Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Increased Risk of Hospitalization and Death in Patients with COVID-19 and Pre-existing Noncommunicable Diseases and Modifiable Risk Factors in Mexico

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Background. The population in Mexico has high prevalence rates of noncommunicable diseases (NCDs). Hospitalization and death of COVID-19 patients in the countries most affected by the pandemic has been associated to chronic comorbidities.

Objective. To describe the prevalence of NCDs in patients with COVID-19 in Mexico and analyze the increased risk due to comorbidities and risk factors on hospitalization, utilization of intensive care units and death.

Methods. A cross-sectional study was performed from 212,802 confirmed COVID-19 cases reported by the Ministry of Health up to June 27, 2020. Odds ratios were performed using logistic regression model.

Results. Up to 47.40% of patients with COVID-19 diagnosis were also reported with a comorbidity, with hypertension being the most frequent (20.12%). The report of at least one NCD significantly increased the risk of death with respect to patients without such diagnoses. Chronic kidney disease increased the risk of death the most (OR 2.31), followed by diabetes (OR 1.69), immunosuppression (OR 1.62), obesity (OR 1.42), hypertension (OR 1.24), chronic obstructive pulmonary disease (OR 1.20). The comorbidities that most increased the risk of ICU and of intubation were diabetes, immunosuppression and obesity.

Conclusion. NCD comorbidities increase the severity of COVID-19 infection. Given high NCD prevalence rates among the Mexican population, the pandemic poses a special threat to the health system and to society. Special prevention measures need to be strengthened for persons with NCD diagnoses in the short-term. In the mid-term, disease control strategies need to be improved to protect these patients against COVID-19 severity.

Key Words: COVID-19, SARS-CoV-2, Non-communicable diseases, Comorbidities, Modifiable risk factors, Intensive care unit, Endotracheal intubation.

Introduction

By December 2019 the health authorities of Wuhan China reported 27 cases of severe acute respiratory syndrome (SARS) of unknown etiology. Authorities in China reported

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a new coronavirus (SARS-CoV-2) identified as a possible etiology of that syndrome (1). On January 30, 2020 the World Health Organization (WHO) declared the COVID-19 outbreak as a public health emergency of international concern and on March 11 issued the declaration of a pandemic (2). By February 28, 2020 the first three cases of COVID-19 were reported in Mexico, while a total of 85,403 confirmed cases had been reported worldwide.

Based on information from the pandemic in China and European countries, the WHO alerted that pre-existing non-communicable diseases (NCD) and modifiable risk factors such as smoking and obesity increase the vulnerability of patients with COVID-19 to becoming severely ill, increasing the risk of hospitalization and death (3). A meta-analysis of confirmed COVID-19 cases from China placed hypertension, diabetes, cardiovascular disease and respiratory system disease as the most prevalent underlying NCDs, in that order (4). Among hospitalized patients in Wuhan, China 64% had at least one comorbidity, with hypertension the most common, while 72.2% of patients with any NCD required intensive healthcare as against 37.3% among those without NCDs (5). A meta-analysis or publications across various countries established that chronic kidney disease trebles the risk of severe COVID-19 infection (6). The increased risk of NCD on COVID-19 severity has also been shown for the United States (7,8). Hospitalized patients in New York were reported with high NCD prevalence rates, with up to 56.6% reporting hypertension, 33.8% diabetes and 41.7% obesity (9).

The Mexican population has a high prevalence of chronic diseases and obesity, placing the population at a particular risk for severe COVID-19. For 2018 up to 18.4% of adults reported hypertension and 10.3% diabetes. With respect to risk factors, 36.1% of the adult population is obese, while 11.4% smokes (10,11). The identification of predictive factors for severe COVID-19 is useful to optimize hospital resources and to strengthen policies towards chronic disease prevention and control.

The aim of this paper is to describe the prevalence of NCDs in patients with COVID-19 in the Mexican general population and to analyze the risks of hospitalization, use of ICU, intubation and death according to the report of underlying NCDs and modifiable risk factors.

Methods

Databases and Data Extraction

This is a cross-sectional study performed from the laboratory-confirmed COVID-19 cases reported by the federal Ministry of Health of Mexico (MoH) through the COVID-19 anonymized and open access database published through the Epidemiological Surveillance System for Viral Respiratory Diseases cut-off date at June 27, 2020 (12). The MoH reports laboratory confirmed cases through two information channels: the epidemiological surveillance system for viral respiratory diseases (SISVER) and the National System for Epidemiological Surveillance (SINAVE). SISVER includes a sample of 475 health care units from a wide range of public and private providers in primary and hospital care in all states of the country who report 10% of ambulatory cases and 100% of hospitalized serious cases and deaths with suspected viral respiratory disease. Information is captured by physicians based on epidemiological study formats and includes patient information, suspected diagnosis and comorbidities (13,14). SINAVE includes all public and private health care units covering all diseases of obligatory reporting (15).

