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Short communication

Disease burden and vaccination priorities in Colombia

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ABSTRACT

Introduction: In the context of the COVID-19 pandemic, vaccination is considered a potentially effective strategy for controlling the disease. The objective of this study is to estimate the number of people with a high risk of morbidity and those who should be prioritized in immunization planning in Colombia.

Materials and methods: The population at risk by age was identified from the national census data of 2018. Various sources were identified to obtain information on the number of patients with different comorbidities, including heart failure, diabetes, chronic kidney failure, cancers, HIV infection, and obesity. Sources were also identified to estimate the number of health workers, teachers and military and police force personnel.

Results: By 2021, Colombia is estimated to have a total of 51,049,498 inhabitants, of whom 14% will be people over 60 years of age. Additionally, of the people with comorbidities younger than 60 years old, 5,233,241 inhabitants are expected to be obese, 592,726 are expected to have diabetes mellitus, 216,389 are expected to have chronic kidney disease, and 521,263 are expected to have heart failure, totaling 15,055,697 individuals. Combining the high-priority groups and health workers, a projected 20 million people will have mortality risk factors.

Conclusions: For Colombia's vaccination strategy to have an impact on reducing mortality, population groups with risk factors, corresponding to approximately 15 million inhabitants, as well as essential workers should be prioritized.

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1. Introduction

In December 2019 in the city of Wuhan, China, a new coronavirus, SARS-CoV-2, was identified, which, by March 2020, was declared by the WHO as a pandemic virus causing coronavirus 2019 disease (COVID-19)[1]. In Colombia, by October 2020, approximately 1 million people had been infected and approximately 25 thousand had died, with the elderly population being the most affected, with approximately 80% of deaths in adults occurring in people over 65 years of age, as well as people with comorbidities[2], such as cardiovascular disease, obesity, diabetes mellitus and chronic respiratory disease[3]. Among people admitted to the intensive care unit (ICU), 46 to 96% have adult respiratory distress syndrome (ARDS), requiring invasive mechan-

ical ventilation and, to a lesser extent, renal replacement therapy, with a mortality rate close to 50%[4]. In Colombia, confinement measures against the pandemic began on March 22, and with these, there was a decrease in productive activities, with economic losses of up to 6% of GDP as well as increased public spending[5].

Vaccination is considered the potentially most effective strategy to control the disease and facilitate a return to normal life and has begun in several countries[6,7]. Among the potential benefits of vaccination is protecting the most vulnerable individuals or groups against infection as well as decreasing the incidence rate of severe COVID-19[8], ICU admission and mortality; this has the benefit of reducing the impact on health services and allowing economic activities to resume.

The objective of this study is to provide an estimate of the numbers of individuals or groups with risk factors in Colombia for severe COVID-19 who present a high risk of morbidity and mortality and to prioritize groups for vaccinations in the country.

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2. Materials and methods

2.1. Information sources

The Colombian population was characterized demographically based on information available from the National Department of Statistics (DANE), and the population density was estimated for 2021 by department, by rural and urban residents, by sex and by age[9]. Information on the number of cases and their ubication (hospital, ICU, death) was obtained from the national public data available through the Instituto Nacional de Salud (National Institute of Health)[10].

For estimating the number of people with different types of comorbidities, those patients younger than 60 years of age were calculated based on information from DANE. Subsequently, based on the risk groups for comorbidities, the prevalence of chronic kidney disease, diabetes mellitus and human immunodeficiency virus (HIV) reported by the Colombian High Cost Diseases Fund (CAC) was taken into account[11,12] for 2019, extrapolating to the population demographic count for 2021 based on DANE projections, excluding the population over 60 years of age. For heart failure, the regional distribution was estimated by age and sex based on arterial hypertension data reported by the CAC[12], subsequently extrapolating prevalence based on epidemiological data from Heart Failure in Colombia, for those under 65 years-old an incidence of 2 per 1000 was calculated[13]. To estimate the prevalence of obesity in the region, values from the 2015 National Survey of the Nutritional Situation of Colombia were used[14]. Obesity was defined according to the World Health Organization recommendations, and it was considered in individuals with a body mass index over 30. The prevalence of chronic obstructive pulmonary disease, as determined by spirometry, was estimated from the PREPOCOL study conducted in 2008 [15], extrapolating the prevalence to the demographic projections for 2021. The prevalence of patients with oncological diagnoses was determined by confirmatory histopathology or clinical testing according to the CAC; assessments of cancer in the adult population covered by the general health system of Colombia were considered [16], as well as incidence by type of cancer according to Colombia National Institute of Cancer 2017 Statistical Yearbook [17].

