

# Impact and risk factors related to the spread of SARS-CoV-2 (Covid-19) in older adults

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## Abstract

**Objective:** To identify and describe the risk factors that increase susceptibility in older adults to infection by SARS-CoV-2 (Covid-19). **Material and methods:** Descriptive, cross-sectional study in adults over 60 years, patients with a positive result (RT-PCR) were analysed to detect SARS-CoV-2. The study was carried out from May 17 to July 21, 2020. A multiple logistic regression model was used to analyse the risk factors of the study population. **Results:** 102 older adults were included with a mean age of  $82.5 \pm 8.8$  years, 55 (54%) were positive and 47 (46%) were negative. When analysing the risk factors related to higher mortality coupled with Covid-19 infection, the statistically significant variable was frailty, with an OR of 11.6 in frail adults compared to robust individuals ( $p$ -value = 0.024.) **Conclusion:** In the vulnerable population, risk factors must be identified and treated, but above all, such factors must be prevented in advance; early detection, isolation, effective treatment must be carried out as well as follow-up of contacts and prevention of the spread of the new virus to reduce mortality in vulnerable groups.

**Keywords:** SARS-CoV-2. Vulnerable population. Elderly. Risk factors.

## Introduction

The 2018 National Survey of Demographic Dynamics (ENADID) reports that Mexico is home to 15.4 million people over the age of 60, representing 12.3% of the total population, and seven out of ten of them have some type of disability or limitation. The main causes of mortality in the 60-74 age group are diabetes mellitus (DM) and in the 75-84 age group, heart disease and neoplasms accounted for 57.8% and 51.9% of deaths respectively; in the over-85 age group, heart disease, DM and chronic lung disease accounted for 45.2% of deaths<sup>1,2</sup>.

The World Health Organisation (WHO) reports that a new coronavirus disease (COVID-19) is evolving rapidly,

increasing the number of patients and fatal cases, presenting serious problems in terms of diagnosis, mode of transmission, long incubation period, increasing cases in the community along with insufficient hospital protection resources<sup>3,4,5</sup>.

Epidemiological data from Wuhan province mention a 5.1 times higher risk of dying in symptomatic older adults aged 60 years, the prevalence of comorbidities being an additional risk factor for a poor prognosis. The WHO mentions that eight out of ten deaths occur among people with at least one comorbidity including cardiovascular disease, hypertension and diabetes.

Older adult populations living in gerontology centres are at high risk of epidemics as they provide an ideal environment for the acquisition and spread of infection,

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as they share common areas, food, rooms and the presence of external visitors in their facilities, favouring the transmission of infectious diseases. This is demonstrated by the study of an outbreak in a gerontology centre in Mexico City, the first case being reported in the nursing area and spread by cross-infection<sup>6</sup>.

This article describes the clinical course and risk factors of a group of older adults who participated in the study.

## Material and Methods

Descriptive, cross-sectional study that included older adults aged 60 years or more from the geriatric service of General Hospital of Mexico “Dr. Eduardo Liceaga” in whom SARS-CoV-2 (Covid-19) infection was detected.

A case was defined as senior patients who tested positive for the reverse transcription-polymerase chain reaction (RT-PCR) test for SARS-CoV-2 and who presented with typical (fever, diarrhoea, dyspnoea, myalgia, chest pain) and atypical clinical symptoms (functional depression, absence of fever, hypoactive delirium) or who were asymptomatic. Upper respiratory tract samples were used, with nasopharyngeal swabs. Given the variability in viral loads and the timing of sampling in relation to the time of exposure to the virus, a negative test result did not rule out the disease and a clinical and radiological picture was assessed.

The different variables to be studied were collected from the clinical records: onset of symptoms, risk factors, laboratory and academic studies, frailty, severity of the disease, cure or death.

Frailty was determined for each senior patient using Linda Fried’s phenotype of frailty model, which includes variables such as unintentional weight loss, self-reported exhaustion, low energy, decreased gait speed and low grip strength according to established cohort points for the Mexican population. Those with three or more of the factors were considered *frail*. Those with one or two factors were deemed *pre-frail* and without any of these variables were considered *non-frail* or *robust*.

