Figure 8. The mean number of comorbidities observed by place of residence is given in Table 3 and per gender in Table 4.

Discussion

Polymorbidity is mentioned by almost everyone who decides to look consecrated when he starts talking about geriatrics. However, assessing polymorbidity is certainly not a simple task (24). Various systems are developed for assessing different numbers of diseases, assigning them with the same or different weights, often ending with various indices. Although such analyses have been ongoing for 40 years, there is no general internationally accepted method of evaluating polymorbidity (25). We consider the simplest and therefore the most effective description of polymorbidity in real life to be the sum of relevant diseases that dominate the geriatric polymorbidity. In addition to traditional risk factors, e.g., risk factors of cardiovascular (CV) diseases (typically diabetes

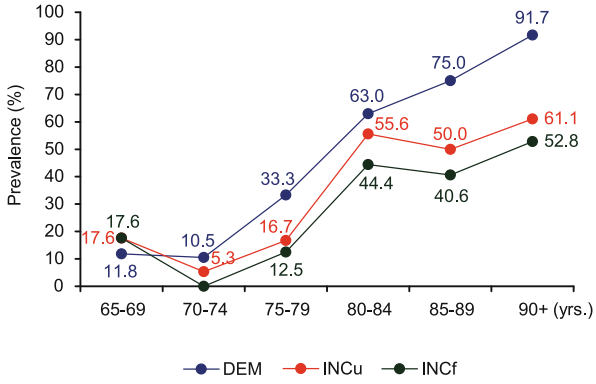

Fig. 6. Prevalence of selected chronic comorbidities by age. DEM – dementia, INCf = fecal incontinence, INCu – urinary incontinence; the significance of prevalence differences in dementia at age 65–69 years and 90 years or older – p < 0.001, in urinary incontinence at age 65–69 years and 90 years or older – p = 0.003, fecal incontinence at age 65–69 years and 90 years or older – p = 0.02.

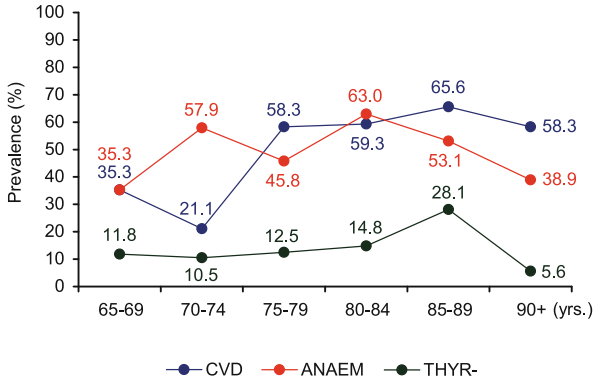

Fig. 7. Prevalence of selected chronic comorbidities by age. ANAEM – anaemia, CVD – chronic venous disease, THYR- – hypothyroidism; the significance of prevalence differences in CVD at age 65–69 years. and 85–89 years – p = 0.04, in anaemia at age 65–69 years. and 80–84 years – p = 0.07, at age 80–84 years and 90 years or older – p = 0.06, in hypothyroidism at age 65–69 years and 85–89 years – p = 0.19; at age 85–89 years and 90 years or older – p = 0.02.

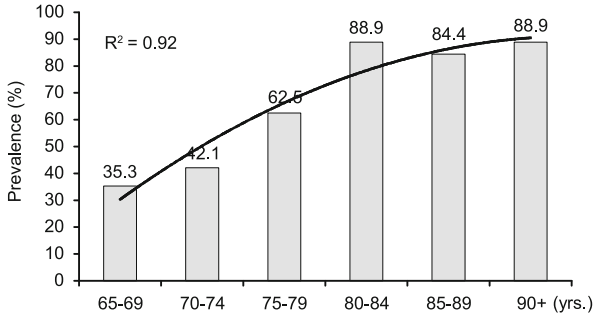

Fig. 8. Excessive polymorbidity by age.

mellitus, hyperlipoproteinemia and CV diseases themselves, and beside diseases that have been proved to shorten life expectancy (malignancies) we understand also the relevance of diseases that fundamentally deteriorate the life quality (incontinence or hearing impairment) as well as those usually underreported in reputable sources (typically immobility, bed sores, depression or dementia). Neither in this case, there is a universal international standard list of diseases to be taken into account. The Multipurpose Australian Comorbidity Scoring System evaluates up to 102 diseases (26).

