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Socioeconomic determinants of COVID-19 in Mexico

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Title:

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ABSTRACT

Objectives: Identifying and quantifying the role that social and economic determinants play in the probability of dying from COVID-19, in the case of Mexico.

Study design: Cross-sectional study based on secondary data.

Methods: In this study, COVID-19 contagion and mortality data were used, as well as socioeconomic variables, from public databases and open access. With which an econometric model was estimated.

Results: It shows that the number of deaths can rise when variables related with vulnerable groups increase, such as poverty, lack of services, gender and age. In addition, having preexisting medical conditions or lacking access to water can be a significant factors in the increase in deaths.

Conclusions: Therefore, this study suggests more policies be developed for vulnerable groups in order to reduce gaps in inequality, particularly given the current situation in which greater inequality can exacerbate the impact of a disease or an unforeseen situation, as is the case of COVID-19.

Keywords: COVID-19; water; health; vulnerability; poverty

Introduction

Infection from the novel coronavirus (SARS-CoV-2), better known as COVID-19, is associated with acute respiratory symptoms and can become serious.¹ In Mexico, a total of 3,811,793 accumulated cases and 288,733 deaths had been official confirmed as of November 2021.² In addition to loss of life and the collapse of health systems in countries, the fight against COVID-19 also involves socioeconomic challenges for society. The pandemic has made even more visible the socioeconomic problems in which society operates, and how they can affect the occurrence of a greater or lesser number of cases and deaths. The health emergency has a particularly greater impact on people in vulnerable situations.¹ This vulnerability not only refers to the lack of access to public or private health systems but also to socioeconomic determinants such as access to drinking water³, poverty¹, lack of services (education, health, nutrition, household utilities)³, inequalities and preexisting illnesses⁴, among others.

Research on how the pandemic affects the world's population is under development, and it highly depends on the information that is being generated. With this in mind, the present study was conducted based on the information available to-date for the purpose of identifying and quantifying the role that social and economic determinants play in the probability of dying from COVID-19, in the case of Mexico.

Methods

Data

The data used by this investigation were obtained from different sources and served as input for constructing a database at the municipal level for the case of Mexico (2,464

municipalities). The information about the accumulated number of infections and deaths from COVID-19 between February 2020-September 2021 was obtained from the Secretary of Health. The socioeconomic information was obtained from the National Institute of Statistics and Geography, the National Institute of Health and Nutrition and the National Council for the Evaluation of Social Development Policy, through a review of the 2015 Inter-Census Survey, the 2018 National Health and Nutrition Survey and the 2010 and 2015 Measurement of Poverty on the Municipal Scale, respectively. It is worth mentioning that all the data for this study came from official and public sources that made them available for use. The municipal identifier number (ID) was the variable that united the different sources.

Model

An econometric model was estimated based on the municipal database that was constructed. That model analyzed the social and economic determinants of the number of deaths from COVID-19 (dependent variable). Regarding this variable, although it can be argued that the data on deaths from COVID-19 are possibly underestimated, this research assumes that the underestimation between municipalities is homogeneous, since in the case of Mexico all the records are carried out by the Secretary of Health; therefore, it should not be a problem for analysis. In addition, the literature review and the socioeconomic context of the country indicate that this variable is primarily dependent on the following variables: i) percentage of occupants in a household without piped water (No_PipedWater)³, number of people in poverty (Poverty)¹, iii) number of people who are vulnerable due to social deprivation (Vul_Deprivation)⁵, iv) number of income-vulnerable people (Vul_Income)¹, v) percentage of the population that is male (Male), vi) percentage of the population 60 years

and over (Older_Adult)⁶, vii) percentage of the population 15 years and over with incomplete elementary school (Inc_Elementary)¹⁰, viii) rate of death from pneumonia per 100 inhabitants (Pneumonia), ix) rate of death from diabetes per 100 inhabitants (Diabetes)⁴, x) rate of death from hypertensive diseases per 100 inhabitants (Hypertension), xi) accumulated number of COVID-19 infections (Infections), xii) number of people lacking access to health services (Lack_Health)⁶ and xiii) total population per municipality (Density)¹. The model uses cross-sectional information with the municipalities in Mexico as the unit of analysis (where municipalities are represented by “i”). In addition, since a discreet dependent variable was involved, the equation was first modeled with a Tobit model, a Poisson model and an ordinary least squares model, and the latter was chosen because of the robustness of the results—not only of the coefficients but also its interpretation and statistical significance. Finally, a multicollinearity test was performed, ruling out this problem among the independent variables of the model, even though they may appear to be correlated.

$$\begin{aligned} \text{Model: } \quad DeathsCOVID_i = & \beta_1 No_PipedWater_i + \beta_2 Poverty_i + \\ & \beta_3 Vul_Deprivation_i + \beta_4 Vul_Income_i + \beta_5 Male_i + \beta_6 Older_Adult_i + \\ & \beta_7 Inc_Elementary_i + \beta_8 Pneumonia + \beta_9 Diabetes_i + \beta_{10} Hypertension_i + \\ & \beta_{11} Infections_i + \beta_{12} Lack_Health_i + \beta_{13} Density_i + \varepsilon_i \end{aligned}$$

Results

The model estimated presents a global significance over 0.9, which demonstrates adequate fit with respect to the selection of the independent variables that were included. In addition,

the majority of the independent variables (10 of 13 or 77% of these variables) are individually statistically significant ($p < 0.1$). The estimated coefficients of the determinants show that the signs are as expected, that is, an increase in the socioeconomic determinants results in an increase in the dependent variable -to a lesser or greater extent depending on the determinant. In order to standardize and compare that increase, based on the estimated coefficients, the possible percentage increases in accumulated number of deaths were estimated using as a reference the average value at the municipal level given possible percentage increases in the different determinants (Table 1). For example, a 20% increase in the number of income-vulnerable people would result in a 35.6% increase in the accumulated number of deaths from COVID-19 ($p < 0.01$), on average in each municipality in Mexico.

