ARTICLE

Demographic variables associated with Covid-19 mortality

José Manuel Madrazo Cabo, Nuvia Adriana Monter Valera, Edith Jocelyn Hernández Sánchez, Mariola Ruiz Sánchez, Gabriela Sánchez Machorro, Crishelen Kurezyn Díaz

Bioethics Center, Autonomous Popular University of the State of Puebla, Puebla, Mexico

Abstract

Objectives: Covid-19 is a betacoronavirus that was initially transmitted to humans from an animal host. It enters the cell by binding its protein S with angiotensin-converted enzyme receptors. It is transmitted through direct contact and respiratory drops. The most affected population so far are older adults and people with chronic conditions. The objective of this research is to analyze the possible association between the structure of the population pyramid, the Gross Domestic Product, the type of isolation and screening used to detect Covid-19 in the countries with the highest and lowest mortality from this disease.

Design and Methods: Some variables take part in the Covid-19 mortality worldwide, such as the population structure, expressed in the population pyramid by country, the type of isolation adopted in each nation, the Gross Domestic Product (GDP) as well as the type of screening that is implemented in the different countries analyzed.

Results: After analyzing the mean difference in the countries with a regressive and progressive population pyramid, an association was identified between the regressive population pyramid structure and the higher mortality rate ($p<0.001$).

Conclusions: The countries with a progressive population pyramid are the most benefited by making their population more screened since the mortality rate decreases significantly compared to the countries with less attribution ($p<0.036$).

Introduction

SARS-CoV-2 is a beta-coronavirus that targets cells through the viral structural peak protein (S) that binds to the angiotensin-converting enzyme receptor 2 (ACE2). The viral particle uses host cell receptors and endosomes to enter cells. The host has a transmembrane serine type 2 protease (TMPRSS2) that facilitates entry into the cell through the virus S protein. Once inside the cell, viral polyproteins that encode the replicase-transcriptase complex are synthesized. The virus then synthesizes RNA through its RNA-dependent RNA polymerase. Finally, structural proteins are formed, and the release of viral particles is achieved.[1,2]

According to the World Health Organization, the contagion occurs through person-to-person. It can be through drops of flush that are expelled by infected patients when they cough, sneeze or speak. They can remain on surfaces for a certain time, depending on factors such as surface, humidity, or heat. Covid-19 infection is believed to have been initially transmitted to humans from an animal host, but the continued risk of transmission through contact with animals is uncertain. No cases of fecal-oral transmission have been reported. There is also no evidence that it survives in water, including sewage.[3-5]

Suman in 2020 argues that the Covid-19 virus can survive up to 72 hours on plastic and stainless steel surfaces, less than 4 hours on copper surfaces, and less than 24 hours on cardboard surfaces. Based on data for other coronaviruses, the duration of viral persistence on surfaces also depends on ambient temperature, relative humidity, and initial inoculum size. Alcohol-based disinfectants can significantly reduce virus survival.[6-8]

Transmission capacity is estimated from the basic reproductive number or R0. A value of R0 below 1 indicates a poor ability to spread infectious disease, R0 values greater than 1 indicates the need to apply control measures. The R0 indicates the potential value of transmission of infectious disease; it does not mean a more extensive disease, nor does it indicate the speed of transmission. Covid-19 has a value of 1.4-2.5, this is a number similar to R0 of the SARS coronavirus at the beginning of the epidemic, which was 2.2-3.7, at the end of the epidemic, this virus had a value of 0, 67-1.23. Another coronavirus, known as MERS, always remained with lower R0 values of 0.29-0.80. Based on these values, COVID-19 could be more easily transmitted than SARS, however, R0 is an average value, there are people who, although infected, will not transmit the disease to anyone. In contrast, others may transmit it to many contacts. This is known as "super-dispersers" as these patients were called in the SARS and MERS epidemics. Control measures can contribute to the reduction of R0. The current statistics on Covid-19 probably show a bias towards the most serious cases, which are the most likely to have been diagnosed. Mild and asymptomatic cases are probably estimated downward.[9,10]

When thinking about previous pandemics, such as Influenza, some points are contrasted with the current situation, analyzing data published by the Center for Disease Control and Prevention

Significance for public health

In the present investigation, there is an analysis of socioeconomic and demographics variables that influence Covid-19 mortality. As established in the Essential Functions of Public Health, it is necessary to implement actions that mitigate, in this case, the Covid-19 for the good of society. Being an emergency and social health that requires effective and immediate action by governments, people, and companies, based on social determinations, analyze the type of isolation applied in each country and the Gross Domestic Product. The purpose is to contribute to the collective effort, generating knowledge in public health that allows the taking of decisions.