Table 1
Estimation of the national population with comorbidities for 2021.

| Risk factor | Group | Region | | | | | | | % of total population |
|---|-------|---------|-----------|-----------|---------|---------|---------|------------|-----------------------|
| | | Bogota | Atlantic | Central | Eastern | Pacific | Amazon | Total | |
| Population over 60 years | Women | 645,387 | 723,977 | 1,048,326 | 660,491 | 690,404 | 149,715 | 3,918,300 | 14,8 |
| | Men | 466,504 | 1,100,519 | 834,177 | 550,989 | 539,971 | 147,546 | 3,639,706 | |
| | Total | | | | | | | 7,558,006 | |
| Individuals with comorbidities younger than 60 years | | | | | | | | | |
| Obesity | Women | | | | | | | 2,693,374 | 10,3 |
| | Men | | | | | | | 2,539,966 | |
| | Total | | | | | | | 5,233,341 | |
| Type 2 diabetes mellitus | Women | 44,963 | 58,666 | 66,785 | 38,285 | 44,027 | 12,518 | 265,245 | 1,2 |
| | Men | 57,221 | 70,336 | 82,917 | 46,190 | 56,394 | 14,424 | 327,481 | |
| | Total | | | | | | | 592,726 | |
| COPD | Women | 34,488 | 41,314 | 49,724 | 34,287 | 32,865 | 10,056 | 202,734 | 1,1 |
| | Men | 57,273 | 75,131 | 86,410 | 61,732 | 55,902 | 19,298 | 355,746 | |
| | Total | | | | | | | 558,481 | |
| Chronic Kidney Disease | Women | 34,538 | 26,609 | 22,085 | 17,023 | 18,452 | 4,106 | 122,813 | 0,4 |
| | Men | 26,316 | 20,274 | 16,828 | 12,970 | 14,060 | 3,128 | 93,576 | |
| | Total | | | | | | | 216,389 | |
| Cancer | Women | | | | | | | 270,561 | 0,5 |
| | Men | | | | | | | 19,068 | |
| | Total | | | | | | | 85,862 | |
| HIV | Women | 3,839 | 4,705 | 5,103 | 1,934 | 2,757 | 731 | 19,068 | 0,2 |
| | Men | 17,285 | 21,187 | 22,977 | 8,708 | 12,412 | 3,292 | 104,930 | |
| | Total | | | | | | | 146,287 | |
| Heart Failure | Women | | | | | | | 94,262 | 0,2 |
| | Men | | | | | | | 94,262 | |
| Total estimate | | 15,421 | 22,698 | 24,613 | 13,026 | 14,851 | 3,651 | 14,628,696 | 28,7 |

2.2. Other prioritized groups

The inclusion of prioritized groups, such as health workers, was considered, taking into account the characterization performed by the Ministry of Health of Colombia in 2016[18] as well as the number of students in the area of health reported by the Ministry of education for the year 2018[19]. Information regarding the number of active military corps personnel in the Colombian territory for 2017 was obtained from the macrosectoral bulletin published on September 5, 2019, by the Comptroller General of the Republic [20]; information regarding the number of active National Police personnel were obtained from the quarterly report of human talent[21]; and, finally, information regarding the entire official teaching body for 2015 was extracted from the Portal Único (Only Portal) of the Colombian government[22].