Polymorbidity has many adverse consequences. One of the crucial ones is that it results in homeostenosis – a condition in which the compensatory possibilities of a senior to overcome various stress situations decrease, since the preexisting reserve capacities of the organism are already utilized by numerous diseases. Obviously, acute diseases can also represent a stress situation. Then it cannot be surprising that COVID-19, which affects the body in a multiorgan and multisystemic manner, is associated with extremely high lethality and mortality in seniors.

We believe that the data usually reported in an attempt to describe polymorbidity are insufficient because they involve only a few diseases. Even in the case of COVID-19, the number of comorbidities observed is usually up to 10, with the highest number being apparently 22 (27). The Charlson Index, which assesses the presence of 22 diseases (28), is probably the most commonly used to assess polymorbidity. A recent representative publication seeking to unify methods for monitoring chronic polymorbidity in seniors suggests tracking 918 diseases (ICD-10 codes) aggregated into 60 groups (29). Based on the data from the U.S. Centers for Disease Control, the list of diseases with their possible association with higher susceptibility to COVID-19 infection or its more severe course contains up to 258 items (30, 31). Our goal was to give a more comprehensive view of polymorbidity in the extreme risk group of seniors with COVID-19. We believe this is essential also for more sophisticated COVID-19 studies (32).

We found a high number of serious COVID-19 comorbidities: on average, 13 out of investigated 48. At the same time, some patients had up to 5 acute and 22 chronic comorbidities. We believe that the COVID-19 regime of patient management (given by a combination of anti-epidemic measures, staff shortages and pressure to release beds for new COVID-19 patients during the second wave of the pandemic in our country) has caused that some of the diseases which would otherwise have been detected during hospitalization remained undiagnosed in these circumstances (for example, we concluded heart valve diseases in only 21 %, but based on our experience we know, their prevalence tends to be higher). Therefore, we consider the frequency of diseases detected by us to be slightly lower than in reality.

More than four out of five patients (83 %) had COVID-19 pneumonia. Thereafter, among acute complications, dehydration had the highest incidence – being diagnosed almost in one-half of the patients (46 %). We have previously pointed out that dehydration is a frequent, underdiagnosed and dangerous disease in the elderlies (33, 34). The third most common acute comorbidity was urinary infections (incidence 30 %). These three diseases had an incidence above 10 %, while the other 8 comorbidities had less than 10 %. Of these, acute renal failure and sepsis (incidence 5.2 % and 4.5 %, respectively) were the most common.

Tab. 5. Age-specific frequency of COVID-19 comorbidities.

