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Effect of Co-Morbidities on Mortality from COVID-19 in Mexico: an Ecological Study

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With the emergence of a SARS-CoV-2 infection pandemic in China and its spread to other countries, mortality was shown to be high and to a greater extent if there were underlying pathologies. It is said {or an ecological analytical cross-sectional study, of the open records of confirmed and discarded cases for COVID-19 of the General Directorate of Epidemiology of the Secretary of Health of Mexico. A specific mortality of 9.79% is reported; being higher in men between the ages of 20 to 59 and over 60 years. Mortality rates from underlying diseases were higher than those reported in the USA in early May 2020. Asthma was found to be a protective factor for COVID-19 mortality. It is concluded that mortality was higher in the presence of comorbidities.

Keywords: COVID-19; Co-Morbidities; Mortality; SARS-CoV-2.

In early December 2019, cases of pneumonia of unknown cause occurred, and affected people worked or went to the local Huanan seafood market in Wuhan, Hubei Province, China[1-4]; as of December 31th, 2019, a case of unknown pneumonia was reported to the World Health Organization (WHO) office in Whuan, China[5].On January 10th, 2020, the first death occurred in China due to this infection[6]. The outbreak is declared a Public Health emergency of international interest on January 30th, 2020[6].On February 7th, 2020 it was reported that the cause of idiopathic pneumonia was a new coronavirus and the WHO called it 2019-nCoV and later it was called SARS-CoV-2[7] and the disease caused by the coronavirus was called COVID -19 on February 11th, 2020[5].After a month, the virus was isolated, its genome was sequenced and its morphology was described; on January 12th, 2020, the virus genome was shared with WHO by the Chinese Center for Disease Control and Prevention[8]. Zhou *et al*.[9], reported that the causer of COVID-19 shares 79.5% of the SARS-CoV sequence; also, it uses the same cell entry receptor, angiotensin-converting enzyme-2, as SARS-CoV.

Zhu e t al.[10], reported the cytopathic effects and morphology and it is a member of a family of coronaviruses that infect humans; grew more in human airway epithelial cells than tissue culture cells, suggesting the potential for increased

infectivity.COVID-19 patients who present with a comorbidcondition may have an increased risk of deterioration andshould therefore be admitted to a designated unit for closemonitoring in accordance with the WHO guidelines forscreening and triage[11].

In a series of 41 patients infected with SASR-CoV-2, 32% had some underlying pathology, diabetes 20%, hypertension 15%, cardiovascular disease 15%, chronic obstructive pulmonary disease (COPD) 2%[12].

The objective was to compare deaths from confirmed and discarded cases of COVID-19, as well as to analyze the effect of co-morbidities on deaths of patients with COVID-19.

MATERIAL AND METHODS

A Cross-sectional study in the Mexican population is designed, with data published by the General Directorate of Epidemiology and the National Epidemiological Surveillance System of the Ministry of Health on May 6th, 2020[13].

Where analyzed all registries published by Secretary of Health in Mexico, with confirmed and discarded cases of COVID-19.

Registries with not full data were eliminated from analysis.

Data were collected on age, gender, symptom onset date, RT-PCR test result, date of death, if applicable, as well as associated factors or diseases (smoking, obesity, pneumonia, cardiovascular disease, asthma, COPD, diabetes, hypertension, chronic kidney disease. Immunosuppression)[13].

A suspected case is a patient who, in the previous 14 days, has presented fever and / or cough, headache, myoarthralgia, dyspnea and has had contact with a confirmed case or has traveled to China, Europe or the USA and becomes confirmed when in addition of the above, it presents positive RT-PCR test[14].To establish whether the case was confirmed or ruled out, it was based on the result of the RT-PCR, recommended by the WHO[15].

For the statistical analysis, variables were crossed with confirmed cases and discarded cases, associated diseases and deaths. Odds Ratios (OR) and 95% confidence intervals were calculated to find an effect between gender, underlying pathologies and the possibility of dying.Logistic regression models were designed for death and being a case of COVID-19, as well as death and not being a case for COVID-19, adjusted by age group and sex, for each of the morbidities.Statistical analysis was performed on STATA ® 13.0 (Stata Corp., College Station, TX, USA)

RESULTS AND DISCUSSION

The sample of public records of confirmed and discarded cases of the General Directorate of Epidemiology, of the National System of Epidemiological Surveillance of the Ministry of Health of Mexico, was made up of 134, 663 records of which 45,032 (33.44%) were confirmed cases and 89,631 (66.56%) were negative for the RT-PCR test[13].

For confirmed cases 27,634 (29.57%) the age range was from 0 to 113 years with a mean of 46.72 ± 15.62 years; for 65,807 (70.43%) discarded cases, the age range was from 0 to 110 years with a mean of 39.92 ± 17.62 years (t = 55.63, degrees of freedom 93439, P = .00001).