A total of 212,802 cases of laboratory-confirmed COVID-19 cases were reported in the MoH data base up to June 27, and 1,799 records with missing or unknown comorbidity or condition were excluded. The following variables were extracted and assessed. For sociodemographic status: age and sex. For modifiable risk factors: smoking and obesity. For type of health care received: ambulatory care, hospitalization and intensive care unit (ICU). For NCD diagnoses: asthma, cardiovascular disease, chronic kidney disease, chronic obstructive pulmonary disease, diabetes types 1 and 2, hypertension and immunosuppression. The descriptors in the database do not define the classification method for comorbidities. The information is obtained through a dichotomous questionnaire that the physician fills with the information provided by the patient. Finally, the variable death was obtained from the database by means of date of death.

The study does not require ethical review because it is based on open, anonymized data from the Mexican Ministry of Health.

Statistical Analysis

Continuous variables were described using measures of central tendency. Categorical variables were described as percentages. A χ^2 test was performed to compare the percentages of patients with and without NCDs and modifiable risk factors against the percentage of patients with and without hospitalization, ICU, endotracheal intubation and death. The likelihood of being hospitalized, admitted to ICU, intubated or death for COVID-19 was assessed according to NCD comorbidities and modifiable risk factors, estimating odds ratios (ORs) with 95% confidence intervals and their corresponding p values. A multivariate logistic regression model was used adjusting by age, sex and for each of the comorbidities and risk factor analyzed (CKD, immunosuppression, diabetes, COPD, hypertension, cardiovascular disease, asthma, obesity and smoking). All statistical analysis was performed using Stata SE version 15.0 software (Stata corporation, College Station, TX, USA).

Results

Of the total number of COVID-19 cases analyzed, the average age was 45.7 years, and 54.71% of cases were men. More than a half of cases (52.92%) were reported by MoH providers catering for the non-insured, followed closely by providers from the Mexican Institute of Social Security (IMSS) catering for formal private sector employees (Table 1).

Comorbidities were reported present in 47.40% of cases (Table 2). The most prevalent NCD reported is hypertension (20.12%) and diabetes (16.44%) (Table 2). As to modifiable risk factors, obesity was reported by 19.59% of cases and smoking by 7.79%. Prevalence of all comorbidities was significantly more elevated in hospitalized COVID-19 cases than in those cases that used only outpatient care ($p < 0.0001$). Hospitalized patients with hypertension were 34.27% and with diabetes 30.77%; regarding risk factors 23.52% were obese and 8.20% smoked. Among patients admitted to the ICU 69.03% had at least one comorbidity while those with hypertension were 34.42% and with diabetes 33.26%. With regard to modifiable risk factors, 28.70% of patients admitted to ICU had obesity and 7.99% smoked. Higher NCD prevalence rates were observed for patients reported with intubation, with hypertension in 37.03% of cases and diabetes in 34.44%. With regard to modifiable risk factors, obesity was reported for 28.72% of patients and smoking for 10.29%. Among deceased patients, 42.20% were reported with hypertension and 36.99% with diabetes, while 25.0% were obese and 8.80% smoked."

Table 1. General characteristics of patients with COVID-19 in Mexico, up to June 27, 2020

Variables	*n* (%)
Total study population	211,003 (100%)
Age, mean (±SD)	45.7 (±16.3)
Sex	
Women	95,561 (45.29)
Men	115,442 (54.71)
Healthcare services providers	
Ministry of Health (Secretaría de Salud)	111,671 (52.92)
Mexican Institute of Social Security (IMSS)	70,458 (33.39)
Institute for Social Security and Services for State Workers (ISSSTE)	9,885 (4.68)
Private healthcare services	5,831 (2.76)
Healthcare services for state employees	5,015 (2.38)
Mexican Petroleum Company (PEMEX)	2,845 (1.35)
Ministry of the Navy (SEMAR)	2,088 (0.99)
Ministry of Defense (SEDENA)	1,357 (0.64)
Municipal government healthcare services	244 (0.12)
University healthcare services	169 (0.08)
Red Cross healthcare services	19 (0.01)
National System for the Integral Development of the Family DIF	8 (0.00)
Not specified	1,413 (0.67)