Comorbidity	Author	n	Type of patients	Age (years)	Prevalence (%)
AH	Blomaard (47)	1 376	Hosp	≥ 70	57
	Neumann-Podczaska (48)	50	Hosp	≥ 60	60
	Becerra-Muñoz (49)	642	Hosp	65 – 74	62
	Graselli (38)	253	ICU	71 – 80	62
	Bielza (41)	630	NH	≥ 70	65
	Gómez-Belda (50)	93	Hosp	70 – 79	67
	Zerah (51)	821	Hosp	≥ 70	67
	McMichael (52)	101	LTC	83m	67
	Becerra-Muñoz (49)	1520	Hosp	≥ 65	69
	Ticinesi (40)	772	Hosp	> 70	69
	Garg (46)	62	COVID	≥ 65	73
	Fagard (53)	105	Hosp	≥ 70	74
	Becerra-Muñoz (49)	878	Hosp	≥ 75	74
	Ko (11)	1 653	Hospe	≥ 65	75
	Gómez-Belda (49)	59	Hosp	≥ 80	75
	Ramos-Rincon (54)	2 772	Hosp	≥ 80	75
	Poco (55)	370	Hosp	≥ 65	76
	Khan (56)	158	Hosp	≥ 70	76
	Capdevila-Reniu (57)	159	Hosp	≥ 80	76
Asthma	Nascimento (58)	1544	ICU	≥ 60	3
	Poco (55)	370	Hosp	≥ 65	4
	Ko (11)	1 653	Hospe	≥ 65	12
	Garg (46)	62	COVID	≥ 65	13
CAD	Bielza (41)	630	NH	≥ 70	10
	Capdevila-Reniu (57)	159	Hosp	≥ 80	16
	Poco (55)	370	Hosp	≥ 65	17
	Ko (11)	1 653	Hospe	≥ 65	21
	Zerah (51)	821	Hosp	≥ 70	22
	Garg (46)	62	COVID	≥ 65	25
	Khan (56)	158	Hosp	≥ 70	30
Cancer	Zerah (51)	821	Hosp	≥ 70	11
	Neumann-Podczaska (48)	50	Hosp	≥ 60	12
	Graselli (38)	253	ICUf	71 – 80	13
	Capdevila-Reniu (57)	159	Hosp	≥ 80	13
	Ramos-Rincon (54)	2 772	Hosp	≥ 80	13
	McMichael (52)	101	LTC	83m	15
	Fagard (53)	105	Hosp	≥ 70	16
	Poco (55)	370	Hosp	≥ 65	17
	Ticinesi (40)	772	Hosp	> 70	19
	Becerra-Muñoz (49)	1520	Hosp	≥ 65	20
CKD	Gómez-Belda (50)	93	Hosp	70 – 79	2
	Becerra-Muñoz (49)	642	Hosp	65 – 74	8
	Becerra-Muñoz (49)	1520	Hosp	≥ 65	11
	Bielza (41)	630	NH	≥ 70	11
	Becerra-Muñoz (49)	878	Hosp	≥ 75	14
	Gómez-Belda (50)	59	Hosp	≥ 80	16
	Ko (11)	1 653	Hospe	≥ 65	23
	Capdevila-Reniu (57)	159	Hosp	≥ 80	26
	Zerah (51)	821	Hosp	≥ 70	36j
COPD	Gómez-Belda (50)	59	Hosp	≥ 80	5
	Graselli (38)	253	ICU	71 – 80	8
	Poco (55)	370	Hosp	≥ 65	9
	Fagard (53)	105	Hosp	≥ 70	10
	Bielza (41)	630	NH	≥ 70	11
	Capdevila-Reniu (57)	159	Hosp	≥ 80	11
	Zerah (51)	821	Hosp	≥ 70	12
	Gómez-Belda (50)	93	Hosp	70 – 79	12
	Ko (11)	1 653	Hospe	≥ 65	13
	Neumann-Podczaska (48)	50	Hosp	≥ 60	14
	Ticinesi (40)	772	Hosp	> 70	14
	Garg (46)	62	COVID	≥ 65	23
	Khan (56)	158	Hosp	≥ 70	25
Dementia	Becerra-Muñoz (49)	642	Hosp	65 – 74	2
	Gómez-Belda (50)	93	Hosp	70 – 79	4
	Neumann-Podczaska (48)	50	Hosp	≥ 60	4

Of the 37 chronic comorbidities studied, four occurred in more than two-thirds of patients (arterial hypertension, chronic renal disease, hepatopathy and coronary artery disease with incidence rates of 86 %, 86 %, 82 % and 79 %, respectively). Other four diseases occurred in more than one-half of patients (heart failure, immobility, dementia and chronic venous disease with incidence rates of 62 %, 57 %, 56 % and 53 %, respectively). The prevalence between one-third and one-half of patients was registered in association with six diseases, between one-quarter and one-third of patients in association with four diseases. Thus, 18 diseases had a prevalence of 25 % or more, while other 8 had their prevalence rates in the range of 10.0 % to 24.9 %.

Even in the most advanced countries in the world, the elderly living in SCF represent a special risk group among seniors, also in association with COVID-19 (35, 36, 37). We confirmed the expectation that SFC residents would have more comorbidities than those living at home. This difference was not only statistically significant, but also quantitatively serious – seniors living in SCF had on average 3.5 more diseases than the other group. The fragility of SCF clients is underlined by their approximately 12 times higher risk of excessive polymorbidity as compared to seniors living at home. This, together with the epidemiological risks of the SCF environment, creates an extremely risky cocktail for the elderly living in SCF in the COVID-19 era.