Table 1 shows the distribution by age group, gender of confirmed cases and discarded cases caused by SARS-CoV-2. For both gender and age groups, there are significant differences between cases with no cases of COVID-19.

Table 2 shows the deaths between confirmed cases and discarded cases; the specific fatality rate for COVID-19 was 9.79%; Among the discarded cases, 1.93% of deaths were registered.

Table 1. Distribution by confirmed and non-cases of COVID-19 in Mexico, until May 6, 2020 (n=93,341)

Variable	Confirmed cases (n=27,634) n (n (%))	Non-cases (65,807) n (%)
Gender		
Female	11,475 (41.52)	34,588 (52.56)
Male	16,159(58.48)	31,219 (47.44)
Total	27,634(100.0)	65,807(100.0)
Age group (years)		
0 to 5	150 (0.54)	2,361 (3.59)
6 to 11	129(0.47)	1,265 (1.92)
12 to 19	335 (1.21)	2,210 (3.36)
20 to 59	21,247(76.89)	51,195 (77.80)
60 and higher	5,773(20.89)	8,776 (13.34)
Total	27,634 (100.0)	65,807 (100.0)

Source: Secretary of Health[13]

Among the deceased with a confirmed diagnosis of SARS-CoV-2, men predominated (68.31%) and in both groups, being a woman was a preventive factor of death in up to 37% (Table 3). By age group, deaths between 20-59 years (50.55%) and 60 or older (49.11%) predominated;

Table 2. Distribution of deaths among cases and non-cases of COVID-19, until May 6, 2020 (n=93,341)

Variable	Confirmed cases (n=27,634) n (%)	Non-cases (65,807) n (%)	Chi-squared test (df)	*P*-value
Deaths			3003 (1)	0.0001
Yes	2,704 (9.79)	1,269 (1.93)		
No	24,930(90.21)	64,538 (98.07)		
Total	27,634 (100.0)	65,807 (100.0)		

Source: Secretary of Health[13]

Table 3. Distribution of deaths by confirmed cases and non-cases of COVID-19, by gender and age group on Mexico, until May 6, 2020

	Confirmed cases COVID-19 (n=27,634)		Non-cases COVID-19 (65,807)	
	Deathsn%	Non-deathsn%	Deathsn%	Non- deathsn%
Gender				
Females	857 31.69	10,61842.59	54142.63	34,04752.67
Male	1,847 68.31	14,31257.41	72857.37	30,49147.33
Total	2,704 100.0	24,930 100.0	1,269100.0	64,538 100.0
OR (CI95%)	0.63 (0.57 to 0.68)	0.67 (0.59 to 0.74)		
Age group (years)				
0 – 5	8 0.30	1420.57	49 3.86	2,3123.58
6-11	0 0	1290.52	120.95	1,2531.94
12-19	10.04	3341.34	25 1.97	2,1853.39
20-59	1,367 50.55	19,88079.74	492 38.77	50,70378.56
60 or higher	1,328 49.11	4,44517.83	691 54.45	8,085 12.53
Total	2,704100.0	24,930 100.0	1,269 100.0	64,538 100.0

Source: Secretary of Health[13]

Table 4. Missing data in co-morbidities and whether confirmed COVID-19 patients in Mexican Sample from the start until May 6th, 2020

	Confirmed COVID-19 patients	Non-confirmed COVID-19 patients
Diabetes	262	135
Hypertension	257	123
COPD	259	125
Asthma	267	119
Cardiovascular disease	265	125
Immunosuppression	263	140
Chronic kidney disease	270	112
Smoking	257	125
Obesity,	247	99
Pneumonia	2	7

Source: Secretary of Health[13]

in the discarded cases, deaths predominated in men (67.37%) with ages 60 or older (57.37%). (Table 3)

When analyzing the co-morbidities, the records were eliminated because they did not know if they suffered from the associated diseases: Table 4 summarized the number of patients with missing data for each disease analyzed in this study.

OR for the association between deaths and co-morbidities, it is reported that those who died from COVID-19 were three times more likely to have had diabetes, hypertension, COPD and chronic kidney disease; for cardiovascular disease, immunosuppression and obesity, the OR were less than 3, but continue to show an effect of these pathologies on death. For smoking, the effect was almost null on death (Table 5).

