Research Article

Impact of the COVID-19 Pandemic on Mortality and Health Resource Use in an Aged Population and Differences According to Frailty Status

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Abstract

Background: The COVID-19 pandemic severely affected the aged population and healthcare system functioning.

Aim: To evaluate the impact of COVID-19 on mortality and health resource use in an aged population and to determine whether the impact differed according to frailty status.
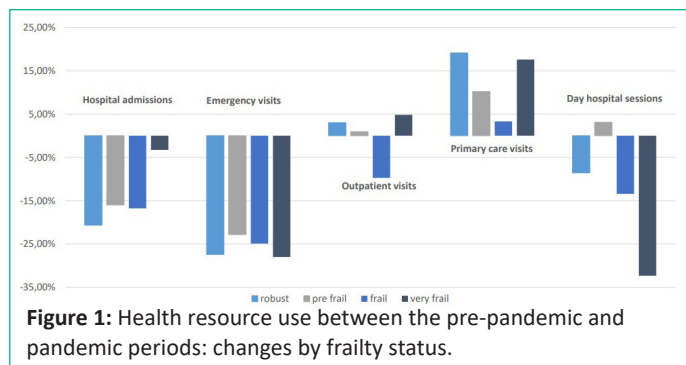
Methods: A population-based observational longitudinal study comparing pre-pandemic and pandemic variables was performed using data retrospectively collected from computerized clinical histories. The study population included all inhabitants aged ≥65 years corresponding to three primary care centres in Barcelona province (Spain). Data were collected on mortality, institutionalization, hospital admissions, emergency visits, outpatient visits, primary care visits, and day hospital sessions in the pre-pandemic (2018-2019) and pandemic (2020-2021) periods. Frailty status was established according to the Electronic Screening Index of Frailty (e-SIF).

Results: 9315 individuals were included in the pre-pandemic cohort (75.4 years, 56% women) and 9774 in the pandemic cohort (73.3 years, 56% women). Compared with the pre-pandemic period, in the pandemic period, mortality overall increased by 21.7% (14.7% for non-frail and 33.0% for frail individuals); emergency visits, hospitalizations, and day hospital sessions decreased by 23.1%, 12.1%, and 3.7%, respectively, and primary care visits increased by 15.0%.

Conclusions: For the population aged ≥65 years in the COVID-19 pandemic period, the mortality of frail individuals was greater than overall mortality for this population, and frailty prevalence overall decreased by 5%. In terms of resource use, use of hospital services decreased and of primary care services increased.

Keywords: COVID-19 pandemic; Frailty; Mortality; Health resource use; Aged

Introduction

COVID-19 was first described in China at the end of 2019 but rapidly spread around the world in early 2020, causing a pandemic with very severe health and socioeconomic consequences. From the first confirmed case in Spain in January 2020 until April 2023, 13.8 million cases were confirmed and deaths numbered 120,715 [1]. A total lockdown in Spain was declared that lasted from March to May 2020. During 2020 and 2021, the healthcare system was severely affected to the point of collapse due to patient overload and healthcare provider illness. Hospitals were forced to reorganize normal operations to deal with the different pandemic outbreaks, resulting in the cancellation of planned interventions, longer waiting lists, a doubling in the number of Intensive Care Unit (ICU) beds, bed relocations, etc. Workload and care pressures also affected the primary healthcare sector, which had to cancel non-urgent visits and to deploy telecare to prioritize more seriously ill patients who required immediate care [2]. Over this period, urgent illnesses were prioritized, and care for all other non-urgent illnesses was postponed. In addition, the fact that many people were afraid to go to hospitals or health centres to avoid possible infection has

Figure 1: Health resource use between the pre-pandemic and pandemic periods: changes by frailty status.

Table 1: Frailty prevalence (95% CI) by sex and age on 1 January 2018, 2020, and 2022.

	1-Jan-18	1-Jan-20	1-Jan-22
Sex:			
• Male	10.04% (9.11-10.96)	11.73% (10.77-12.69)	10.31% (9.41-11.20)
• Female	14.11% (13.17-15.06)	15.98% (15.01-16.95)	15.27% (14.33-16.21)
Age, years:			
• 65-69	3.23% (2.56-3.90)	4.28% (3.52-5.04)	3.40% (2.74-4.06)
• 70-74	6.40% (5.41-7.40)	7.01% (6.01-8.01)	5.94% (5.02-6.86)
• 75-79	11.67% (10.05-13.29)	12.34% (10.81-13.86)	12.13% (10.66-13.61)
• 80-84	22.80% (20.56-25.04)	27.62% (25.09-30.15)	24.98% (22.55-27.41)
• 85-89	30.93% (27.86-34.00)	33.33% (30.38-36.29)	32.88% (29.89-35.86)
• 90-94	28.37% (24.09-32.65)	38.95% (34.28-43.63)	39.62% (34.91-44.32)
• ≥95	25.85% (18.69-33.01)	31.11% (23.20-39.02)	41.67% (32.72-50.62)
Overall	12.33% (11.67-13.00)	14.39%* (13.69-15.09)	13.61%* (12.92-14.28)