In terms of age, among seniors hospitalized for COVID-19, we have seen a phenomenon that we know from the past, namely that polymorbidity clearly increases to the age of 84, reaches a certain plateau and slightly declines after the age of 85. This is also reflected in the frequency of excessive polymorbidity. In this regard, we consider it necessary to point out that practically nine out of ten seniors aged 80 years or older hospitalized for COVID-19 had 11 or more serious comorbidities at the same time. Quite surprisingly, we did not find a systematic relationship between the age and incidence of total acute polymorbidity. Among acute comorbidities, we only showed it in urinary infections (their incidence systematically increased with age, with OR for 90-year old seniors or older as compared to 65 – 69-year

	Becerra-Muñoz (49)	1520	Hosp	≥ 65	6
	Poco (55)	370	Hosp	≥ 65	8
	Blomaard (47)	1 376	Hosp	≥ 70	9
	Becerra-Muñoz (49)	878	Hosp	≥ 75	9
	Gómez-Belda (50)	59	Hosp	≥ 80	17
	Ticinesi (40)	772	Hosp	> 70	23
	Capdevila-Reniu (57)	159	Hosp	≥ 80	31
	Ramos-Rincon (54)	2 772	Hosp	≥ 80	31
	Fagard (53)	105	Hosp	≥ 70	38i
	Bielza (42)	630	NH	≥ 70	49
	Zerah (51)	821	Hosp	≥ 70	54
DM	Graselli (38)	253	ICU	71 – 80	18
	Bielza (41)	630	NH	≥ 70	18
	Gómez-Belda (50)	59	Hosp	≥ 80	22
	Gómez-Belda (50)	93	Hosp	70 – 79	23
	Becerra-Muñoz (49)	642	Hosp	65 – 74	25
	Ticinesi (40)	772	Hosp	> 70	25
	Zerah (51)	821	Hosp	≥ 70	25
	Becerra-Muñoz (49)	1520	Hosp	≥ 65	26
	Ramos-Rincon (54)	2 772	Hosp	≥ 80	26
	Becerra-Muñoz (49)	878	Hosp	≥ 75	28
	Capdevila-Reniu (57)	159	Hosp	≥ 80	29
	Blomaard (47)	1 376	Hosp	≥ 70	30
	Garg (46)	62	COVID	≥ 65	31
	McMichael (52)	101	LTC	83m	32
	Neumann-Podczaska (48)	50	Hosp	≥ 60	38
	Fagard (53)	105	Hosp	≥ 70	41
	Ko (11)	1 653	Hospe	≥ 65	42
	Nascimento (58)	1544	ICU	≥ 60	43
	Poco (55)	370	Hosp	≥ 65	44
	Khan (56)	158	Hosp	≥ 70	49
HEP	Nascimento (58)	1544	ICU	≥ 60	1
	Graselli (38h)	253	ICU	71 – 80	2
	Becerra-Muñoz (49)	1520	Hosp	≥ 65	4
	McMichael (52)	101	LTC	83m	6
HF	Gómez-Belda (50)	93	Hosp	70 – 79	3
	Garg (46)	62	COVID	≥ 65	10
	Bielza (41)	630	NH	≥ 70	11
	Gómez-Belda (50)	59	Hosp	≥ 80	14
	Poco (55)	370	Hosp	≥ 65	22
	Zerah (51)	821	Hosp	≥ 70	23
HLP	Graselli (38g)	253	ICU	71 – 80	23
	Becerra-Muñoz (49)	642	Hosp	65 – 74	46
	Becerra-Muñoz (49)	1520	Hosp	≥ 65	49
	Becerra-Muñoz (49)	878	Hosp	≥ 75	50
	Ramos-Rincon (54)	2 772	Hosp	≥ 80	51
MI history	Blomaard (47)	1 376	Hosp	≥ 70	19
Obesity	Bielza (41)	630	NH	≥ 70	6
	Ticinesi (40)	772	Hosp	> 70	7
	Nascimento (58)	1544	ICU	≥ 60	8
	Zerah (51)	821	Hosp	≥ 70	10
	Ramos-Rincon (54)	2 772	Hosp	≥ 80	16
	Poco (55)	370	Hosp	≥ 65	21
	Becerra-Muñoz (49)	878	Hosp	≥ 75	22
	Becerra-Muñoz (49)	1520	Hosp	≥ 65	25
	Gómez-Belda (50)	93	Hosp	70 – 79	29
	Gómez-Belda (50)	59	Hosp	≥ 80	29
	Becerra-Muñoz (49)	642	Hosp	65 – 74	30
	McMichael (52)	101	LTC	83m	31
	Garg (46)	62	COVID	≥ 65	41
Stroke history	Ko (11)	1 653	Hospe	≥ 65	9
	Neumann-Podczaska (48)	50	Hosp	≥ 60	22
	Zerah (51)	821	Hosp	≥ 70	22