(CDC). McFall-Johnsen highlights that both Influenza and Covid-19 have a predilection for the population of older adults, having a significantly higher impact after the age of 65. During the analysis conducted in the United States, 1,358 cases were confirmed, 38 of which resulted in death, a mortality rate of 2.8%. Meanwhile, South Korea implemented free coronavirus tests, conducting more than 180,000. 66 deaths of 7,869 cases were reported, with a mortality rate of 0.84%. Still, older patients in South Korea had a much higher death rate than younger patients. Patients older than 80 years had a mortality rate of 7.2%.[11,12]

Older people and people with chronic conditions, such as diabetes, hypertension, and obesity, have faced increased mortality from Covid-19. In a series of cases in China, the case-fatality rate was less than 0.5% among people under the age of 50, 1.3% between 50 to 59, and 3.6% between 60 to 69. The case-fatality rate may approach 10% for people over the age of 60, with risk more than 20 times greater than people under the age of 50 without a high-risk condition.[13,14]

South Africa has faced saturation of health services since more than 80% of people go to public health services for chronic diseases such as tuberculosis and HIV. Despite the efforts made to combat Covid-19, this country had to decrease the intensity of their blockages and isolation. On May 19, 2020, when a less stringent blockade was established, South Africa had recorded 17,200 cases and 312 deaths and had carried out 488,609 tests.[15] For its part, Iceland carried out a study that consisted of tests aimed at people with a high risk of infection and detection of the population (from 20 to 70 years) analyzing 6% of the population. This study contributed to the success of the measures implemented to curb the spread of the virus. As of April 4, 2020, a total of 1,221 of 9,199 people (13.3%) who underwent directed tests were positive. Children under 10 years of age are less likely to be infected than older people, with percentages of 6.7% and 13.7%, respectively. In the randomized screening group, the difference was even more marked, as none of the 848 children younger than 10 years tested positive, compared to 100 of 12,232 people (0.8%) older than 10 years. An increase in the percentage that tested positive was observed with age. However, it is not clear whether this is because children are less likely to become infected or symptomatic.[16]

So far, there are no reports that relate the type of screening and the structure of the population pyramid in each country with the current mortality from Covid-19. However, there are estimates that associate the population pyramid structures with the mortality projected by Covid-19. It is considered important to analyze the variables to have real conclusions with current figures.

The present study aimed at analyzing the possible association between the structure of the population pyramid, type of isolation, Gross Domestic Product, and screening used to detect Covid-19 in the countries with the highest and lowest mortality.

Specific objectives

1. Compare the mortality rate of Mexico with other countries, due to Covid-19 and analyze the relationship of mortality with strategies used to control infections.
2. Analyze the countries with the highest and lowest mortality from Covid-19 and compare their population pyramid structures.
3. Compare the mortality rate of countries that have carried out screening.

Design and Methods

This research is a cross-sectional study because it is carried out at a specific time that corresponds to the period of health contingency in the selected countries (March-June 2020), and analytical because the objective is to analyze the possible association between different variables with Covid-19 mortality. The following variables were analyzed:

A population pyramid, which due to its structure, is classified as regressive; is the type with the largest adult population, stationary; it has a balance of all age groups and progressive; it is the type with the highest young population.

Isolation is classified into three types: high; (strict isolation), which is described in the study with the color red, moderate; (isolation for risk groups with authorization of essential activities) described in yellow, and smart; (without isolation and strict hygiene measures) represented with the color blue. Gross Domestic Product and screening used to detect Covid-19 in countries with the highest and lowest mortality.

In the databases of Medline, Elsevier, UpToDate, Cochrane, Pubmed, Ebsco in June 2020, we searched for articles on the mortality due to Covid-19 and types of the population pyramid, type of isolation, gross domestic product and type of screening. Only three articles were found related to the topic. However, these publications made estimates based on the predictions of the World Health Organization and the authors themselves.

When reviewing journals such as New England Journal of Medicine, Lancet, and JAMA Network in June 2020, 25 articles on research-related topics were analyzed, of which, in the end, information from 14 of these was used to substantiate. Updated information was obtained from the official websites of Johns Hopkins University, University of Oxford, World Health Organization, Our World in Data, Government of Mexico, to make charts and graphics for analysis.[17,18]

A systematic review of documents and statistics expressing mortality in the ten countries most affected by Covid-19 and the ten least affected was carried out. Similarly, information was sought in the media by country, to obtain the type of isolation because this information is not published in indexed articles (links in the webliography).

The variables were analyzed to assess the association between them, to establish statistical inferences, since they were quantitative variables, the difference in means of the groups established was measured through the statistical package for <Excel version Microsoft Office 365.

This research is a study with non-probability sampling since, due to the diversity of information, the objects of study were selected based on the specific variables of the study (convenience sampling).[19]

Results

The countries with the highest and lowest Covid-19 mortality rates were identified in the Covid-19 Information Center at Johns Hopkins University. This rate quantifies the number of deaths per 100,000 people. These data were obtained until 05/21/2020, placing in the ten countries with the highest mortality: Belgium (80.1), Spain (59.6), United Kingdom (53.8), Italy (53.5), France (42), Sweden (37.6), The Netherlands (33.4), Ireland (32.3), United States (29.5) and Switzerland (22.2), as well as the countries with the lowest mortality: Sri Lanka (0.04), Libya (0.04), Venezuela (0.03), Taiwan (0.03), Benin (0.03), Zimbabwe (0.03), Malawi (0.02), Angola (0.01), Nepal (0.01), Ethiopia (0).

A comparative chart of the ten countries with the highest and lowest mortality was made considering the type of isolation they

adopted in response to the Covid-19 pandemic associated with their population pyramid.