## Statistical analysis

The socio-demographic and clinical data of the older adults included in this study were analysed according to whether they were positive or negative cases to the test (RT-PCR) to compare risk factors associated with susceptibility to become infected with SARS-CoV-2 and according to whether they were cured or died from

Covid-19. Data are shown with mean and standard deviation for continuous variables and with absolute and relative frequency for nominal or ordinal variables. A Student’s t-test for independent samples or the Mann-Whitney U-test was performed depending on whether there was normality or not in the continuous variable, as well as a Pearson’s chi-squared test or Fisher’s exact test to see if there were statistically significant differences in a bivariate manner among categorical variables. An infection ‘curve’ of older adults was plotted from the first to the last day of SARS-CoV-2 virus confirmation using RT-PCR test. The association of potential risk factors for death from Covid-19 was analysed using a multiple logistic regression model. Results were considered statistically significant with a p-value of less than 0.05.

Statistical analysis was performed using STATA statistical software version 15.1.

## Outcome

The study period included 102 older adults aged 60 years and older with a mean age of  $82.5 \pm 8.8$  years and 60 (58.8%) were female. 55 subjects (53.9%) were positive for SARS-CoV-2 virus. A Pearson’s chi-square test found that people whose frailty status was classified as frail had a higher frequency of virus infection compared to people classified as robust (p-value=0.034). Like in the bivariate manner, Fisher’s exact test found a higher frequency (p-value=0.036) of SARS-CoV-2 in people with at least one of the following diseases: hypothyroidism, dyslipidaemia, asthma, chronic kidney disease or obstructive sleep apnoea syndrome compared to people with none of these diseases (Table 1).

Fisher’s exact test (Table 2) showed that people who became ill with Covid-19 and had to go to hospital were more likely to die than those who remained at home during their infection. Similarly, the higher the severity of the patient, the higher the mortality. Bivariate analysis found no statistically significant differences between people who died and did not die from Covid-19 on variables such as sex, diabetes mellitus, hypertension or obesity. Figure 1 shows the SARS-CoV-2 infection confirmation curve by PCR test, which occurred from 17 May to 21 July, with the highest number of positive cases occurring on 2 June 2020.

## P-values

Whilst analysing risk factors related to increased mortality and SARS-CoV-2 infection (Covid-19) using a

**Table 1.** Socio-demographic and clinical data of positive or negative test for COVID-19 by RT-PCR

Variable	Total (n = 102)	Positive (n = 55)	Negative (n = 47)	p-value
Mean age (SD)	82.5 (8.8)	82.6 (9.4)	82.4 (8.0)	0.918 <sup>a</sup>
Sex				
Females, n (%)	60 (58.8)	19 (34.5)	41 (87.2)	<0.001 <sup>b</sup>
Diabetes Mellitus, n (%)	36 (35.3)	20 (36.4)	16 (34.0)	0.807 <sup>b</sup>
Hypertension, n (%)	73 (71.6)	35 (63.6)	38 (80.9)	0.055 <sup>b</sup>
Cardiopathy, n (%)	24 (23.5)	12 (21.8)	12 (25.5)	0.659 <sup>b</sup>
Obesity, n (%)	13 (12.7)	5 (9.1)	8 (17.0)	0.231 <sup>b</sup>
COPD, n (%)	24 (23.5)	10 (18.2)	14 (29.8)	0.168 <sup>b</sup>
Smoking				
No, n (%)	47 (46.1)	21 (38.2)	26 (55.3)	
Yes, n (%)	11 (10.8)	4 (7.3)	7 (14.9)	
No longer smokes, n (%)	44 (43.1)	30 (54.5)	14 (29.8)	0.038 <sup>c</sup>
Immunosuppression				
None, n (%)	93 (91.2)	50 (90.9)	43 (91.5)	
Cancer, n (%)	7 (6.9)	4 (7.3)	3 (6.4)	
Immunoregulators or steroids n (%)	2 (2.0)	1 (1.8)	1 (2.1)	1.000 <sup>c</sup>
Frailty				
Robust, n (%)	35 (34.3)	14 (25.5)	21 (44.7)	
Pre-frail, n (%)	38 (37.3)	20 (36.4)	18 (38.3)	
Frail, n (%)	29 (28.4)	21 (38.2)	8 (17.0)	0.034 <sup>b</sup>
Other diseases				
None, n (%)	93 (91.2)	47 (85.5)	46 (97.9)	
One or more, n (%)	9 (8.8)	8 (14.5)	1 (2.1)	0.036 <sup>c</sup>

<sup>a</sup>Student's t-test for independent samples was performed.