[a] – hyperlipoproteinemia, [b] – active malignancy, [c] – 71–79 years, CAD – coronary artery disease, cancer – different malignancies (solid/hematological) included, CKD – chronic kidney disease, COVID – laboratory-confirmed COVID-19, [d] – hepatopathy, [e] – community-dwelling, [f] – including malignancies in remission, [g] - hypercholesterolemia, [h] – chronic, HEP – hepatopathy, HF – heart failure, HLP – hyperlipoproteinemia, Hosp – hospitalized, [i] – cognitive decline, [j] – chronic renal failure, LTC – long-term care facility, [m] – mean, MI – myocardial infarction, NH – nursing home

old seniors, being 7.5 (CI=1.49–37.66)). For chronic comorbidities, we have seen all three possible types of the relationship between their prevalence and age: 1) increase with age (either up to a certain age – e.g. in coronary artery disease or chronic venous disease, or systematically – e.g. in heart failure, atrial fibrillation, chronic kidney disease, immobility, malnutrition, dementia and incontinence, with a possible slight decrease at the highest age), 2) a more or less stationary state (e. g. in diabetes or anemia), 3) decrease with age (e.g. in obesity).

An unprecedented number of COVID-19 papers have been published in less than a year and a half since the outbreak. However, the comparison of our findings with literary data can be difficult. On the one hand, the problem is that although the data had been obtained correctly and published in high-ranked journals, some of them do not reflect reality (e.g., 19 % out of 341 seniors aged 71–80 years had no comorbidity (38), the highest number of comorbidities was 5 (39), most often 3 chronic comorbidities in 772 hospitalized patients older than 70 years (40), in 70-year-old or older nursing home residents, the mean number of comorbidities was 2 (41)). On the other hand there was the usual lack of specific geriatrically oriented data, as well as the lack in their structure – number of diseases monitored and their subtler differentiation according to age (42, 43, 44), or stating only the frequency of individual diseases but not polymorbidity. Not only the quantitative assessment of polymorbidity, but also the classification of the clinical severity of diseases occurs arbitrarily (45). Some available information from senior groups with at least 17 probands is summarized in Table 5 (due to the differences in the prevalence of certain diseases between races, we did not include papers from Asian countries). Overall, the authors noticed different comorbidities, and these occurred with distinctly different frequencies (which is certainly not due only to regional differences in disease prevalence and diagnostic criteria used, but also owing to the ability to diagnose/register individual diseases during the COVID-19 regimen and capacity of the health system at a given time). Of our patients, each patient had at least 4 comorbidities studied, while in the U.S, 5.6 % of COVID-19 patients aged 65 or older had no comorbidity (46).

Our findings can be applied to the group of seniors we analyzed – those who had to be hospitalized due to severe course of COVID-19 (therefore, we did not include COVID-19 patients who were hospitalized primarily for a cause other than COVID-19 albeit diagnosed with COVID-19). In our opinion, the strength of our study is that we did not use the data routinely reported for administrative purposes, but we registered them manually in a targeted way for the purpose of this study in order to make the procedure more accurate.

We consider these limitations in our study: 1) The number of probands – according to our knowledge, however, more comprehensive information on comorbidities in seniors with COVID-19 in a comparable age and comorbid structure has not yet been published. 2) The absence of quantification of the disease severity. 3) The arbitrariness of the inclusion of monitored comorbidities as acute or chronic – however, as we assessed patients primarily admitted for COVID-19, we do not expect comorbidities classified as chronic to be so acutely aggravated that they themselves require urgent hospitalization (which does not, of course, mean that there are no patients among the diabetics in our group who would not be hyperglycemic, etc.); SARS-CoV-2 pneumonia is one of the expected serious organ localizations of this infection and is usually seen as an integral part of COVID-19. However, it is far from accompanying every case of COVID-19, and in real practice, it is difficult to distinguish between cases of an isolated COVID-19 pneumonia and pneumonia caused simultaneously by SARS-CoV-2 virus and another pathogen. Therefore, we perceived COVID-19 pneumonia as an acute complication – comorbidity of the underlying COVID-19. At the same time however, we also reported results without including it as an acute complication. 4) Diseases have been diagnosed not according to their "strict definitions", but in the "real life" setting. 5) Informal criteria for admitting a COVID-19 patient – patients who could be managed in outpatient settings were though not admitted.