2.3. Geographical distribution

The geographical distribution was examined taking into account first the geographical-administrative divisions, called departments (32 divisions in the country), and the geographic regions, ordered as follows: the capital, Bogota (with approximately 8 million inhabitants); the Atlantic region (departments of Atlántico, Bolívar, Cesar, Córdoba, La Guajira, Magdalena, Archipiélago de San Andrés and Sucre); the Central region (departments of the Andean zone of Antioquia, Caldas, Huila, Quindío, Risaralza and Tolima); the Pacific region (departments of Cauca, Chocó, Nariño and Valle del Cauca); the Eastern region (the other Andean departments of Cundinamarca, Boyacá, Santander and Norte de Santander); and finally, the Amazon region (departments of Amazonas, Arauca, Caquetá, Casanare, Guainía, Guaviare, Meta, Putumayo, Vaupés and Vichada).

3. Results

3.1. Colombian population

According to the National Population and Housing Census conducted by DANE in 2018, a total of 51,049,498 inhabitants are estimated for 2021; these projections were used to estimate individuals or groups with risk factors for severe COVID-19.

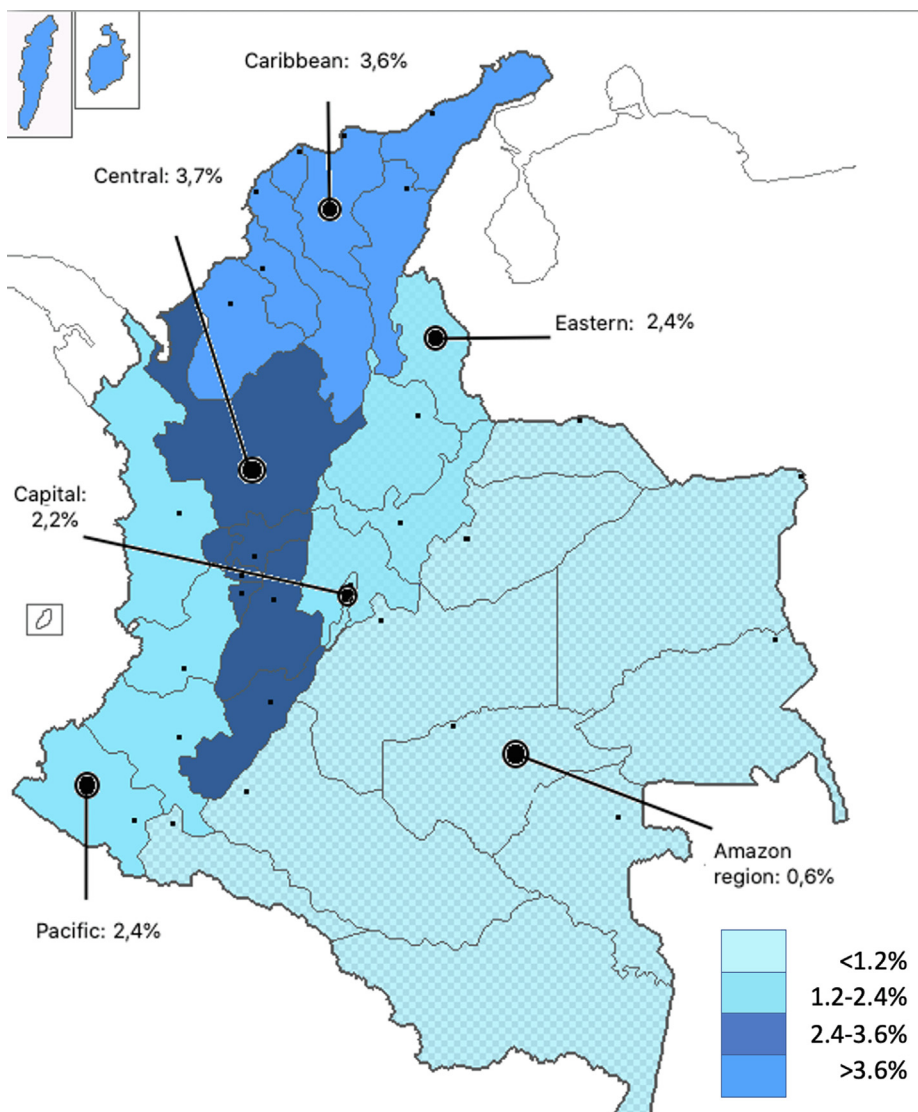


Fig. 1. Distribution of prioritized groups by age for vaccination against COVID-19 in Colombia. Colors show the Percentage distribution of those over 60 years-old in different regions.