Ministry of Health (in Spanish, Secretaría de Salud); Mexican Institute of Social Security (in Spanish, Instituto Mexicano del Seguro Social, IMSS); Institute for Social Security and Services for State Workers (in Spanish, Instituto de Seguridad Social y Servicios para los trabajadores del Estado, ISSSTE); Mexican petroleum company (in Spanish, Petóleos Mexicanos, PEMEX); Ministry of the Navy (in Spanish, Secretaría de Marina, SEMAR); Ministry of Defense (in Spanish, Secretaría de la Defensa Nacional, SEDENA).

Patients with COVID-19 and NCD comorbidities had greater risk of hospitalization comparted to patients without an NCD diagnosis or risk factors, as shown by the odds ratio (OR) expressing the risk multiplier with respect to not having the NCD diagnosis or risk factor (Table 3). CKD is the NCD that poses greatest hospitalization risk (OR 2.54), followed by immunosuppression (OR 2.17), diabetes (OR 1.98) and COPD (OR 1.34). Patients with modifiable risk factors also had a greater risk of hospitalization, of 1.29 in the case of obesity. Interestingly, asthma and smoking were found to be a protective factor of hospitalization (OR 0.83 and OR 0.93, respectively).

Admission to the ICU also showed increased risks for patients with NCD and modifiable risk factors. Among patients with any NCD the risk was similar to hospitalization (OR1.89). The highest risk was observed in the case of diabetes (OR 1.66) followed by immunosuppression (OR 1.62). With regard to modifiable risk factors, cases with obesity had greater risk (OR 1.59). Again, smoking turned out to be a protective factor (OR 0.85).

Similarly, the report of endotracheal intubation was associated to greater risk for patients with any NCD (OR1.95). The NCD posing greatest risk was diabetes (OR 1.68) followed by immunosuppression (OR 1.32). Asthma was found to be a protective factor of endotracheal intubation (OR 0.73). The modifiable risk factor of obesity increased the risk of intubation by 1.62 times, but no significant association was found with smoking.

Regarding mortality, higher risk was reported for patients with NCDs and modifiable risk factors (OR 1.99). The highest risk was observed in the case of CKD (OR 2.31) followed by diabetes (OR 1.69). With regard to modifiable risk factors, cases with obesity had greater risk (OR 1.42). Again, asthma was found to be a protective factor of death (OR 0.82).

Discussion

Our study suggests that people with COVID-19 disease and presence of NCD comorbidities in Mexico had a higher likelihood to be hospitalized, to be admitted to the ICU and to be intubated. The NCD that places persons infected with COVID-19 at risk of being hospitalized is CKD, and for UCI admission and endotraqueal intubation is diabetes.

Limitations of our study are those of the sources of information based as it was on official reports stemming from a COVID-19 surveillance system that has not been adequately validated (12). No analyses have been undertaken yet of the quality of the database, although anecdotal

Table 2. Prevalence of comorbidities and risk factors among patients with COVID-19 infection by healthcare services used and death, in Mexico, from February 2020 to June 27, 2020

Comorbidity/Condition	All study population		Ambulatory		Hospitalized			ICU admission			Required endotracheal intubation			Death		
								Yes			Yes			Yes		
	N	Prevalence %	*N*	Prevalence%	*N*	Prevalence%	*p*[a]	*N*	Prevalence%	*p*[a]	*N*	Prevalence%	*p*[a]	*N*	Prevalence%	*p*[a]
COVID-19, diagnosis only	110,987	52.60	87,903	60.41	23,084	35.25	0.000	1,706	30.97	0.000	1,773	28.83	0.000	7,135	27.52	0.000
At least one comorbidity/risk factor	100,016	47.40	57,605	39.59	42,411	64.75	0.000	3,802	69.03	0.000	4,376	71.17	0.000	18,793	72.48	0.000
Comorbidities																
Hypertension	42,453	20.12	20,006	13.75	22,447	34.27	0.000	1,896	34.42	0.000	2,277	37.03	0.000	10,942	42.20	0.000
Diabetes	34,685	16.44	14,531	9.99	20,154	30.77	0.000	1,832	33.26	0.000	2,179	34.44	0.000	9,592	36.99	0.000
Asthma	5,854	2.77	4,353	2.99	1,501	2.29	0.000	143	2.60	0.415	114	1.85	0.000	533	2.06	0.000
Cardiovascular disease	4,949	2.35	2,215	1.52	2,734	4.17	0.000	262	4.76	0.000	297	4.83	0.000	1,382	5.33	0.000
CKD	4,581	2.17	1,450	1.00	3,131	4.78	0.000	232	4.21	0.000	307	4.99	0.000	1,750	6.75	0.000
COPD	3,721	1.76	1,363	0.94	2,358	3.60	0.000	197	3.58	0.000	243	3.95	0.000	1,286	4.96	0.000
Immunosuppression	2,895	1.37	1,248	0.86	1,647	2.51	0.000	156	2.83	0.233	151	2.46	0.996	741	2.86	0.000
Risk factors																
Obesity	41,344	19.59	25,940	17.83	15,404	23.52	0.000	1,581	28.70	0.000	1,766	28.72	0.000	6,481	25.00	0.000
Smoking	16,445	7.79	11,073	7.61	5,372	8.20	0.000	440	7.99	0.585	536	10.29	0.006	2,282	8.80	0.000