<sup>b</sup>A Pearson's Chi-Square test was performed.

<sup>c</sup>Fisher's exact test was performed.

SD: standard deviation; COPD: chronic obstructive pulmonary disease.

Other diseases: hypothyroidism, dyslipidaemia, asthma, chronic kidney disease and obstructive sleep apnoea syndrome.

multiple logistic regression model, the variable found to be statistically significant was frailty, with an OR of 11.6 in frail adults compared to robust individuals (p-value=0.024). The variables of sex, age, diabetes mellitus, hypertension and obesity were not found to be statistically significant. However, it was decided to leave them in the model as an adjustment because they have been widely reported in the literature to be associated with Covid-19 mortality (Table 3).

## Discussion

The World Health Organisation (WHO) reports an estimated statistical projection that in 2050 there will be 1.5 million people over the age of 65. In Mexico, the population is ageing rapidly. The ratio of women and men over 60 to the total population in 1990 was 6.6% and 5.1%, respectively; it is projected that in 2030, the

incidence of women and men over 60 to the total population will be 15.6% and 13.7%, respectively. Mexico City would be the place with the highest percentage in the country<sup>7,8</sup>.

It has been observed worldwide that the severity of Covid-19 disease depends on the age of the patient. Adults over the age of 65 account for 80% of hospitalisations and have a 23 times higher risk of death than those under 65 years of age. The predominant clinical features are fever, cough, dyspnoea and may progress to acute respiratory distress syndrome, cytokine release syndrome, endotheliitis, coagulopathy, multiple organ failure and eventually death. In our series, the predominant symptoms were diarrhoea (32%), functional depression (19%) and fever defined as greater than or equal to 37.3°C or an increase of 1.1°C in basal temperature. Unfortunately, clinical data in older adults are mostly atypical for an infectious process and even

**Table 2.** Socio-demographic data in geriatric patients with a confirmed diagnosis of Covid-19

Variables	Deaths (n = 23)	Recovered patients (n = 32)	p-value
Mean age (SD)	84.2 (11.1)	81.4 (8.0)	0.343 <sup>a</sup>
Pre-existing conditions			
Diabetes Mellitus	7 (30.4)	13 (40.6)	0.438 <sup>b</sup>
Hypertension	15 (65.2)	20 (62.5)	0.836 <sup>b</sup>
Heart diseases	7 (30.4)	5 (15.6)	0.190 <sup>b</sup>
Obesity	2 (8.7)	3 (9.4)	1.000 <sup>c</sup>
COPD	6 (26.1)	4 (12.5)	0.290 <sup>c</sup>
Immunosuppression			
Cancer	3 (13.0)	1 (3.1)	
No immunosuppressive disease	20 (87.0)	30 (93.8)	
Chronic treatment with immunosuppressants	0 (0.0)	1 (3.1)	0.298 <sup>c</sup>
Other pre-existing comorbidities			
None	19 (82.6)	28 (87.5)	
One or more	4 (17.4)	4 (12.5)	0.707 <sup>c</sup>
Frailty			
Robust	3 (13.0)	11 (34.4)	
Pre-frail	8 (34.8)	12 (37.5)	
Frail	12 (52.2)	9 (28.1)	0.100 <sup>c</sup>
Clinical data			
Care			
Home	4 (17.4)	22 (68.8)	
Hospital	19 (82.6)	10 (31.2)	<0.001 <sup>c</sup>
Asymptomatic	2 (8.7)	16 (50.0)	
Mild	0 (0.0)	5 (15.6)	
Moderate	8 (34.8)	10 (31.2)	
Severe	13 (56.5)	1 (3.1)	<0.001 <sup>c</sup>