3.2. Groups with comorbidities

The main risk group for severe COVID-19 is older adults, corresponding to 14% of the population, with the highest concentration in the capital (Bogotá) and the departments (geographical-administrative divisions) of Antioquia and Valle del Cauca (western part of the country, Pacific region). Table 1 and Fig. 1 show the population groups at risk by age based on geographic region. According to the National Institute of Health in Colombia, up to February 10th, 2021, just before the vaccination started, 343,015 cases in the population with 60 years-old or more were reported, and 55,329 were hospitalized or died (16,13% of those with Covid-19). For those under 60, 1,830,332 cases were reported and 25,260 (1,38%) had been hospitalized or died.

Obesity is considered one of the main risk factors for morbimortality in patients with COVID-19. According to the National Survey of the Nutritional Situation of Colombia (ENSIN) conducted in 2015, it was estimated that 56.5% of the adult population between 18 and 65 years was overweight and that 17.7% were obese. Based on population estimates for 2021, a total of 5,233,341 Colombians under 60 years of age will be obese.

Among the comorbidity risk factors for severe COVID-19 are arterial hypertension, type 2 diabetes mellitus and chronic kidney

Table 2
Health workers at the national level.

| Professionals and specialists | | % of total population |
|---|-----------|-----------------------|
| Bacteriology | 22,198 | |
| Nursing | 58,470 | |
| Surgical instrumentation | 10,154 | |
| Medicine | 97,483 | |
| Nutrition and diet | 706 | |
| Dentistry | 47,596 | |
| Pharmaceutical chemistry | 7,063 | |
| Therapy | 51,747 | |
| Total | 295,417 | 0,6 |
| Technologist, technicians and auxiliary personnel | | 0,5 |
| Total | 267,583 | |
| Students in health sciences | | 0,3 |
| Total | 166,335 | |
| Logistical support | | 1,0 |
| Total | 488,636 | |
| Total health workers | 1,217,971 | 2,4 |

Table 3
Priority population groups (essential workers).

| Region | | | | | | | Total | % of total population |
|------------------------|---------|---------|--------------|--------------|---------|------------|-----------|-----------------------|
| | Bogota | North | Central West | Central East | Western | South East | | |
| Teachers 2016 | 267,000 | 653,039 | 611,200 | 428,200 | 427,300 | 197,394 | 2,584,133 | 5,1 |
| Military corps 2017 | | | | | | | | |
| Army | | | | | | | 199,816 | |
| Navy | | | | | | | 28,545 | |
| Air Force | | | | | | | 9,515 | |
| | | | | | | | 237,876 | 0,5 |
| National Police 2020 | | | | | | | 159,247 | 0,3 |
| Total population group | | | | | | | 3,219,132 | 6,3 |

disease. The prevalence of arterial hypertension for 2019 per 100 inhabitants was 8.4, and the prevalence of congestive heart failure for 2015 was 2.3%. Thus, it is estimated that by 2021, a total of 4,288,157 inhabitants in the region will suffer from arterial hypertension. With an incidence of 2 cases per 1,000 for those under 65, 94,262 inhabitants under 60 will suffer from heart failure. The prevalence of type 2 diabetes mellitus in the population for 2019 was 2.58 per 100 inhabitants. If this prevalence is taken into account, it is estimated that by 2021, a total of 1,317,077 inhabitants will suffer from this disease and that 592,726 of those will be under 60 years of age. The prevalence of chronic kidney disease (CKD) in 2019 was 1.8%; therefore, in 2021, an estimated 916,514 inhabitants will suffer from CKD, of whom 24% (216,389 inhabitants) will be younger than 60 years.