[a] *p* value was estimated by means of chi squared test, comparing the percentage of COVID-19 patients (with and without comorbidities) regarding healthcare services use: ambulatory *versus* hospitalization manage, ICU admission versus no ICU admission, required intubation versus no required intubation.

evidence suggests that quality has been improving on a daily basis. As in other countries, the number of confirmed COVID-19 cases is underreported, although this could be a greater concern in Mexico given low levels of testing (16). Furthermore, the sentinel system reports cases based on a sample which may be biased towards MoH providers. These limitations pose minor challenges for our study as we aim to assess the relative risks posed by NCDs and modifiable risk factors on health services utilization; the completeness of reports would play a negligible error. However, health care institutions could be subjected to different internal constraints on health service utilization. Sampling biases would, could, therefore be more challenging. However, the observed distribution of cases across institutions does not deviate significantly over normal distribution of hospital utilization in Mexico across public institutions. Private providers, however, could be under-represented.

NCD comorbidities represent a higher risk of hospitalization, and once interned, contribute less but still significantly to ICU admission and endotracheal intubation. For instance, a systematic review and meta-analysis reported that among 1,382 COVID-19 patients, diabetes was the second more frequent comorbidity, and diabetic patients had a significant increased risk of ICU admission (OR 2.79, $p < 0.0001$), and they also resulted to be at higher mortality risk (OR 3.21, $p < 0.0001$) (17). In China, a study had reported risk factors for severe COVID-19 disease in 167 confirmed cases, showing that among patients with diabetes, severe cases were significantly more common than in non-severe patients ($p < 0.001$) (18).

Our results are congruent with previous studies, showing that a higher prevalence of NCD comorbidities and risk factors among COVID-19 patients as well as greater risk for hospitalization (3,4,6,8,9,14,15,19). Hypertension and diabetes are the most prevalent NCDs in patients with COVID-19 in Mexico, and with CKD, pose the most significant risk of hospitalization. Among the reported modifiable risk factors, obesity also places a significant challenge on hospitalization. While diabetes and hypertension prevalence are higher among COVID-19 patients than in the general population, obesity is somewhat lower (11).

Asthma patients presented a protective factor for hospitalization, intubation and death in this Mexican population. Other countries have reported that is unclear if asthma increases the risk of contracting COVID-19, or increases the risk of worse outcomes from COVID-19 disease. Probably COVID-19 can trigger asthma exacerbations, given that viral respiratory infections are a frequent cause of asthma attacks (20), and exacerbations that require emergency department visits and hospitalizations increase annually when viral infections increase (16). However, studies from China and Korea did not find that patients with asthma had more risk to be hospitalized in the COVID-19 infection (19,21,22). The low prevalence of Asthma as a chronic respiratory disease related to Covid-19, has conditioned

Table 3. Adjusted risk of hospitalization, ICU admission, endotracheal intubation and death in patients with COVID-19, in Mexico, from February 2020−June 27, 2020