The group of countries with the highest mortality is associated with the regressive population pyramid, only Sweden has a stationary rate, and no country reports the progressive rate. In the group with the lowest mortality, the progressive type is predominant (except for Taiwan) and the moderate type of isolation (Figure 1). According to the groups of countries associated with their type of isolation, the "smart" isolation group obtained mean mortality of 16. The moderate isolation group obtained a mean of 13.2 and the high isolation group 57.4 (Figure 2). Based on the results shown in Figure 2, a comparative graph is made where the average mortality in each of the groups of countries is shown on the x-axis and the type of isolation on the y-axis. The increase in mortality in countries with high isolation can be identified, obtaining an R2 of 0.699. It shows an identifiable trend line. The comparison of mean mortality in smart isolation and moderate isolation groups did not show statistically significant differences ($p<0.13$). In the comparison of the average mortality of the moderate and high isolation groups, a value of $p<0.017$ was obtained, and in the comparison of the average mortality of the high isolation and smart isolation groups, a $p<0.001$ was obtained. Both differences are statistically significant.

Figure 3 shows a comparison of the type of population pyramid and the type of isolation. At the top are the groups of countries by type of population pyramid and the mortality rate per 100,000 inhabitants. The prevalence of moderate isolation is observed again in the progressive population pyramid group, with mean mortality of 0.73. In the regressive population pyramid group, there are subgroups of the three types of isolation, obtaining a mortality average in the moderate isolation subgroup of 11.5, an average in the high isolation subgroup of 57.8 and an average in the smart isolation subgroup of 10.9, the average mortality of the regressive population pyramid group of 24.2. The stationary population pyramid group obtained a mean mortality of 10.6.

When comparing the average mortality of each group of countries concerning their type of population pyramid, the following results were obtained: The comparison of the mean mortality of the group with the progressive and stationary pyramid got a $p<0.001$. A comparison of mean mortality of the stationary and regressive pyramid group obtained a $p<0.08$, and the comparison of the mean mortality of the regressive and progressive pyramid group obtained $p<0.001$, therefore the differences they are statistically significant (Figure 4).

In the group of countries with a regressive population pyramid, the three types of isolation were identified. Therefore, a comparison was made between these subgroups. A comparison of the average mortality of intelligent and moderate isolation obtained a $p<0.24$. The comparison of the mean of moderate and high isolation had a $p<0.46$, and the comparison of the mean of high and intelligent insulation had a $p<0.22$. In the comparisons, statistically significant results are surely not reported due to the number of concepts analyzed. However, it seems that high isolation is associated with higher mortality. Of the countries in Figure 3, groupings are made corresponding to their Gross Domestic Product (GDP). A comparison was made of the countries with the highest GDP, average GDP value, and lowest GDP concerning the average mortality of each group. The results were: group with higher GDP: average mortality of 21.43, group with half GDP value: average mortality 15.13 and group with lower GDP: average mortality of 10.88.[20,21]

The comparison of the mean mortality of the group with the highest and lowest GDP obtained a $p<0.33$. The comparison of the mean mortality of the group with the highest and lowest GDP value obtained a $p<0.42$, and the comparison of the mean mortality of the groups with medium and lower GDP got a $p<0.25$. It seems that the higher the GDP, the higher the mortality rate; however, no statistically significant differences were found between the groups.

Countries were analyzed by their type of screening, mortality, population pyramid structure, and type of isolation. It can be seen that most of the countries with the lowest screening correspond to those with a progressive population pyramid. In the group with the highest screening, the countries with a regressive pyramid predominate obtained average mortality in the group with the highest screening of 18.3 and 5.6 in the group with the lowest screening. When comparing the same variables in countries with a regressive population pyramid, it was found that the countries with the highest screening obtained a mortality of 21.5 and the countries with the lowest screening obtained average mortality of 0.5. When comparing the type of screening type, mortality, population pyramid, and type of isolation in countries with a progressive population pyramid, the following results are obtained: the group

Country	Mortality rate (100,00 inhabitants)	Type of isolation	Population pyramid	Country	Mortality rate (100,00 inhabitants)	Type of isolation	Population pyramid
Belgium	80.1	High	Regressive	Ethiopia	0.00	Moderate	Progressive
Spain	59.6	High	Regressive	Nepal	0.01	Moderate	Progressive
United Kingdom	53.8	High	Regressive	Angola	0.01	Moderate	Progressive
Italy	53.5	High	Regressive	Malawi	0.02	Moderate	Progressive
France	42	High	Regressive	Zimbabwe	0.03	Moderate	Progressive
Sweden	37.6	Smart	Stationary	Benin	0.03	Moderate	Progressive
Netherlands	33.4	Smart	Regressive	Taiwan	0.03	Smart	Regressive
Ireland	32.3	Moderate	Regressive	Venezuela	0.03	Moderate	Progressive
United States	29.5	Moderate	Regressive	Libya	0.04	Moderate	Progressive
Switzerland	22.2	Moderate	Regressive	Sri Lanka	0.04	Moderate	Progressive
Average mortality	44.4			Average mortality	24		

Based on: Johns Hopkins University, coronavirus resource center (05/21/20). Population pyramid net, media.

Figure 1. Countries with the highest and lowest mortality due to Covid-19, type of isolation, and population pyramid structure.