Table 5. Distribution of deaths by cases and non-cases of COVID-19, by co-morbidities in Mexico

	Confirmed cases COVID-19 (n=27,634)		Non-cases COVID-19 (65,807)	
	Deaths n %	Non-deaths n %	Deaths n %	Non- deaths n %
Diabetes				
Yes	1,075 40.07	4,116 16.67	511 49.78	6,737 10.46
No	1,608 59.93	20,57383.33	742 50.22	57,682 89.54
OR (CI95%)	3.34 (IC95%3.07 to 3.63)		5.90 (5.25 to 6.62)	
Hypertension				
Yes	1,173 45.70	4,896 10.83	548 20.48	9,672 15.01
No	1,511 54.30	19,797 89.17	708 79.52	54,756 84.99
OR (CI95%)	3.14 (2.89 to 3.41)		4.38 (3.91 to 4.91)	
COPD				
Yes	1825.67	499 2.02	163 13.02	1,558 2.42
No	2,501 94.33	24,193 97.98	1,089 86.98	62,872 97.58
OR (CI95)	3.53 (2.96 to 4.20)		6.04 (5.09 to 7.17)Asthma	
Yes	75 2.80	841 3.41	166 6.20	1,948 3.02
No	2,606 97.20	23,845 96.59	2,513 93.80	62,479 96.98
OR (CI95%)	0.82 (0.64 to 1.03)		0.53 (0.38 to 0.74)	
Cardiovascular disease				
Yes	166 6.20	6272.54	164 13.07	1,948 3.02
No	2,513 93.80	24,063 97.46	1,091 86.93	62,479 96.98
OR (CI95%)	2.54 (2.13 to 3.02)		4.82 (4.07 to 5.72	
Pneumonia				
Yes	2,008 74.26	6,374 25.57	879 69.27	7,676 11.90
No	696 25.74	18,554 74.43	390 30.73	56,855 88.10
OR (CI95%)	8.67 (7.92 to 9.50)		16.69 (14.78 to 18.85)	
Immunopression				
Yes	100 3.73	387 1.63	122 9.76	1,666 2.59
No	2,581 96.27	23,303 98.37	1,128 90.24	62,751 97.41
OR (CI95%)	2.43 (1.95 to 3.04)		7.13 (6.02 to 8.46)	
Chronic kidney disease				
Yes	196 7.31	514 2.08	170 13.50	1,380 2.14
No	2,484 92.69	24,170 97.92	1,089 86.50	63,056 97.86
OR (CI95%)	3.71 (3.13 to 4.40)		1.29 (1.09 to 1.52)	
Obesity				
Yes	801 29.82	5,019 20.32	241 19.13	9,141 14.18
No	1,885 70.18	19,682 79.68	1,019 80.87	55,307 85.82
OR (CI95%)	1.67 (1.53 to 1.82)		1.43 (1.24 to 1.65)	
Smoking				
Yes	245 9.14	2,186 8.85	159 12,69	6,535 10.14
No	2,435 90.86	22,511 91.15	1,094 87.31	57,894 89.86

Asthma prevented death in confirmed cases (18%) and non-cases (47%) (Table 5).

Regarding the discarded cases of COVID-19, the OR between diabetes, hypertension, COPD, cardiovascular disease, pneumonia, immunosuppression, chronic kidney disease, obesity and smoking, in all cases an effect of pathologies on the possibility is detected. of death and much higher the OR than those obtained in the cases (Table 5).

With the logistic regression model, for confirmed cases with diabetes, the age group acted as a confounder, an effect that was not found for gender, a similar result for the discarded cases.Similar results for hypertension, chronic obstructive pulmonary disease, cardiovascular disease, pneumonia, immunosuppression, chronic kidney disease. Obesity had a slight effect on mortality in confirmed cases and discarded cases; Smoking had virtually no effect on deaths (Table 6).

The samples reported as confirmed cases of COVID-19 were 27,634 with 2,704 deaths, with a specific rate of 9.79%. COVID-19 deaths

Table 6. OR crude and adjusted of mortality and co-morbidities, by age group and gender among cases COVID-19 and non-cases in Mexico