* Standardized rate

resulted in delayed diagnoses and increased mortality due to non-COVID-19-related illnesses [3]. It is suspected that healthcare organizational changes due to the COVID-19 pandemic mostly affected the aged population, especially more frail and more vulnerable individuals facing mobility and technological barriers.

Frailty, a highly prevalent geriatric syndrome (10-15% of the population aged ≥65) [4], is characterized by a decrease in the body's functional reserves and ability to respond to external stressors, and leads to increased vulnerability to disease, adverse health outcomes, functional decline, disability, and dependence [5]. Frailty has also been associated with an increased use of healthcare and community services, as frail individuals are at a higher risk of hospitalization and admission to nursing homes, and more frequently use emergency, outpatient, and primary care services [6,7]. The healthcare burden gradually increases as frailty increases; for instance, the healthcare cost for frail individuals is calculated to be 2.4 times greater than for non-frail individuals [8,9].

The aim of this study was to evaluate the impact of COVID-19 on mortality and health resource use in an aged population and to determine whether the impact differed according to frailty status.

Methods

Study Design and Population

A population-based observational longitudinal study with follow-up was conducted from 1 January 2018 to 1 January 2022 to compare the pre-pandemic and pandemic periods (2018-2019 and 2020-2021, respectively). Data were obtained retrospectively from computerized primary care and hospital medical records. The study population included all inhabitants aged ≥65 years corresponding to three primary care centres managed by Maresme Health Consortium (CSdM) in the province of Barcelona (Catalonia, Spain). Included in the pre-pandemic cohort (2018-2019) and the pandemic cohort (2020-2021) were 9315 and 9774 individuals aged ≥65 years, respectively. The study protocol was approved by the local ethics committee (reference: CEIm CSdM 06/20).

Study Variables

Frailty status was established according to the Electronic Screening Index of Frailty (e-SIF), a validated tool that considers 42 clinical conditions documented in computerized clinical notes to classify individuals in one of four possible categories: robust, pre-frail, frail, and very frail [10]. Frailty scores were cal

Table 2: Mortality (95% CI) by age, sex, and frailty groups in the pre-pandemic and pandemic periods.

		Pre-pandemic period(2018-2019)			Pandemic period(2020-2021)		
		All	**Non-frail**	**Frail**	**All population**	**Non-frail**	**Frail**
Sex							
	• Male	6.89(6.11-7.67)	5.96(5.19-6.73)	15.2(11.70-18.70)	7.96(7.15-8.77)	6.01(5.25-6.77)	22.62(14.92-18.88)
	• Female	5.03(4.44-5.62)	4.01(3.44-4.59)	11.2(8.93-13.48)	6.15(5.52-6.79)	4.74(4.12-5.35)	13.60(11.32-15.87)
Age, years							
	• 65-69	0.96(0.60-1.33)	1.00(0.62-1.38)	0.00(0.00-0.00)	0.99(0.62-1.36)	0.92(0.55-1.28)	2.56(-0.03-5.47)
	• 70-74	2.81(2.24-3.49)	2.68(2.00-0.34)	4.73(1.27-8.19)	2.91(2.25-3.56)	2.57(1.93-3.21)	7.39(3.48-11.29)
	• 75-79	4.71(3.64-5.78)	4.50(3.34-5.62)	6.25(2.64-9.86)	5.42(4.37-6.47)	5.16(4.06-6.25)	7.24(3.80-10.68)
	• 80-84	5.85(4.59-7.10)	5.37(4.00-6.74)	7.47(4.52-10.42)	9.48(7.83-11.14)	7.70(5.92-9.47)	14.16(10.39-17.93)
	• 85-89	13.52(11.24-15.79)	11.77(9.19-14.35)	17.41(12.86-21.96)	16.72(14.38-19.06)	14.22(11.53-16.90)	21.71(17.22-26.20)
	• 90-94	30.23(25.87-34.59)	28.90(23.81-33.99)	33.61(25.11-42.11)	33.49(28.96-38.02)	29.96(24.32-35.60)	39.02(31.48-46.57)
	• ≥95	37.41(29.50-45.33)	35.78(26.64-44.92)	42.11(25.66-58.55)	46.67(28.14-55.19)	47.31(36.97-57.65)	45.24(29.54-60.94)
Overall		5.84(5.36-6.31)	4.89(4.42-5.35)	12.62(10.70-14.54)	7.11*(6.60-7.62)	5.61*(5.12-6.10)	16.79*(14.82-18.76)