(05/20/20) Country Groups	Mortality rate (100,000 inhabitants)	Average mortality
Countries with "Smart" isolation		16
Sweden	36.7	
Taiwan	0.03	
Germany	9.7	
Netherlands	33.2	
Korea	0.5	
Countries with moderate isolation		13.2
Mexico	4.4	
Brazil	8.5	
United States	28.1	
Switzerland	22.2	
China	0.3	
Canada	16.2	
Countries with high isolation		57.4
Spain	59.4	
Italy	53.2	
United Kingdom	53.2	
France	41.8	
Belgium	79.7	

Based on: Johns Hopkins University, coronavirus resource center (05/21/20). Population pyramid net, media.

Figure 2. Relationship of the mortality rate of countries affected by Covid-19, by degree of isolation.

with the highest screening had mean mortality of 3.5 and the group with the lowest screening of 5.6. It can be seen that there is a difference in mortality with the types of screening in countries with a progressive population pyramid (Figure 5).

Figure 6 represents the relationship between the type of screening and the average mortality in countries with a regressive and progressive population pyramid. The comparison of mortality in countries with high screening and low screening in the regressive population pyramid was $p<0.001$, which is statistically significant. It also shows the difference in mortality by type of screening in countries with a progressive population pyramid. The comparison of mortality in these two groups obtained a value of $p<0.036$, finding a statistically significant difference.

Discussion

With the data obtained by the analysis, it is possible to identify that the population pyramid structure has a strong impact in the

Progressive Population Pyramid	Mortality (100,000 inhabitants)	Regressive Population Pyramid	Mortality (100,000 inhabitants)	Stationary Population Pyramid	Mortality (100,000 inhabitants)
Venezuela	0.03	Costa Rica	0.2	Norway	4.4
Ethiopia	0.0	Ireland	32.3	Australia	0.4
Tanzania	0.04	Thailand	0.08	Brazil	9
Zimbabwe	0.03	Canada	16.6	SUBGROUP AVERAGE	4.6
Turkey	5.1	Japan	0.6	Russia	2.0
Indonesia	0.4	Poland	2.5	Sweden	37.6
Mexico	4.8	Saudi Arabia	1.0	TOTAL GROUP AVERAGE	10.6
India	0.2	Switzerland	22.2		
China	0.3	United States	28.5		
Sri Lanka	0.04	SUBGROUP AVERAGE	11.5		
Angola	0.01	Spain	59.6		
Malawi	0.02	Belgium	80.1		
Benin	0.03	Italy	53.5		
Nepal	0.01	France	42		
Libya	0.04	United Kingdom	53.8		
TOTAL GROUP AVERAGE	0.73	SUBGROUP AVERAGE	57.8		
		Taiwan	0.03		
		Netherlands	33.4		
		Korea	0.5		
		Germany	9.8		
		SUBGROUP AVERAGE	10.9		
		TOTAL GROUP AVERAGE	24.2		

Based on: Johns Hopkins University, coronavirus resource center (05/21/20). Population pyramid net, media.

Figure 3. Comparison of country groups by type of population pyramid, type of isolation and mortality.

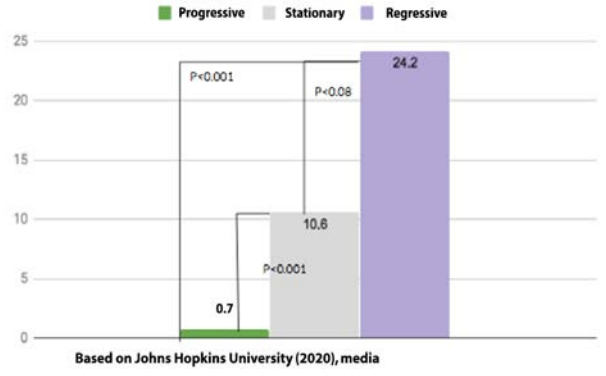
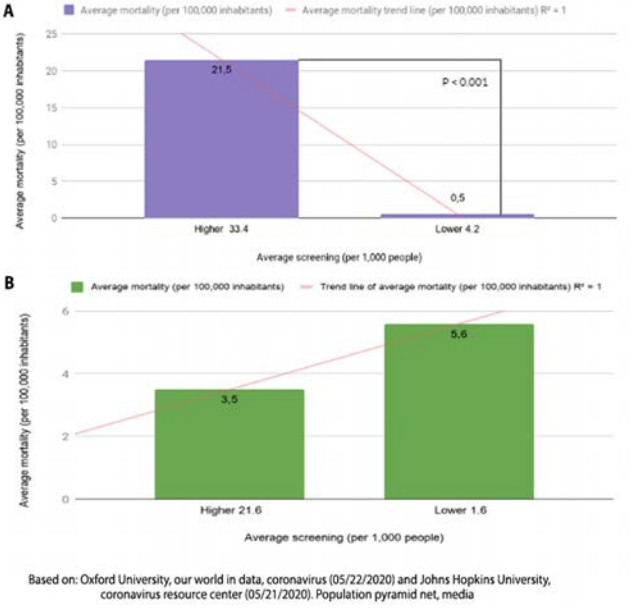


Figure 4. Average mortality rate of the countries grouped by type of population pyramid.