Co-morbilities	OR crude (CI95%)	OR adjusted by agegroup (CI95%)	OR adjusted by gender (CI95%)
Diabetes			
Cases COVID-19	3.34 (3.07 to 3.63)	2.39 (2.18 to 2.61)	3.34 (3.07 to 3.63)
Non-cases	5.89 (5.25 to 6.62)	3.78 (3.33 to 4.29)	5.89 (5.25 to 6.62)
Hypertension			
Cases COVID-19	3.14 (2,89 to 3.41)	2.09 (1.91 to 2.28)	3.17 (2.92 to 3.44)
Non-cases	4.38 (3.91 to 4.91)	2.68 (2.36 to 3.04)	4.35 (3.89 to 4.88)
COPD			
Cases COVID-19	3.53 (2.96 to 4.20)	1.92 (1.60 to 2.31)	3.65 (3.06 to 4.35)
Non-cases	6.04 (5.09 to 7.57	2.71 (2.25 to 3.27)	5.97 (5.03 to 7.10)
Asthma			
Cases COVID-19	0.53 (0.38 to 0.74)	0.57 (0.40 to 0.80)	0.55 (0.39 to 0.77)
Non-cases	0.82(0.64 to 1.04)	0.92 (0.72 to 1.18)	0.88 (0.69 to 1.12)
Cradiovascular disease			
Cases COVID-19			
Non-cases	2.54 (2.13 to 3.02)	1.52 (1.26 to 1.82)	2.53 (2.12 to 3.02)
	4.82 (4.07 to 5.72)	2.73 (2.28 to 3.26)	4.74 (4.00 to 5.63)
Pneumonia			
Cases COVID-19	8.40 (7.67 to 9.20)	6.68 (6.17 to 7.44)	8.18 (7.47 to 8.96)
Non-cases	16.69 (14.78 to 18.85)	14.24 (12.56 to 16.15)	16.40 (14.51 to 18.52)
Immunosuppression			
Cases COVID-19	2.43 (1.95 to 3.04)	2.15 (1.70 to 2.72)	2.49 (1.99 to 3.12)
Non-cases	4.07 (3.36 to 4.94)	3.32 (2.73 to 4.05)	4.09 (3.37 to 4.96)
Chronic kidney disease			
Cases COVID-19			
Non-cases	3.71 (3.13 to 3.13)	2.72 (2.27 to 3.25)	3.67 (3.10 to 4.36)
	7.13 (6.02 to 8.46)	4.38 (3.67 to 5.24)	
Obesity			
Cases COVID-19	1.67 (1.53 to 1.82)	1.72 (1.57 to 1.88)	1.69 (1.55 to 1.85)
Non-cases	1.43 (1.24 to 1.65)	1.27 (1.10 to 1.47)	1.46 (1.26 to 1.68)
Smoking			
Cases COVID-19	1.04 (0.90 to 1.19)	0.99 (0.86 to 1.48)	0.96 (0.83 to 1.10)
Non-cases	1.29 (1.09 to 1.52)	1.13 (0.95 to 1.34)	1.20 (1.02 to 1.42)

Source: Analysis of data of Secretary of Health[13]

predominated in men ages 20 to 59 and those aged 60 or older. Globally, the WHO reported a mortality from COVID-19 of 6.34%[16].

According to the same WHO report, Italy had a specific mortality rate of 12-80%, the United Kingdom of 12.78%, Spain 10.3%, the United States of America, 3.97% and Brazil of 2.96%[16].

The case-specific mortality in Mexico was 9.79% and according to the WHO report of May 6th, 2020, overall the case-specific mortality was 6.9%, for the Americas region it was 5.38% and for Europe 9.3 %[17].

There is currently evidence that mortality rates are higher in men than in women, as indicated by the Italian Institute of Health in one of its reports, where of 23,188 deaths, approximately 70% of these were men, as well as in China and South Korea[18]. In Mexico, mortality was higher in men (68.31%) than in women (Table 2 and 3).

The incidence of SARS-CoV-2 infection has been seen to be more frequent in adult male patients between the ages of 34 and 59, and it has also been observed that people 60 years of age or older and with comorbidities represent severe cases that may present coinfections[19]. Among the confirmed cases in Mexico, mortality between 20 and 59 years was 50.55% and 49,115 in those over 60 years of age (Table 3).

In the United States, the National Center for Health Statistics, until May 9th, 2020 reports that patients with comorbidities of all ages are 49,770; stratifying each comorbidity and reporting a specific mortality of 14.27% in people with diabetes, 7.34% for kidney failure, 43.41% for pneumonia, 3.45% for cardiovascular disease, 7.72% for COPD, 2.65% for obesity and 20.22% for hypertension[20]. In Mexico, among the confirmed cases of diabetes, mortality was 40.07; 45.70% among those with hypertension, 74.26% in those with pneumonia, 29.82% in those with obesity, 9.14% among smokers 6.20% among those with cardiovascular disease, 7.31% among those who reported chronic kidney disease, 5.67% among those with COPD 3.73% among those with some type of immunosuppression and 2.80% among those with asthma (Table 5). In general, the specific death rate from co-morbidities was higher than that reported in the USA.

Of the discarded cases of COVID-19 they had an overall mortality of 1.93%[13]. One explanation for the higher OR's for the pathologies included in this analysis, among the discarded cases of having COVID-19, is that they all had a respiratory condition that made them consider themselves suspected of being infected with SARS-CoV-2.

CONCLUSION

Mortality in Mexico among confirmed cases of COVID-19 is higher for adult men, over 20 years and older adults. Regarding the underlying pathologies, mortality was higher in Mexico than in other affected countries.In this population it was three times more likely to die having diabetes and confirmed COVID 19 and six times more likely to die by having diabetes but not confirmed for COVID-19. same for other pathologies except asthma.

Conflict of interest

Nothing to declare

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None

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