Mortality is defined as deaths/100 inhabitants during the period.
*Standardized rate

Table 3: Health resource use by sex, age groups, and frailty status for the pre-pandemic and pandemic periods.

	Pre-Pandemic Period (2018-2019)									
	Hospital admissions		Emergency visits		Outpatient visits		Primary care visits		Day hospital sessions	
	Mean(95% CI)	p	Mean(95% CI)	p	Mean(95% CI)	p	Mean(95% CI)	p	Mean(95% CI)	p
Sex										
• Male	0.28(0.26-0.31)	<0.001	1.23(1.17-1.29)	<0.036	7.87(7.50-8.23)	<0.001	25.3 (25.5-27.1)	<0.001	0.91(0.75-1.08)	<0.001
• Female	0.19(0.17-0.21)		1.10(1.06-1.15)		6.18(5.92-6.44)		28.6 (27.9-29.4)		0.53(0.42-0.64)	
Age, Years										
• <80	0.16(0.14-0.17)	<0.001	0.99(0.95-1.03)	<0.001	7.15(6.88-7.42)	0.387	24.0 (23.5-24.6)	<0.001	0.68(0.57-0.78)	<0.001
• ≥80	0.40(0.37-0.44)		1.54(1.46-1.62)		6.38(6.02-6.74)		35.9 (34.7-37.2)		0.74(0.55-0.94)	
Frailty Status										
• Robust	0.11(0.10-0.12)		0.76(0.72-0.80)		4.74(4.50-4.99)		17.5 (17.0-18.0)		0.42(0.32-0.51)	
• Pre-frail	0.29(0.26-0.31)	<0.001	1.36(1.30-1.43)	<0.001	8.56(8.18-8.95)	<0.001	33.7 (32.8-34.6)	<0.001	0.93(0.72-1.14)	<0.001
• Frail	0.53(0.47-0.59)		2.11(1.94-2.27)		11.6(10.7-12.5)		52.2 (49.8-54-6)		1.05(0.82-1.29)	
• Very frail	0.81(0.66-0.95)		2.93(2.53-3.34)		11.6(9.78-13.4)		59.9 (55.3-64.5)		1.98(1.17-2.79)	
• Overall	0.23(0.22-0.24)	---	1.16(1.12-1.20)	---	6.92(6.70-7.14)	---	27.61(27.1-28.1)	---	0.70(0.60-0.79)	---
	Pandemic Period (2020-2021)									
	Hospital admissions		Emergency visits		Outpatient visits		Primary care visits		Day hospital sessions	
	Mean (95% CI)	p	Mean (95% CI)	p	Mean (95% CI)	p	Mean (95% CI)	p	Mean (95% CI)	p
Sex										
• Male	0.24(0.22-0.26)	<0.001	0.92(0.87-0.97)	0.153	7.70(7.36-8.03)	<0.001	30.1(29.2-30.9)	<0.001	0.76(0.62-0.90)	<0.001
• Female	0.17(0.16-0.19)		0.87(0.83-0.91)		6.52(6.24-6.79)		33.1(32.3-33.8)		0.60(0.48-0.73)	
Age, years										
• <80	0.14(0.13-0.16)	<0.001	0.76(0.72-0.79)	<0.001	7.40(7.13-7.66)	0.064	28.1(27.5-28.6)	<0.001	0.73(0.61-0.84)	<0.001
• ≥80	0.35(0.33-0.38)		1.23(1.16-1.30)		6.11(5.77-6.44)		41.2(39.842.6)		0.54(0.39-0.68)	
Frailty Status										
• Robust	0.09(0.08-0.10)		0.55(0.52-0.58)		4.89(4.64-5.13)		20.8(20.3-21.4)		0.38(0.30-0.46)	
• Pre-frail	0.24(0.22-0.26)	<0.001	1.05(0.99-1.11)	<0.001	8.64(8.27-9.03)	<0.001	37.1(36.2-38.0)	<0.001	0.96(0.76-1.17)	<0.001
• Frail	0.44(0.32-0.49)		1.58(1.46-1.71)		10.4(9.70-11.2)		54.0(51.6-56.3)		0.91(0.62-1.20)	
• Very frail Robust	0.78(0.65-0.91)		2.11(1.83-2.39)		12.1(10.7-13.6)		70.4(66.2-74.7)		1.34(0.80-1.88)	
• Overall	0.20(0.19-0.22)	---	0.89(0.86-0.92)	---	7.04(6.82-7.25)	---	31.75(31.2-32.3)	---	0.67(0.58-0.76)	---