References

1. Dúbrava M. Prečo dnes na Slovensku excesívne zomierame na SARS-CoV-2? Cardiology Lett 2021; 30 (1): 10–13.

2. Modig K, Ahlbom A, Ebeling M. Excess mortality from COVID-19: weekly excess death rates by age and sex for Sweden and its most affected region. Eur J Public Health 2021; 31 (1): 17–22.

3. Prieto-Alhambra D, Balló E, Coma E et al. Filling the gaps in the characterization of the clinical management of COVID-19: 30-day hospital admission and fatality rates in a cohort of 118 150 cases diagnosed in outpatient settings in Spain. Int J Epidemiol 2021; 49 (6): 1930–1939.

4. Maestre-Muñiz MM, Arias Á, Arias-González L, Angulo-Lara B, Lucendo AJ. Prognostic Factors at Admission for In-Hospital Mortality from COVID-19 Infection in an Older Rural Population in Central Spain. J Clin Med. 2021; 10 (2): 318.

5. Richardson S, Hirsch JS, Narasimhan M et al. Presenting Characteristics, Comorbidities, and Outcomes Among 5700 Patients Hospitalized With COVID-19 in the New York City Area. JAMA 2020; 323 (20): 2052–2059.

6. Dúbrava M, Jánošiová J, Koščálová A, Šuba J ml. Gerontokardiológia: COVID-19. Cardiology Lett 2020; 29 (5–6): 293–302.

7. An ad hoc WHO technical consultation managing the COVID-19 infodemic: call for action. Geneva: World Health Organization; 2020.

8. Sloane PD, Zimmerman S. The Impact of the COVID-19 Pandemic on Scientific Publishing. J Am Med Dir Assoc 2021; 22 (3): 484–488.

9. Harrison SL, Fazio-Eynullayeva E, Lane DA, Underhill P, Lip GYH. Comorbidities associated with mortality in 31,461 adults with COVID-19 in the United States: A federated electronic medical record analysis. PLoS Med 2020; 17 (9): e1003321.

10. Tisminetzky M, Delude C, Hebert T, Carr C, Goldberg RJ, Gurwitz JH. Age, Multiple Chronic Conditions, and COVID-19: A literature review. J Gerontol A Biol Sci Med Sci 2020: glaa320.

11. Ko JY, Danielson ML, Town M et al. Risk Factors for COVID-19-associated hospitalization: COVID-19-Associated Hospitalization Surveillance Network and Behavioral Risk Factor Surveillance System. Clin Infect Dis 2020: ciaa1419.

12. Kalyanaraman Marcello R, Dolle J et al. Characteristics and outcomes of COVID-19 patients in New York City's public hospital system. PLoS One 2020; 15 (12): e0243027.

13. Corradini E, Ventura P, Ageno W et al. Clinical factors associated with death in 3044 COVID-19 patients managed in internal medicine wards in Italy: results from the SIMI-COVID-19 study of the Italian Society of Internal Medicine (SIMI). Intern Emerg Med 2021; Apr 24: 1–11.

14. Stokes EK, Zambrano LD, Anderson KN et al. Coronavirus Disease 2019 Case Surveillance - United States, January 22-May 30, 2020. MMWR Morb Mortal Wkly Rep 2020; 69 (24): 759–765.

15. Holler JG, Eriksson R, Jensen TØ et al. First wave of COVID-19 hospital admissions in Denmark: a nationwide population-based cohort study. BMC Infect Dis 2021; 21 (1): 39.

16. Aliberti MJR, Covinsky KE, Garcez FB et al. A fuller picture of COVID-19 prognosis: the added value of vulnerability measures to predict mortality in hospitalised older adults. Age Ageing 2021; 50 (1): 32–39.

17. Owen RK, Conroy SP, Taub N et al. Comparing associations between frailty and mortality in hospitalised older adults with or without COVID-19 infection: a retrospective observational study using electronic health records. Age Ageing 2021; 50 (2): 307–316.

18. Ozturk S, Kurtulus Ozturk E, Yildiz Kaya S. Clinical and radiological characteristics of COVID-19 patients without comorbidities: A single-center study. Wien Klin Wochenschr 2021: 1–7.

19. Palmieri L, Vanacore N, Donfrancesco C, et al. Clinical Characteristics of Hospitalized Individuals Dying With COVID-19 by Age Group in Italy. J Gerontol A Biol Sci Med Sci 2020; 75 (9): 1796–1800.