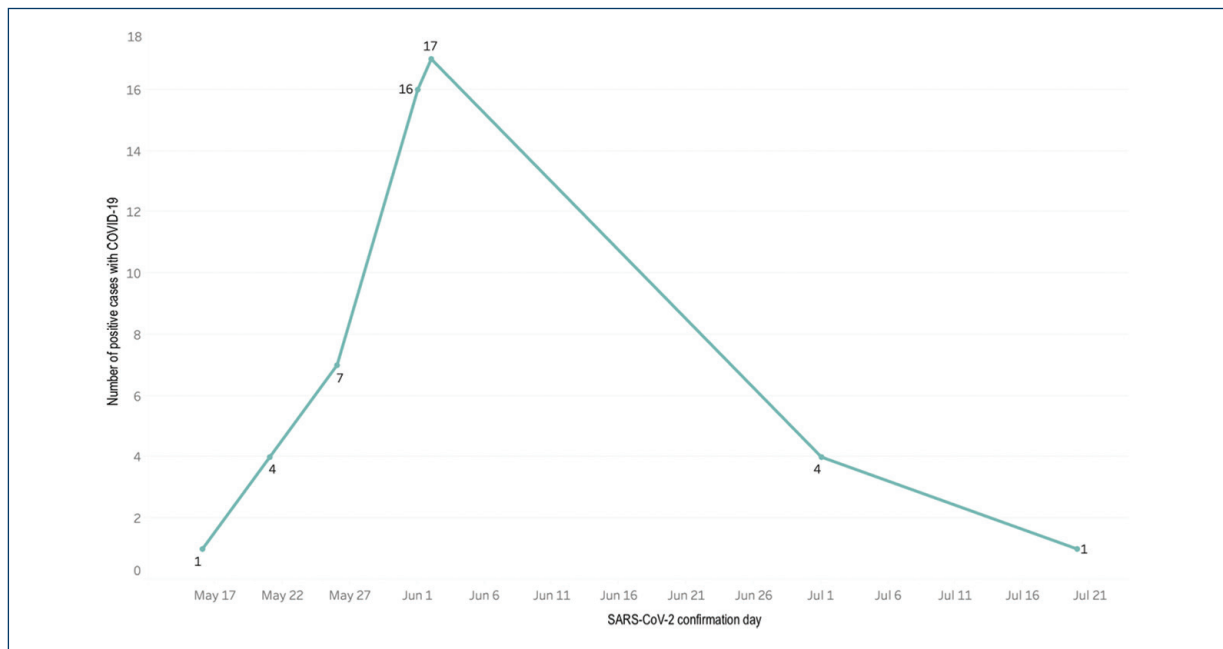
<sup>a</sup>Mann-Whitney U test was performed.

<sup>b</sup>A Pearson's Chi-squared test was performed.

<sup>c</sup>Fisher's exact test was performed.

Comorbidity: dyslipidaemia, asthma, chronic kidney disease and obstructive sleep apnoea syndrome.

COPD: chronic obstructive pulmonary disease.



**Figure 1.** Covid-19 Outbreak in the National Model Centre for Gerontology Care, Research and Training "Arturo Mundet".

**Table 3.** Logistic regression model of factors associated with Covid-19 survival

Variable	OR	CI 95%	p-value
Sex			
Females	1.0	-	-
Males	2.5	0.6-10.2	0.206
Age	1.0	0.9-1.1	0.861
Diabetes Mellitus			
No	1.0	-	-
Yes	0.4	0.1-1.5	0.157
Hypertension			
No	1.0	-	-
Yes	1.1	0.3-3.9	0.868
Obesity			
No	1.0	-	-
Yes	0.8	0.1-5.6	0.802
Frailty			
Robust	1.0	-	-
Pre-frail	3.8	0.6-24.8	0.161
Frail	11.6	1.4-97.8	0.024*

\*Statistically significant with a p-value < 0.05.

more so in frail persons. As demonstrated by multiple comorbidities such as heart disease, diabetes and obesity, which increase mortality in older patients<sup>9</sup>.

The poor response of older patients to physiological stress events can be explained by the fact that the immune system undergoes age-related changes characterised by a gradual decline called immunosenescence, which prevents pathogen recognition and elimination. This results in a chronic increase in systemic inflammation, defects in the innate immune system due to ineffective pathogen recognition and macrophage activation and reduced natural killer (NK) cell cytotoxicity, and in the adaptive immune system due to thymic atrophy and accumulation of anergic memory lymphocytes, as well as the presence of lymphopenia. In the aforementioned series, five (9%) patients had immunosuppressive factors, in addition to advanced age, such as cancer and chronic use of corticosteroids<sup>10</sup>.