culated for data corresponding to 1 January 2018, to 1 January 2020 and to 1 January 2022. For both the pre-pandemic and pandemic periods, data were collected (including date of event occurrence) on mortality, institutionalization in convalescent units and nursing homes, hospital admissions, emergency visits, outpatient visits, primary care visits, and day hospital sessions. Data for the e-SIF variables and for age, sex, health resource use, and mortality were sourced from primary care computerized medical histories, the pharmaceutical receipt database, and the hospital information system.

Statistical Analysis

The main sociodemographic and clinical characteristics of the study population were described using mean and Standard Deviation (SD) values for numerical variables and percentages for categorical variables. Prevalence of frailty (including frail and very frail categories) and its 95% CI at the beginning of each period and mortality rate (and its 95% CI) during each period were estimated for all study population and for age and sex groups. Since age distributions were somewhat different in the two periods, frailty prevalence and mortality rates were standardized by the direct method to enable comparison. Health resources were described for each study period using means and 95% CI for the overall population and for age, sex and frailty groups. Within each period, comparisons between age and sex groups (both with two categories) were done using the Mann-Whitney U test and comparisons for the four frailty categories were done using the Kruskal-Wallis test. Statistical significance in all statistical tests was set to p<0.05.

Results

For the pre-pandemic period (2018-2019), 9315 individuals were included with a mean (SD) age of 75.4 (7.96) years, and for the pandemic period (2020-2021), 9774 individuals were included with a mean (SD) age of 73.3 (7.87) years. Women represented 56% of the population in both periods. Table 1 shows frailty prevalence rates on 1 January 2018, 2020, and 2022 for the entire study population and by sex and age. The standardized frailty prevalence rates were 12.3%, 14.4%, and 13.6% on 1 January 2018, 2020, and 2022, respectively. For all three dates, prevalence was higher in women than in men and increased with age. Frailty prevalence increased by 16.7% on 1 January 2020 over 1 January 2018 and decreased by 5.4% on 1 January 2022 over 1 January 2020. Table 2 shows the standardized mortality rates for the pre-pandemic and pandemic periods for the entire study population, by sex and age, and for the non-frail and frail groups. In the pandemic period compared to the pre-pandemic period, overall mortality for the population aged ≥65 years increased by 21.7%: by 15.5% in men and 22.3% in women, and by 14.7% in non-frail and 33.0% in frail individuals.

Table 3 shows details of health resource use in both periods for the entire study population, by sex, by age groups (<80 and ≥80 years), and by frailty status, while Figure 1 depicts changes in health resource use between the two periods by frailty status. It can be observed that, in the pandemic period compared to the pre-pandemic period, hospital resource use decreased but primary care resource use increased. In both periods, health resource use increased as frailty increased, with individuals aged ≥80 years accounting for higher rates of hospital admissions, emergency visits, and primary care visits than individuals aged <80 years. Except for primary care, men used all healthcare services more frequently than women. In the pandemic period, emergency visits, hospital admissions, and day hospital sessions decreased by 23.1%, 12.1%, and 3.7%, respectively, while primary care visits and outpatient visits increased by 15.0% and 1.7%, respectively. As can be observed in Figure 1, health resource use varied between periods according to frailty status; for instance, outpatient visits by frail individuals decreased but increased for the other frailty categories, and day hospital sessions decreased most for frail and very frail individuals. The institutionalization rate was 4.9% (95% CI: 4.8-5.1%) in the pre-pandemic period and 4.5% (95% CI: 4.1-4.9%) in the pandemic period.

Discussion

Our findings regarding the population aged ≥65 years for the COVID-19 pandemic period (2020-2021) compared to the pre-pandemic period (2018-2019) indicate the following: a) overall mortality increased by 22%; b) mortality increase for frail individuals (33%) was double that of non-frail individuals (15%); c) frailty prevalence decreased by 5% (compared to a 17% increase in the pre-pandemic period); and d) hospital resource use decreased, while primary care resource use increased, but not homogeneously according to frailty status.