	Risk of hospitalization			Risk of ICU admission			Risk of endotracheal intubation			Death		
Comorbidity/Condition	**Adjusted odds ratio**	**95% CI**	***p***	**Adjusted odds ratio**	**95% CI**	***p***	**Adjusted odds ratio**	**95% CI**	***p***	**Adjusted odds ratio**	**95% CI**	***p***
At least one comorbidity/risk factor (n = 100,016)	1.84	1.80−1.88	0.000	1.89	1.78−2.01	0.000	1.95	1.82−2.06	0.000	1.99	1.93−2.05	0.000
Comorbidities[a]												
Chronic kidney disease (n = 4,581)	2.54	2.36−2.73	0.000	1.12	0.97−1.29	0.125	1.30	1.15−1.48	0.000	2.31	2.15−2.48	0.000
Immunosuppression (n = 2,895)	2.17	1.99−2.36	0.000	1.62	1.37−1.92	0.000	1.32	1.11−1.57	0.002	1.62	1.47−1.78	0.000
Diabetes (n = 34,685)	1.98	1.93−2.03	0.000	1.66	1.56−1.77	0.000	1.68	1.58−1.78	0.000	1.69	1.63−1.74	0.000
COPD (n = 3,721)	1.34	1.24−1.44	0.000	1.05	0.90−1.22	0.530	1.05	0.91−1.20	0.518	1.20	1.11−1.3′	0.000
Hypertension (n = 42,453)	1.26	1.23−1.29	0.000	1.08	1.01−116	0.019	1.09	1.02−1.16	0.006	1.24	1.20−1.28	0.000
Cardiovascular disease (n = 4,949)	1.05	0.98−1.12	0.133	1.11	0.97−1.27	0.130	1.01	0.89−1.14	0.912	0.93	0.87−1.00	0.051
Asthma (n = 5,854)	0.83	0.78−0.89	0.000	1.01	0.85−1.19	0.953	0.73	0.60−0.88	0.001	0.82	0.74−0.90	0.000
Risk factors[a]												
Obesity (n = 41,344)	1.29	1.25−1.32	0.000	1.59	1.49−1.69	0.000	1.62	1.53−1.71	0.000	1.42	1.37−1.47	0.000
Smoking (n = 16,445)	0.93	0.90−0.97	0.000	0.85	0.77−0.94	0.002	0.94	0.86−1.03	0.179	0.97	0.92−1.02	0.284

Odds Ratio were adjusted by age, sex, and for each of the comorbidities and risk factor analyzed (CKD, immunosuppression, diabetes, COPD, hypertension, cardiovascular disease, asthma, obesity and smoking).

[a]Adjusted Odds Ratio in COVID-19 patients with NCDs comorbidities were compared to COVID-19 patients without each NCD comorbidities. Adjusted Odds Ratio in COVID-19 patients with risk factors were compared to COVID-19 patients without each risk factors.

asthma to be considered as a protective factor for covid-19 infection. This can be explained by immune response conditioned by chronic respiratory disease itself, as well as a different and routine treatment of asthmatic patients with inhaled corticosteroids alone or in combination with bronchodilators, which have demonstrated their ability to suppress viral replication and decrease the production of cytosines responsible for the inflammatory storm by COVID-19. A widely used drug among patients with asthma is montelukast, which have bronchodilator and anti-inflammatory effects, it even decreases the need for high doses of steroids (23). Moreover, montelukast has exhibited antiviral efficacy against ZIKA infection in vitro and in vivo, showing that montelukast could disrupt the integrity of the virions to release the viral genomic RNA, hence irreversibly inhibiting viral infectivity (24).

Regarding the protective effect of smoking, another cross-sectional study in France showed that current smokers are less likely to develop severe COVID-19 disease. They hypothesized a protective mechanism for nicotine, which binds to ACE2 receptors, preventing the SARS-CoV-2 virus from attaching, reducing the amount of virus that enters lung cells (25). Like our study, several biases could be incurred due to the fact that the way in which the physician compiled the information classified the patient as a "smoker" is unknown. There is no information on the quantity, frequency, or time of evolution. Likewise, when questioned, and according to the severity of the clinic condition, patients can deny smoking to a health professional. Another type of research design is necessary to test this hypothesis.

Our study shows higher NCD comorbidity prevalence in confirmed COVID-19 cases than China but lower than the USA and European countries, except for diabetes. China reported hypertension present in 16.37−21.1% of studies, diabetes in 7.87−9.7% and smoking in 7.63% (4,5,26). Among hospitalized patients in New York, hypertension was reported at 56.6%, obesity at 41.7, and diabetes at 33.8% (9). Italy reports 17% of admissions diabetes, 49% hypertension, and 21% cardiovascular disease; in Sweden: 23% diabetes, 34% hypertension, and 16% chronic lung disease; while in Spain: 17% presented diabetes and 30% had cardiovascular disease (27).