Ageing is accompanied by a state of frailty and long-standing chronic degenerative diseases and leads to early functional deterioration, dependence, disability and adverse prognosis with increased mortality. Neuropsychiatric disorders, the endocrine, immune and musculoskeletal systems are the systems most implicated in the onset of frailty. This variable was found to be statistically significant, with an OR of 11.6 in frail adults compared to robust individuals (p-value=0.024). Although Mexico is considered one of the countries with

the highest number of obese people in the world, we can observe a very important contrast here, since only 12.7% are obese, most of them being pre-frail and frail. The pathogenesis of frailty syndrome is involved in the above, with one of the most important factors being the loss of muscle mass associated with ageing or sarcopenia, which is the physical characteristic of most adults. Follow-up assessments include falls, mobility, functionality, hospitalisations and death, with more adverse outcomes in those categorised as frail<sup>11,12,13</sup>.

Different studies have documented that the age range of the deaths was 38 to 97 years with a mean of 77 years. Ninety-three percent occurred in the over 60-age group, 57.5% had metabolic problems such as DM and hypo or hyperthyroidism, as well as heart disease and chronic obstructive pulmonary disease (COPD). In our study, the mean age was higher with an average of 82.5 ± 8.8 years, with a predominance of positive cases in males with 36 (65%) and 19 (34.5%) females<sup>6</sup>.

Metabolic diseases such as DM coupled with hypertension may face an increased risk of 2019-nCoV infection and may greatly affect the development and prognosis of pneumonia. Studies in our population have reported a case fatality of 12.1% higher than the global average (5.2%). In addition, patients with age ≥ 60 years, DM and hypertension had six (OR=6.43, 95% CI 2.50-16.49), ten (OR=10.03, 95% CI 3.80-26.49) and seven (OR=7.22, 95% CI 2.78-18.74) times the risk of death. In contrast to what was found in our series where DM occurred in 20 (36.4%) of the patients, seven patients (30.4%) died and 13 patients (40.6%) were cured, with an OR of 0.4 (p-value=0.157), although this was not statistically significant, possibly due to the small number of the study sample. However, taking into account these risk factors widely described as poor prognostic factors for the disease<sup>14,15</sup>.

We know that the greatest risk of serious illness and death from COVID-19 among the Mexican population is pre-existing comorbidities. In our study, the comorbidities presented by the patients were hypertension, diabetes mellitus, heart disease and COPD.

Meta-analyses of retrospective studies confirm that COPD is associated with a 5.9-fold increased risk of progression, with a higher risk of death identified in individuals who have hypertension, diabetes, cardiovascular disease or cerebrovascular disease<sup>16</sup>. In contrast to our study, the total number of residents with COPD was 24 (23.5%), with 10 (18.2%) positive cases and 6 (26.1) patients who died. We also observed that the predominant factors were Hypertension with an OR

1.1, (p-value=0.868.), Obesity 0.8, (p-value=0.802.), with the sample size limitation associated with statistical significance<sup>17</sup>.

Several European countries have reported that healthcare workers account for more than 20% of all confirmed positive cases. In China, it has been documented that 63% of healthcare workers acquired the disease during the period when there were no protocols for the use of personal protective equipment<sup>18</sup>.

## Conclusion

COVID-19 infection presents a daily challenge against time to avoid the contagion, morbidity and mortality it causes worldwide. Despite the fact that scientific advances represent an important effort for the knowledge of the virus, its diagnosis and treatment, information continues to be biased and the cases of infection and deaths have been increasing exponentially. Concomitantly, we are able to recognise that one of the most vulnerable populations is that of the elderly. It is necessary to disclose and go deeper into the risk factors that resulted in this study, as well as taking into account that this population has medical and health conditions apart from the pandemic, such as social abandonment, chronic illnesses, psychiatric and cognitive conditions that could further limit their survival. We must involve family members, caregivers and medical personnel around the elderly and instil prevention of these risk factors in order to contribute to a decrease in COVID-19 mortality.

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## Conflicts of interest

The authors declare that does not exist a conflict of interest.

## Ethical disclosures

**Protection of human and animal subjects.** The authors declare that no experiments were performed on humans or animals for this study.

**Confidentiality of data.** The authors declare that they have followed the protocols of their work center on the publication of patient data.

**Right to privacy and informed consent.** The authors have obtained the written informed consent of the patients or subjects mentioned in the article. The corresponding author is in possession of this document.

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