Our finding of an increase in mortality in the pandemic period corroborate data reported for Spain [11] and other European countries [12-14]. Excess mortality (difference between observed and expected mortality) according to Ministry of Health data for Spain was 73,222 additional deaths in 2020, 29,312 additional deaths in 2021, and 34,019 additional deaths in 2022 [15]. In 2022, the excess mortality represented an increase of 17% in overall mortality in Spain. Although the exact causes of

the excess deaths are not known, they can most likely be attributed to COVID-19 and to heat waves. Apart from deaths directly attributed to COVID-19, excess mortality may also be indirectly influenced by COVID-19 due to poorer control of underlying diseases, less access to healthcare services, and delays in the diagnosis and treatment of severe diseases such as cancer [12-14,16]. We found a 22% increase in mortality in the pandemic period over the pre-pandemic period, but also that this increase was not equally distributed, as it was double in frail individuals (33%) compared to non-frail individuals (15%). The causes of greater excess mortality among frail people are not completely understood. However, it is reasonable to speculate that causes include their greater physical vulnerability, the limitation on invasive organ support therapy use, and the numerous severe outbreaks in geriatric and nursing homes, inadequately prepared to deal with the pandemic. The evidence suggests that frailty in COVID-19 patients is associated with longer hospital stays, more severe disease, a higher risk of needing mechanical ventilation, and greater mortality [17-19]. The increased mortality in the frail population may explain the decrease observed in frailty prevalence by the end of the pandemic period. Decreased frailty prevalence occurred in individuals aged <90 years but not in individuals aged ≥90 years, who experienced both increased mortality and increased frailty prevalence.

Regarding health resource use, the COVID-19 pandemic had an important impact on the use of hospital services, especially in the number of hospitalizations and emergency visits, which we found to be reduced by approximately 15% and 25%, respectively. This finding corroborates finding for other countries, as changes in health resource use were reported worldwide during the pandemic [20,21]. Changes in health resource use may have several causes, such as confinement itself, a reduction in demand due to fears of infection in a health centre, or restrictions to healthcare services, due to access limitations, cancellations, and closures. Patient and clinical procedure prioritization in an unfamiliar pandemic situation, work overload, and resource shortages pose great difficulties for health systems and their staff. Establishing priorities for treatment is an ethical and professional dilemma for healthcare providers, as it requires them to try and consider the common good over the individual good. But, prioritizing should not mean neglecting patients, who should never feel abandoned. Health authorities need to provide clear, transparent, and explicit rules for patient prioritization based not only on efficiency criteria, but also considering ethical and equity parameters [22]. Furthermore, healthcare decisions need to be made by experienced clinicians, and be individualized using replicable clinical guidelines based on the best scientific evidence on safety and effectiveness [23]. Changes in health resource use differ depending on frailty phenotypes, and the healthcare services reorganization that occurred during the COVID-19 pandemic seems to have most severely affected frail individuals. In our study, frail individuals compared to non-frail individuals showed quite similar reductions in hospitalizations and emergency visits, greater reductions in outpatient visits and day hospital sessions, and a smaller increase in primary care visits.

In this population-based study of individuals aged ≥65 years in the catchment area of three primary care centres, we used, as robust outcome measures, reliable and validly recorded mortality and health resource use data. Our study, despite those main strengths, also presents some limitations. First, the study sample was limited to a specific geography area and may not be representative of all Catalan and Spanish individuals aged ≥65

years. Second, since all the included individuals were ascribed to the same general hospital, between-hospital variations could not be assessed. Third, data protection and confidentiality restrictions meant that full access was not allowed to all electronic clinical history data or to other potentially relevant clinical and sociodemographic characteristics, so a more in-depth assessment of factors related to health resource use was not possible. Fourth, differences between the pre-pandemic and pandemic periods could not be statistically compared as databases were independent (one for each period) with no common identifier that would permit paired data comparisons. Finally, the fact that the e-SIF definition of frailty considers an accumulation of clinical conditions model makes it difficult to differentiate between health resource use due to frailty and due to comorbidity.

In conclusion, for the population aged ≥65 years in the COVID-19 pandemic period, overall mortality increased by 22%, and mortality increase for frail individuals (33%) was double that for non-frail individuals (15%), with the result that overall frailty prevalence decreased by 5% at the end of this period. In terms of health resource use, use of hospital services decreased and of primary care services increased, with variations according to frailty status.

Author Statements

Conflicts of Interest

The authors have no conflicts of interest to declare.

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