When analyzing which determinants could more greatly impact the accumulated number of average deaths per municipality, the population 60 years or more is in first place ($p < 0.01$), followed by the population 15 years or more with incomplete elementary education ($p < 0.01$), and third, those who are vulnerable due to social deprivation ($p < 0.01$). That is, the likely greater impact on an increase in the amount of deaths could be primarily due to increased issues related with vulnerable groups, including poverty, social deprivation, gender and age. Other factors that could directly affect the increased number of deaths from this disease, to a lesser degree, are a larger amount of people who lack access to health services ($p < 0.05$), a higher number of COVID-19 infections ($p < 0.01$) and greater density ($p < 0.05$).

Nonetheless, COVID-19 is a coronavirus that has different effects depending on each person. For the majority of the people who get infected, the intensity of the symptoms are slight to moderate and they recover without the need for hospitalization. Nevertheless, it can be a serious disease, particularly for older adults or people with preexisting medical conditions or comorbidities such as diabetes, heart disease, high blood pressure, pneumonia and asthma, among others. For the case of Mexico, the results predict that, for example, an increase of 30% in the death rate per 100 inhabitants for cases of high blood pressure ($p < 0.01$), pneumonia or diabetes ($p < 0.01$) would result in an average increase in the number of accumulated deaths per municipality of 5.5%, 7.6% and 19.8%, respectively. That is, of the three comorbidities included in the analysis, diabetes would more greatly impact the accumulated number deaths.

Lastly, the use of facemasks and handwashing with soap and water are considered crucial for being able to reduce or prevent the spread of COVID-19. In the case of the municipalities in Mexico, the data indicate that, for example, a 20% increase in occupants in a household without water would result in a 13.3% increase in average accumulated cases of death from COVID-19 per municipality. This demonstrates that household access to water is crucial for fighting this illness, as are the other socioeconomic variables.

Discussion and conclusion

Death from COVID-19 appears to be statistically significantly associated with socioeconomic and health determinants at the municipal level in Mexico, and these relationships can be more pronounced when analyzed by type of determinant. The population living in conditions without access to piped water, older adults 60 years and

over, people with incomplete elementary education, those who live in poverty and those with comorbidities such as diabetes can have a greater risk of dying from COVID-19. Thus, decision-makers should more closely consider several variables that are important for public policies, including: the large gap in socioeconomic inequality, the high prevalence of comorbidities, the existence of regions and social groups that are highly vulnerable due to their socioeconomic situation, access to more high quality public services, and the reduced institutional capacity. These factors are especially important in situations such as the current one, where an increase in these variables can more greatly exacerbate the impact that the presence of another disease or unforeseen outbreak can have on society, as is the case of COVID-19.

Author statements

Ethical approval

Ethical approval was not required for this study.

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Competing interests

None declared.

Data availability

Data were obtained from an open-access database.

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Table 1

Social and economic determinants of the number of deaths from COVID-19

DEPENDENT VARIABLE		AVERAGE	Results from the		SCENARIOS – INCREASES IN THE DETERMINANTS WITH THEIR							
Model: Ordinary least squares (OLS)			Econometric Model		AVERAGE VALUE AS A REFERENCE (%)							
Number of accumulated deaths (DeathsCOVID)		107	(R ² = 0.95)		10%	20%	30%	40%	50%	60%	70%	80%
INDEPENDENT VARIABLES		Coefficient	Significance	INCREASE IN THE ACCUMULATED AMOUNT OF INFECTIONS AND DEATHS (%)								
DETERMINANTS	No_PipedWater	8.8%	1.2491	0.026	11.3%	12.3%	13.3%	14.4%	15.4%	16.4%	17.4%	18.5%
	Poverty	21,821	0.0006	0.476	13.1%	14.3%	15.5%	16.7%	17.9%	19.1%	20.2%	21.4%
	Vul_Deprivation	13,193	0.0033	0.000	44.7%	48.8%	52.9%	56.9%	61.0%	65.1%	69.1%	73.2%
	Vul_Income	3,838	0.0083	0.000	32.6%	35.6%	38.6%	41.5%	44.5%	47.5%	50.4%	53.4%
	Male	51.3%	0.6558	0.794	34.7%	37.8%	41.0%	44.1%	47.3%	50.5%	53.6%	56.8%
	Older_Adult	12.9%	5.4368	0.000	72.4%	79.0%	85.5%	92.1%	98.7%	105.3%	111.9%	118.5%
	Inc_Elementary	29.2%	2.1517	0.000	64.8%	70.7%	76.6%	82.5%	88.4%	94.3%	100.2%	106.0%
	Pneumonia	0.0146	428.2682	0.150	6.4%	7.0%	7.6%	8.2%	8.8%	9.4%	9.9%	10.5%
	Diabetes	0.0535	303.9750	0.004	16.7%	18.3%	19.8%	21.3%	22.8%	24.4%	25.9%	27.4%
	Hypertension	0.0169	268.6482	0.100	4.7%	5.1%	5.5%	6.0%	6.4%	6.8%	7.2%	7.7%
	Infections	1,391	0.0193	0.000	27.7%	30.2%	32.7%	35.3%	37.8%	40.3%	42.8%	45.3%
	Lack_Health	8,371	0.0033	0.032	28.3%	30.9%	33.4%	36.0%	38.6%	41.1%	43.7%	46.3%
Density	292.7	0.0311	0.018	9.4%	10.2%	11.1%	11.9%	12.8%	13.6%	14.5%	15.3%	