Our results suggest a lower risk of hospitalization among COVID-19 patients from NCD comorbidities in comparison to China. Yang et al found OR for hypertension of 2.36 as against 1.26 in our study in Mexico and, respectively, for COPD of 2.46 as against 1.34, and for cardiovascular disease of 3.42 as against 1.05 (4). These differences may be both a function of health system capacities and guidelines in China and in Mexico as of disease severity.

Further studies are necessary to assess the risk posed by subjacent population-level chronic disease prevalence and the risk of contracting COVID-19 and of being hospitalized by this disease. Mexico has a significant morbidity and mortality from noncommunicable diseases, with ischemic heart

disease, CKD and diabetes among the main causes of premature death (28). For instance, results of the 2018 National Health and Nutrition Survey, shows that the prevalence of some NCDs and lifestyle risk factors were: overweight 39.1%, obesity 36.1%, hypertension 18.4%, diabetes 10.3% and smoking 11.4% (11). These prevalences were higher than average for the entire Americas region: obesity (28.3%), hypertension (17.6%), and diabetes (8.3%) (29).

Non-communicable chronic diseases such as hypertension, diabetes, COPD and chronic kidney disease directly and indirectly affect the cardiovascular and respiratory systems. The presence of a state of inflammation in the cardiovascular system in COVID-19 patients has been demonstrated, with the increased release of inflammatory cytokines and cardiac enzymes such as troponin, which can cause diffuse microangiopathy with thrombosis. Inflammation in the heart can lead to myocarditis, failure, arrhythmias, acute coronary syndrome, and death (30,31). Human coronaviruses SARS-CoV and SARS-CoV-2 bind to their target cells through angiotensin-converting enzyme 2 (ACE2), which is expressed by epithelial cells of the lung, intestine, kidney, and blood vessels (32,33). The expression of ACE2 is significantly increased in patients with hypertension and diabetes types 1 and 2 treated with angiotensin-converting enzyme inhibitors and angiotensin II receptor blockers. Therefore, the increased expression of ACE2 facilitates infection with COVID-19, increasing the risk of developing severe and fatal COVID-19 (34).

Modifiable risk factors such as obesity and smoking have been proven its importance for COVID-19 severity. Obesity is association with a functional immune deficit, with disruption of pancreatic beta cells, and with the enhancement of thrombosis (35), while smoking doubles the likelihood of severe COVID-19 infection (36). However, information on these pathophysiological mechanisms is emerging and clinical trials are required to confirm this dynamic in the Mexican population.

The COVID-19 pandemic has brought to the forefront once again the importance of NCD prevalence and control as cofactors of morbidity and mortality in conjunction with infectious diseases. Mexico has among the highest rates of CKD and diabetes in the world, yet persons living with diabetes are usually diagnose late, and most remain outside the boundaries of effective coverage of best practices and hence most suffer uncontrolled diabetes exposing them to complications (11).

The COVID-19 epidemic should be further researched in the context of other NCD epidemics and underlying social and economic determinants and risk factors following a syndemic approach to enable predictions based on how interactions between epidemics amplify disease burden as well as improving disease prevention and care (37). NCD and infectious disease control should be integrated with policies towards healthy spaces and environments, reducing disparities and tackling the social determinants of health, including education (38). Cardiovascular problems, diabetes and obesity start from an early age, so primary prevention is necessary, through physical activity and screening programs from school age (39). Regarding secondary prevention, it is necessary to strengthen patient-physician communication at the first and second levels of care to improve adherence to pharmacological and non-pharmacological treatment (40).

To tackle COVID-19 it is now more necessary than ever to determine predictive factors for severe infection to enable risk stratification, optimize reallocation of hospital resource, and guide public health recommendations and interventions (6).

Conclusions

The COVID-19 pandemic places Mexico at a particular risk now and in the future due to the high levels of comorbidities accompanying infections and hospitalization as well as admittance to ICU and endotracheal intubation. Hypertension followed by diabetes are the most prevalent NCDs accompanying COVID-19 cases, while CKD poses a sever risk of hospitalization. Health policy in the post COVID-19 Mexico must place chronic diseases at the center of discussion to ensure health system integration with economic, social and environmental policies.

The COVID-19 pandemic has brought to the fore the importance of addressing an epidemiological scenario where both infectious and chronic degenerative diseases coexist. Even with a COVID-19 vaccine available, the disease will remain, probably with a higher incidence than what is observed for seasonal influenza. It is therefore critical to redouble efforts to prevent and control NCDs in Mexico to reduce morbidity and mortality as well as health service utilization in a pandemic scenario of infectious and chronic diseases.

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Conflicts of Interest

The authors declare no conflict of interest in this article.

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