REGRESSIVE				
COUNTRY	SCREENING (per 1,000 people)	MORTALITY (Per 100,000 inhab.)	POPULATION PYRAMID	TYPE OF ISOLATION
HIGHER SCREENING				
South Korea	16.2	0.5	regressive	smart
Canada	39.2	16.2	regressive	moderate
Germany	37.57	9.7	regressive	smart
United Kingdom	31.59	53.2	regressive	high
United States	42.79	28.1	regressive	moderate
AVERAGE	33.4	21.5		
LOWER SCREENING				
Japan	2.1	0.6	regressive	moderate
Taiwan	2.9	0.03	regressive	smart
Ukraine	6.6	1.4	regressive	moderate
Thailand	5.3	0.08	regressive	moderate
AVERAGE	4.2	0.5		
PROGRESSIVE				
COUNTRY	SCREENING (per 1,000 people)	MORTALITY (Per 100,000 inhab.)	POPULATION PYRAMID	TYPE OF ISOLATION
HIGHER SCREENING				
Kazajistan	35.7	0.51	progressive	moderate
Chile	25.5	4.0	progressive	moderate
Panama	13.5	7.4	progressive	high
El Salvador	11.5	0.5	progressive	high
Turkey	21.9	5.1	progressive	moderate
AVERAGE	21.6	3.5		
LOWER SCREENING				
Mexico	1.48	4.4	progressive	moderate
Ecuador	3.51	18.19	progressive	moderate
Ethiopia	0.73	0.0	progressive	moderate
Zimbabwe	01.05	0.03	progressive	moderate
AVERAGE	1.6	5.6		

Based on: Oxford University, our world in data, coronavirus (05/22/2020) and John Hopkins University, coronavirus resource center (05/21/2020), population pyramid net, media

Figure 5. Comparison of type of screening mortality rate, type of population pyramid and type of isolation in countries with regressive and progressive population pyramid.



Based on: Oxford University, our world in data, coronavirus (05/22/2020) and Johns Hopkins University, coronavirus resource center (05/21/2020). Population pyramid net, media

Figure 6. Type of screening and its relationship with the average mortality in countries with regressive (A) and progressive (B) population pyramid.

Covid-19´s mortality, since those countries with regressive pyramid despite high screening, it does not affect lower mortality, in contrast with those countries with a progressive pyramid, where the high screening impacts on the reduction of mortality. In the interactive website OurWorldinData, it is reported the level of screening of every country, where you can see the relation with the mortality. With the highest level of screening is Lithuania with 2.44 daily test per 1000 inhabitants, and with the lowest level of screeing is Mexico with 0.44 daily test per 1000 inhabitants. The latest estimate of total screening in Mexico is 1.48 per 1000 inhabitants, which means that for every 1000 inhabitants, only 14.8 have been screened. These results demonstrate that Mexico has had an ineffective screening, and this could be affecting the mortality rate that is being estimated.[22]

Ibañez Martí, explains the dynamics of the beginning of cases in an epidemic, the index case is indicated in the primary outbreak, and the cases increase until they reach the maximum and then decreased. In the secondary outbreak that depends on the incubation period, new cases can appear, until transmission ceases when the susceptible individuals are exhausted. In the transmission outbreaks person by person, the curve rise will be slow and progressive. Every secondary case could give rise to new cases, and that is the reason why the curve usually adopts a bimodal shape depending on the latest cases from the secondary cases.[23,24]

Fajardo *et al*., in their analysis of Influenza in 2009 in Mexico, identified the behavior of the epidemic graph. The "epidemic wave" until July 9 lasted four months and the curve was bimodal, with the first phase between March 11 and May 27 and a second phase between May 28 and July 9; in the first month of the first phase, it has slow growth. In the following 15 days, from April 12 to 27, growth is rapid and reaches a maximum of 407 cases, before declining in the following month. The second phase of this wave begins on May 28 and reaches its maximum one month later, and later there is a decline that lasts until July 9, the date on which it was decided to cut the data for publication.[25-27]

Based on Fajardo's analysis of the epidemic behavior, about the influenza epidemic, it is estimated that there is a second wave in the Covid-19 pandemic, due to the still vulnerable patients. Despite the prevention measurements of every country, this second wave is expected. Countries with a progressive population pyramid, such as Mexico, would be recommended to take preventive measures according to the results of this analysis, which would be intelligent or moderate isolation and the application of the highest possible screening to the population.