20. Singh MK, Mobeen A, Chandra A, Joshi S, Ramachandran S. A meta-analysis of comorbidities in COVID-19: Which diseases increase the susceptibility of SARS-CoV-2 infection? Comput Biol Med 2021; 130: 104219.

21. Das P, Upadhyay RK, Misra AK, Rihan FA, Das P, Ghosh D. Mathematical model of COVID-19 with comorbidity and controlling using non-pharmaceutical interventions and vaccination. Nonlinear Dyn 2021; May 19: 1–15.

22. Corrao G, Rea F, Blangiardo GC. Lessons from COVID-19 mortality data across countries. J Hypertens 2021; 39 (5): 856–860.

23. Thakur B, Dubey P, Benitez J et al. A systematic review and meta-analysis of geographic differences in comorbidities and associated severity and mortality among individuals with COVID-19. Sci Rep 2021; 11 (1): 8562.

24. Dúbrava M. Možnosti hodnotenia polymorbidity. Geriatria 2008; 14 (2): 58–67.

25. Guralnik J.M. Assessing the impact of comorbidity in the older population. Annals Epidemiol 1996; (6)5: 376–380.

26. Holman CDJ, Preen DB, Baynham NJ, Finn JC, Semmens JB. A multipurpose comorbidity scoring system performed better than the Charlson index. J Clin Epidemiol 2005; 58 (10): 1006–1014.

27. Jain V, Yuan JM. Predictive symptoms and comorbidities for severe COVID-19 and intensive care unit admission: a systematic review and meta-analysis. Int J Public Health 2020; 65 (5): 533–546.

28. Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. J Chronic Dis 1987; 40 (5): 373–383.

29. Calderón-Larrañaga A, Vetrano DL, Onder G et al. Assessing and Measuring Chronic Multimorbidity in the Older Population: A Proposal for Its Operationalization. J Gerontol A Biol Sci Med Sci 2017; 72 (10): 1417–1423.

30. Centers for disease control and prevention. Underlying medical conditions associated with high risk for severe COVID-19: Information for health care providers. https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinical-care/underlyingconditions.html

31. Beckman MF, Mougeot FB, Mougeot JC. Comorbidities and Susceptibility to COVID-19: A Generalized Gene Set Data Mining Approach. J Clin Med 2021; 10 (8): 1666.

32. Dúbrava M, Celec P, Pastorek M, Koščálová A, Jánošiová J, Šuba J ml. COVID-19, NETs a GER. Geriatria 2020; 26 (2): 43–49.

33. Dúbrava M, Jánošiová J. Dehydratácia u hospitalizovaných seniorov. Geriatria 2014; 20 (3): 103–107.

34. Dúbrava M, Jánošiová J. Dehydratácia a seniori–tabula rasa alebo len pocit neistoty? Geriatria 2014; 20 (3): 115–124.

35. Sepulveda ER, Stall NM, Sinha SK. A Comparison of COVID-19 Mortality Rates Among Long-Term Care Residents in 12 OECD Countries. J Am Med Dir Assoc 2020; 21 (11): 1572–1574.e3.

36. Stern C, Klein DB. Stockholm City's Elderly Care and Covid19: Interview with Barbro Karlsson. Society 2020; Jul 19: 1–12.

37. Telle KE, Grøsland M, Helgeland J, Håberg SE. Factors associated with hospitalization, invasive mechanical ventilation treatment and death among all confirmed COVID-19 cases in Norway: Prospective cohort study. Scand J Public Health 2021; 49 (1): 41–47.

38. Grasselli G, Zangrillo A, Zanella A et al. Baseline Characteristics and Outcomes of 1591 Patients Infected With SARS-CoV-2 Admitted to ICUs of the Lombardy Region, Italy. JAMA 2020; 323 (16): 1574–1581.

39. Ciceri F, Castagna A, Rovere-Querini P et al. Early predictors of clinical outcomes of COVID-19 outbreak in Milan, Italy. Clin Immunol 2020; 217: 108509.

40. Ticinesi A, Nouvenne A, Cerundolo N et al. Trends of COVID-19 Admissions in an Italian Hub during the Pandemic Peak: Large Retrospective Study Focused on Older Subjects. J Clin Med 2021; 10 (5): 1115.

41. Bielza R, Sanz J, Zambrana F et al. Clinical Characteristics, Frailty, and Mortality of Residents With COVID-19 in Nursing Homes of a Region of Madrid. J Am Med Dir Assoc 2021; 22 (2): 245–252.