The PREPOCOL study evaluated the prevalence of chronic obstructive pulmonary disease (COPD) in urban cities of Colombia in 2008 in people over 40 years of age, reporting a total prevalence of 8.9%. Based on the prevalence and population estimates for 2021, it is estimated that 558,481 people between 40 and 60 years of age will suffer from COPD, with 44% of them being men between 50 and 59 years of age.

According to the CAC, the prevalence rate for cancer in 2019 was 0.53%; when age-adjusted to 587.7 cases per 100,000 inhabitants based on the population estimate for the total Colombian population in 2021, 270,561 inhabitants are expected to have active cancer. Regarding the population with HIV, a prevalence of 0.23 per 100 inhabitants was estimated for 2019, with a total of 109,056 cases nationwide; by 2021, an estimated 104,930 individuals under 30 years of age will have HIV.

It is estimated that by 2021, the population over 60 years of age and under 60 years of age with comorbidities will total 15,055,697 inhabitants, who mostly reside in the Atlantic and Central regions.

3.3. Prioritized populations

Regarding populations without comorbidities that will be prioritized given their high impact on the economy and on the social development of the country, health workers and students, military personnel, National Police and teachers were included. In 2016, there was an estimated 563,000 health workers, of whom 55% were professionals and specialists and 45% were technicians, technologists and assistants. Health workers over 50 years of age represent 14.1% of this group; therefore, there was an estimated 483,617 younger than 50 years of age. In 2018, There were 166,335 students active in health care and 488,636 logistical support workers, for a total of 1,217,971 people (Table 2). For the Military Forces, according to the macrosectoral Bulletin, in December 2017, there were 237,875 active personnel in the Colombian Military Forces (National Army (84%), Navy (12%) and Air Force (4%)). In 2020, there were 159,247 active personnel in the National

Police. Finally, in 2016, there were 2,584,133 teachers in the country, with the highest density in the departments of Cundinamarca, Antioquia and Valle del Cauca. Therefore, a total of 3,219,132 inhabitants composed prioritized population groups of essential workers (Table 3).

4. Discussion

In Colombia, vaccination is required to decrease mortality, at the national level, from the disease caused by SARS-CoV-2; as such, the target population is considered people over 60 years of age and under 60 years of age with obesity or some other comorbidity considered to cause increased mortality, such as diabetes mellitus, CKD, COPD, cancer, HIV and heart failure. Our study estimates that in 2021, there will be a total of approximately 15 million inhabitants (approximately 30% of the total population of the country) who should be the initial targets for immunization in the vaccination strategy. Given the effectiveness of the vaccine, a significant decrease in hospital admissions and the return of vital economic activities in the country should be expected [23].

Additionally, other population groups, such as health workers, were included, given that they are a main part of the workforce in the context of a health emergency and are at the greatest risk of exposure. These essential workers have been prioritized in the vast majority of countries so as to preserve health system operations [24,25]. Students in the health area were also included, given that their training is relatively short and has been significantly affected by the pandemic. Prolonging this unprecedented situation could lead to significant gaps in training at different levels in future professionals [26,27] and compromise the quality of health service provision in the future, generating a major public health problem. Teachers were included to ensure the safe return of children to classrooms and thus ensure the continuation of quality basic education at the national level [28]. Additionally, teachers may help facilitate the vaccination of families. Some studies have indicated that the group that may be most in favor of vaccination is teachers [29]. Finally, Military Forces and National Police personnel were prioritized due to their importance in Colombia’s post-conflict context, one of the longest lasting of the 20th century and the most extensive in the region.

Among the limitations of the present study was the lack of updated national data on the prevalence of various diseases for the year 2020, the regional distribution of disease and age; therefore, estimates based on older data were required.

In conclusion, for Colombia to reduce mortality and resume economic activities in the context of the pandemic, it is necessary to prioritize population groups with risk factors, corresponding to approximately 15 million inhabitants, including some prioritized essential workers who guarantee the continuity of essential tasks,

such as health, education and national security, bringing the total to approximately 20 million inhabitants nationwide.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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