The last time the world responded to a global emerging disease epidemic of the scale of the current Covid-19 pandemic was the 1918-19 H1N1 influenza pandemic. In that pandemic, some communities, notably in the United States (US), responded with a variety of non- pharmaceutical interventions (NPIs), and two fundamental strategies are possible: mitigation and suppression. The actual pandemic global growth estimates are down, and one estimate suggests that a 1% lower growth in the global economy would translate to between 14 million and 22 million more people living in extreme poverty. We'll use numbers from the Imperial College report and the lastest UNO population report: absent measures to stem the rate of infection.[28-30] People with other health issues have a higher risk of mortality from Covid-19, and people in low-income countries are at increased risk of non-communicable diseases, as well as infectious diseases like HIV/AIDS and malaria. But the different age distribution still means that low-income countries will likely lose far fewer people to the virus than high-income countries.[31,32] This conclusion agrees with the results of this analysis. In the case, the lower mortality ratio for Covid-19 was found in the countries with a progressive population pyramid, which are mostly low-income countries. High-income countries have higher Covid-19 mortality due to their population pyramid structure, this being the conclusion of both analyzes. The regressive population pyramid structure accompanied by high isolation is estimated to be associated with increased mortality per 100,000 population. As well as we note the association of countries with a progressive population pyramid structure and moderate isolation with less mortality per 100,000 inhabitants. Larochelle in 2020, discusses the risk that each type of person contracting Covid-19 and the recommendations that are given regarding going to work. Older people have faced increased death from Covid-19. In a large series of cases in China, the case fatality rate was less than 0.5% among people under the age of 50, 1.3% between 50 to 59, and 3.6% between 60 to 69. These data affect the case fatality rate. approaching 10% for people over 60, with risk more than 20 times greater than people under 50 without a high-risk chronic condition. Covid-19's low, medium, and high-risk categories are mentioned in the analysis based on age and the presence of high-risk chronic conditions identified by the CDC. People with high risk in both domains should consider stopping to work and people with high risk in one domain and medium risk in the other, should discuss the risk with a doctor.[14,33]

A plan is required for the safe reentry of Covid-19 high-risk individuals and occupational risk. Universal testing of staff and patients in healthcare settings should be considered. As the economy of different countries increases, this implies millions of employees and it put you at risk of getting the disease of Covid-19 on the job.[34,35]

The recommendations given by Larochelle (2020) are highly related to the study carried out, and the results. It has been concluded that countries with a regressive population pyramid have had higher mortality from Covid-19, this, due to the number of older adults among its population. Older adults are the people with the most chronic risky conditions. Therefore, they are the people most at risk of having unfavorable results when contracting Covid-19.[314] It should be considered a policy in which people seeking to return to work, school, or social activities are tested for infection and antibodies. Negative tests would certify freedom of movement for some time. If the antibodies are found to provide long-term protection against reinfection and transmission, which is plausible but not yet well established, a positive serological test would ensure certification. The stringency of a test regimen could be raised or lowered, depending on the community prevalence of Covid-19. China is following a version of this approach by rating community risk on a four-level color-coded scale. The risk of contagion would be avoided by modifying the insulation measures abruptly.[36-38]

Therefore, It is agreed that more screening is necessary to have a lower risk of contagion and to detect all possible cases to have an impact on mortality. In countries with a progressive population pyramid, the performance of higher screening and intelligent or moderate isolation has positive results according to the results of the analysis carried out, reflecting lower mortality. On the other hand, with high isolation in regressive pyramids, mortality is statistically higher.

Conclusions

Countries with a regressive population pyramid are more affected by Covid-19, reporting high mortality (per 100,000 inhabitants). The association of the regressive population pyramid and high isolation reflects a higher mortality rate. Finally, there is no significant difference in the mortality of countries that had

smart isolation and moderate isolation.

In countries with a progressive population pyramid, they present significantly less mortality than those with a regressive pyramid, regardless of the type of isolation performed. However, in this group, if high screening impacts favorably, reduces mortality.

The appropriate protection measures for each country must correspond to their level of risk of contracting the infection and of having an unfavorable result. The risk must be measured concerning the population pyramid, age of the patient, and their comorbidities, to implement the corresponding isolation and screening measures.

During the following months after the analysis carried out, the outcome of mortality from Covid-19 has been observed in different countries. The variable that had the most impact was screening since isolation was intermittent in most countries with a regressive population pyramid and remained moderate in most countries with a progressive population pyramid.

As can be seen in the coronavirus resource center at Johns Hopkins University, mortality in countries with a regressive population pyramid did not have a significant change, unlike countries with a progressive population pyramid. When comparing mortality and screening in countries with the two types of population pyramid in June 2020 and September 2020, it was concluded that countries with a progressive population pyramid can significantly modify their mortality if they screen the population, since these Countries having low screening increased their mortality. Unlike countries with a regressive population pyramid, screening does not have a strong impact on mortality because their type of population pyramid predisposes them to higher mortality.

Correspondence: Crishelen Kurezyn Díaz, 45 Poniente #1947, Col. La Noria, C.P. 72410, Puebla, Mexico. Tel. +52.222.2154527.
E-mail: crishelen.kurezyn@upaep.mx

Key words: Covid-19; mortality; isolation; population pyramid; country.

Contributions: JMMC, theoretical framework, data analysis, review and criticism, correction on topics of interest, article conclusions; NAMV, realization of material and methods, the importance for public health, theoretical framework; EJHS, realization of the theoretical framework, generation of graphics, and discussion of the article; MRS, GSM, recruitment of information, theoretical framework, data analysis, generation of tables, and creation of graphs; CKD, realization of design and methods, data analysis, article review and criticism, corrections on important topics.

Acknowledgements: We thank the Popular Autonomous University of the State of Puebla for the support provided to carry out this study.

Conflict of interest: The authors declare that they have no conflicts of interest. This article aims to generate useful medical information for decision-making.