42. Thiabaud A, Iten A, Balmelli C et al. Cohort profile: SARS-CoV-2/COVID-19 hospitalised patients in Switzerland. Swiss Med Wkly 2021; 151:w20475.

43. Navaratnam AV, Gray WK, Day J, Wendon J, Briggs TWR. Patient factors and temporal trends associated with COVID-19 in-hospital mortality in England: an observational study using administrative data. Lancet Respir Med 2021 Apr; 9 (4): 397–406.

44. Ng WH, Tipih T, Makoah NA et al. Comorbidities in SARS-CoV-2 Patients: a Systematic Review and Meta-Analysis. mBio 2021;12 (1): e03647–20.

45. Doidge JC, Gould DW, Ferrando-Vivas P et al. Trends in Intensive Care for Patients with COVID-19 in England, Wales, and Northern Ireland. Am J Respir Crit Care Med 2021; 203 (5): 565–574.

46. Garg S, Kim L, Whitaker M et al. Hospitalization Rates and Characteristics of Patients Hospitalized with Laboratory-Confirmed Coronavirus Disease 2019 - COVID-NET, 14 States, March 1–30, 2020. MMWR Morb Mortal Wkly Rep 2020; 69 (15): 458–464.

47. Blomaard LC, van der Linden CMJ, van der Bol JM et al. Frailty is associated with in-hospital mortality in older hospitalised COVID-19 patients in the Netherlands: the COVID-OLD study. Age Ageing 2021; 50 (3): 631– 640.

48. Neumann-Podczaska A, Chojnicki M, Karbowski LM et al. Clinical Characteristics and Survival Analysis in a Small Sample of Older COVID-19 Patients with Defined 60-Day Outcome. Int J Environ Res Public Health 2020; 17 (22): 8362.

49. Becerra-Muñoz VM, Núñez-Gil IJ et al. Clinical profile and predictors of in-hospital mortality among older patients hospitalised for COVID-19. Age Ageing 2021; 50 (2): 326–334.

50. Gómez-Belda AB, Fernández-Garcés M, Mateo-Sanchis E, Madrazo M, Carmona M, Piles-Roger L, Artero A. COVID-19 in older adults: What are the differences with younger patients? Geriatr Gerontol Int 2021; 21 (1): 60–65.

51. Zerah L, Baudouin É, Pépin M et al. Clinical Characteristics and Outcomes of 821 Older Patients With SARS-Cov-2 Infection Admitted to Acute Care Geriatric Wards. J Gerontol A Biol Sci Med Sci 2021; 76 (3): e4–e12.

52. McMichael TM, Currie DW, Clark S et al. Epidemiology of Covid-19 in a Long-Term Care Facility in King County, Washington. N Engl J Med 2020; 382 (21): 2005–2011.

53. Fagard K, Gielen E, Deschodt M, Devriendt E, Flamaing J. Risk factors for severe COVID-19 disease and death in patients aged 70 and over: a retrospective observational cohort study. Acta Clin Belg 2021; 1–8.

54. Ramos-Rincon JM, Buonaiuto V, Ricci M et al. Clinical Characteristics and Risk Factors for Mortality in Very Old Patients Hospitalized With COVID-19 in Spain. J Gerontol A Biol Sci Med Sci 2021; 76 (3): e28–e37.

55. Poco PCE, Aliberti MJR, Dias MB et al. Divergent: Age, Frailty, and Atypical Presentations of COVID-19 in Hospitalized Patients. J Gerontol A Biol Sci Med Sci 2021; 76 (3): e46–e51.

56. Khan MS, Dogra R, Miriyala LKV et al. Clinical characteristics and outcomes of patients with Corona Virus Disease 2019 (COVID-19) at Mercy Health Hospitals, Toledo, Ohio. PLoS One 2021; 16 (4): e0250400.

57. Capdevila-Reniu A, Pellice M, Prieto-González S et al. Clinical characteristics and outcome of patients aged over 80 years with covid-19. Medicine (Baltimore) 2021; 100 (8): e24750.

58. Nascimento MM. Clinical characteristics of 1544 Brazilians aged 60 years and over with laboratory evidence for SARS-CoV-2. Arch Gerontol Geriatr 2021; 96: 104462.

Received December 10, 2021.
Accepted December 20, 2021.