Funding: Funds belonging to the Popular Autonomous University of the State of Puebla (UPAEP), a resource destined for the UPAEP Bioethics Center..

Ethics approval and consent to participate: Not applicable, as this is an observational study that uses only public medical information and statistical data analysis with no experimentation with people or contact with patients.

Received for publication: 23 June 2019.
Accepted for publication: 5 October 2020.

Journal of Public Health Research 2020;9:1827
doi:10.4081/jphr.2020.1827

References

1. Sanders MJ. Pharmacologic treatments for coronavirus disease 2019 (COVID-19) A Review. JAMA 2020;323:1824-36.
2. Hu D, Zhu C, Ai L, et al. Genomic characterization and infectivity of a novel SARS-like coronavirus in Chinese bats. Emerg Microb Infect 2018;7:1-10.
3. WHO. Novel coronavirus 2019. Available from: https://www.who.int/es/emergencies/diseases/novel-coronavirus-2019/advice-for-public/q-a-coronaviruses
4. World Organization for Animal Health. Questions and answers on the 2019 coronavirus disease (COVID-19), section on Surveillance and events in animals. Accessed on: April 13, 2020. Available from: https://www.oie.int/en/scientific-expertise/specific-information-and-recommendations/questions-and-answers-on-2019novel-coronavirus/
. Ji W, Wang W, Zhao X, et al. Cross-species transmission of the newly identified coronavirus 2019-nCoV. J Med Virol 2020;92:433-40.
6. Suman R, Javaid M, Haleem A, et al. Sustainability of coronavirus on different surfaces. J Clin Exp Hepatol 2020;10:386-90.
7. Van Doremalen N, Bushmaker T, Morris DH, et al. Aerosol and surface stability of SARS-CoV-2 as compared with SARS-CoV-1. N Engl J Med 2020;382:1564-7.
8. Moorer WR. Antiviral activity of alcohol for surface disinfection. Int J Dent Hyg 2003;1:138-42.
9. Trilla A. [Un mundo, una salud: la epidemia por el nuevo coronavirus COVID-19].[Article in Spanish]. Med Clin 2020; 154:175-7.
10. Lu R, Zhao X, Li J, et al. Genomic characterisation and epidemiology of 2019 novel coronavirus: implications for virus origins and receptor binding. Lancet 2020;395:565-74.
11. Business Insider [Internet]. The coronavirus death rate is roughly 3.4%, but that doesn't tell the full story. Here's everything we know so far about how deadly COVID-19 really is. Available from: https://www.businessinsider.fr/us/coronavirus-death-rate-by-age-countries-2020-3
12. Chan JF, Yuan S, Kok KH, et al. A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster. Lancet 2020;395:514-23.
13. Larochelle MR. Is it safe for me to go to work? Stratification of risks for workers during the Covid-19 pandemic. N Engl J Med 2020;383:e28.
14. Folgueira MD, Munoz-Ruiperez C, Alonso-Lopez MA, Delgado R. SARS-CoV-2 infection in health care workers in a large public hospital in Madrid, Spain, during March 2020. medRxiv 2020. doi:10.1101/2020.04.07.20055723v2
15. Karim SSA. The South African response to the pandemic. N Engl J Med 2020;382:e95.
16. Gudbjartsson D, Helgason A, Jonsson H, et al. Spread of

SARS-CoV-2 in the Icelandic population. N Engl J Med 2020;382:2302-15.
17. Johns Hopkins University Coronavirus resource center [Internet]. Mortality in the most affected countries. 2020. Available from: https://coronavirus.jhu.edu/data/mortality
18. Government of Mexico, CONACYT [Internet]. COVID-19 in Mexico. 2020. Available from: https://coronavirus.gob.mx/datos/
19. Hernández Sampieri R. Fernández Collado C, Baptista Lucio P. [Metodologia de la investigacion].[Book in Spanish]. México, DF: McGraw-Hill Education; 2013.
20. Economipedia [Internet]. Países por PIB. Available from: https://economipedia.com/ranking/paises-por-pib.html
21. Worldometer [Internet]. GDP by Country. 2020. Available from: https://www.worldometers.info/gdp/gdp-by-country/
22. OurWorldInData [Internet]. Coronavirus pandemic (COVID-19). Available from: https://ourworldindata.org/coronavirus
23. Ibañez Martí C. [Formas de presentación de un brote epidémico].[Article in Spanish]. Available from: https://www.madrimasd.org/blogs/salud_publica/2007/05/09/65263
24. Pan American Health Organization / World Health Organization. [Capítulo III- Investigación de brotes en las personas].[in Spanish]. 2020. Available from: https://www.paho.org/hq/index.php?option=com_content&view=article&id=10543:2015-capitulo-iii-investigacion-brotes-personas&Itemid=41414&lang=es
25. Public Health of Mexico [Internet]. [Perfil epidemiológico de la mortalidad por influenza humana A (H1N1) en México].[in Spanish]. Available from: http://saludpublica.mx/index.php/spm/article/view/6924/8818
26. Health Secretary [Internet]. [Social communication, newsletter 2009-127a].[in Spanish]. 04-17-2009. Available from: www.salud.gob.mx
27. Centers for Disease Control and Prevention [Internet]. 2008-2009 influenza season week 14 ending April 11, 2009. Available from: https://www.cdc.gov/flu/weekly/weeklyarchives2008-2009/weekly14.htm
28. Imperial College London [Internet]. Report 9: Impact of non-pharmaceutical interventions (NPIs) to reduce COVID-19 mortality and healthcare demand. Available from: https://www.imperial.ac.uk/mrc-global-infectious-disease-analysis/covid-19/report-9-impact-of-npis-on-covid-19/
29. Smith RD. Responding to global infectious disease outbreaks: Lessons from SARS on the role of risk perception, communication and management. Soc Sci Med 2006;63:3113-23.
30. Anderson RM, Heesterbeek H, Klinkenberg D, Hollingsworth TD. How will countrybased mitigation measures influence the course of the COVID-19 epidemic? Lancet 2020;395:931-4.
31. Center for Global Development [Internet]. What a population's age structure means for COVID-19's impact in low-income countries. 2020. Available from: https://www.cgdev.org/blog/what-populations-age-structure-means-covid-19s-impact-low-income-countries
32. United Nations [Internet]. World Population Prospects 2019. Available from: https://population.un.org/wpp/
33. China CDC weekly [Internet]. The epidemiological characteristics of an outbreak of 2019 novel coronavirus diseases (COVID-19) - China, 2020. The Novel Coronavirus Pneumonia Emergency Response Epidemiology Team. Available from: http://weekly.chinacdc.cn/en/article/id/e53946e2-c6c4-41e9-9a9b-fea8db1a8f51
34. Centers for Disease Control and Prevention [Internet]. People at increased risk. 2020. Available from: https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/people-at-higher-risk.html
35. WHO. Surveillance protocol for SARS-CoV-2 infection among health workers. 2020. Available from: https://www.who.int/publications/i/item/WHO-2019-nCoV-HCW_Surveillance_Protocol-2020.1
36. Studdert D, Hall M. Disease control, civil liberties, and mass testing - Calibrating restrictions during the Covid-19 pandemic. N Engl J Med 2020;383:102-4.
37. Parmet WE, Sinha MS. Covid-19 - the law and limits of quarantine. N Engl J Med 2020;382:e28.
38. American Enterprise Institute [Internet]. National coronavirus response: a road map to reopening. Available from: https://www.aei.org/research-products/report/national-coronavirus-response-a-road-map-to-reopening/

Webliography

Types of isolation, means of communication

https://elpais.com/elpais/2020/04/29/planeta_futuro/1588176612_605148.html
https://irlandaenespanol.com/mentiras-verdades-coronavirus/
https://www.bbc.com/mundo/noticias-internacional-51806501
https://www.bbc.com/mundo/noticias-internacional-51806501
https://www.bbc.com/mundo/noticias-internacional-52040027
https://www.bbc.com/mundo/noticias-internacional-52175725
https://www.dw.com/es/corea-del-sur-controla-al-virus-sin-cuarentena/av-52864877
https://www.dw.com/es/maduro-flexibiliza-medidas-de-aislamiento-a-ni%C3%B1os-y-ancianos/a-53287113
https://www.eitb.eus/es/noticias/sociedad/detalle/7207080/coronavirus-francia-impondra-cuarentena-lleguen-extranjero/
https://www.elsoldemexico.com.mx/mundo/belgica-inicia-un-sistema-de-rastreo-de-infectados-por-covid-19-5271089.html
https://www.eltiempo.com/mundo/mas-regiones/aislamiento-inteligente-que-paises-no-han-confinado-a-la-poblacion-482400
https://www.europapress.es/internacional/noticia-benin-anuncia-primer-caso-coronavirus-burkines-estuvo-belgica-20200316164704.html
https://www.europapress.es/internacional/noticia-zimbabue-confirma-primer-muerto-pais-pandemia-coronavirus-20200323154001.html
https://www.france24.com/es/20200519-arte-taiwan-modelo-covid19-pandemia
https://www.infobae.com/america/mundo/2020/04/01/modelo-chino-el-metodo-de-la-policia-de-nepal-para-detener-a-distancia-a-los-que-violan-la-cuarentena/
https://www.laprensa.com.ni/2020/02/23/internacionales/2643789-coronavirus-italia-impone-aislamiento-estricto-a-zonas-donde-se-ha-propagado-el-brot
https://www.lavanguardia.com/vida/20200128/473200203657/sri-lanka-adopta-medidas-de-prevencion-tras-su-primer-caso-de-coronavirus.html
https://www.milenio.com/internacional/coronavirus-canada-relaja-medidas-aislamiento-pese-casos
https://www.prensa-latina.cu/index.php?o=rn&id=35245 7&SEO=instituciones-estatales-de-etiopia-inician-receso-por-covid-19
https://www.prensa-latina.cu/index.php?o=rn&id=362878& SEO=angola-enfatiza-medidas-de-contencion-a-la-covid-19
https://www.swissinfo.ch/spa/sociedad/covid-19-explicaciones_distanciamiento-social--c%C3%B3mo-est%C3%A1-calando-en-suiza/45628518
https://www.xataka.com/legislacion-y-derechos/gobierno-declara-cuarentena-obligatoria-toda-espana-excepciones-esto-que-se-podra-hacer