COVID-19 distribution in Bogotá, Colombia: effect of poverty during the first 2 months of pandemic

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ABSTRACT

Background The current SARS-CoV-2 pandemic has especially affected individuals living in conglomerate settings having poverty as common characteristic. However, evidence of the association between COVID-19 severity and social determinants is still scarce, particularly, for Latin American countries. The objective was to assess the effect of socioeconomic deprivation in the clinical severity of COVID-19 infection among different localities of Bogotá, Colombia.

Methods Secondary analyses using data of SARS-CoV-2 infected cases in Bogotá from 6 March 2020 to 19 April 2020 were carried out. Direct and indirect indicators of deprivation at area level and individual demographic characteristics (age, sex and type of case) were included in the analyses.

Findings 1684 COVID-19 cases were included in the study. There were 217 (12.9%; 95% CI 11.3 to 14.5) serious cases, of which 32.6% (95% CI 26.4 to 38.8) cases were deceased. In the multilevel logistic regression, age, sex (female), type of case (different of imported case), number of serious cases recorded the previous day and multidimensional poverty were associated with serious cases (median OR: 1.72, 95% CI 1.56 to 1.87).

Interpretation This paper explored the association between COVID-19 severity and social determinants. Expressions of poverty were associated with more severe cases during first 2 months of pandemic. It is a clear syndemic for the joint presentation of COVID-19 and other comorbidities among more serious cases.

INTRODUCTION

Epidemics are historical events that show the exaggerated increase of a disease, and due to the crisis that it generates, it allows to unveil the problems of the societies in which it occurs.[1] Among the social determinants of health, poverty is one that manifests its impact on societies more quickly in the way in which the occurrence of the disease is distributed among populations. The current SARS-CoV-2 pandemic has especially affected elderly and frail individuals living in congregate settings, people from black and minority ethnic groups,[2 3] and low wage and frontline workers,[4] all of these having poverty as common characteristic. In general, deprived populations are deemed to experience higher disease burden and mortality due to, among others, inadequate healthcare access, increased economic collapse proper to the pandemic crisis[5] and living in environments that are conducive to a disease epidemic.

SARS-CoV-2 emerged in late 2019 with a series of pneumonia cases of unknown aetiology in Wuhan, China. On 13 October 2020, COVID-19 was present in around 200 countries, counting over 38 million cases and 1 million deaths[6] and still infecting people throughout the world. People with comorbidities and homeless populations have also been highly affected during the pandemic.[5] Many of them experiencing simultaneously chronic mental or physical conditions, increased frequency of substance abuse (including alcohol and sharing of needles) and the practice of worst self-care habits, all of which could lead to potential problems with screening, quarantining and treating people infected by COVID-19.[7] Moreover, financial protection during outbreak is not always available, particularly in low-middle income scenarios; hence, out-of-pocket expenditure poses a substantial economic challenge for the less favoured, forcing to reject or diminish the distancing measures and its effectiveness or making it impossible to comply due to the type of jobs they have.

Locally, Colombia is one of the countries with the widest levels of socioeconomic and health inequities. Bogotá, its capital, faces serious problems of poverty, social disparities and barriers to access health service.[8] During COVID-19 pandemic, the first case in the country was reported in Bogotá by 6 March 2020. This case and the subsequent cases were related with the Bogota international airport, which became the main gateway of COVID-19 to Bogotá,[9] for people from Mexico, USA, Europe and Brazil mainly. On 14 October, the country reports over 930 000 cases, 30% approximately coming from the capital city.[10] This study was aimed to assess the effect of socioeconomic deprivation in the clinical severity of COVID-19 infection among different areas of Bogotá.

METHODS

Study setting

Bogotá, as the capital city of Colombia, is the largest economic and industrial centre of the country. The city houses more than 8 million inhabitants and generates about 26% of the national gross domestic product.[11] Socially, the city holds the largest flow of Colombia's national and international migrants[12] and contains the widest industrial and manufacturing park in the central region of the country.[13] Moreover, it encompasses the nation's largest urban centre, which poses different health and social challenges marked by deep economic gaps. For political purposes, Bogotá is divided in 20 administrative zones (districts), called localities (19 urban and 1 rural), which enable the internal management of aspects such as security, education

Table 1 Cases of COVID-19 (by severity of infection) in Bogotá, Colombia (6 March–19 April 2020)

	Cases					
	Total (n=1684)		Serious (n=217)		Non-serious (n=1 471)	
Variable	n	%	n	%	n	%
Sex: female (%)	850	50.4	86	39.6	764	51.9
Severity of COVID-19						
Hospitalised	147	8.7	147	67.7	0	0.0
Deceased patients	70	4.2	70	32.3	0	0.0
Type of COVID-19 case						
Related case	284	16.8	19	8.8	265	18.0
Under study case	948	56.2	155	71.4	793	53.9
Unknown origin case	121	7.2	29	13.4	92	6.3
Age (mean SD)	43	18.5	60	17.2	40	17.3

and health services provision. These divisions reveal different productive dynamics and communities with different economic capacity and lifestyles.[14]

Study design

Secondary analyses were carried out using the registry of SARS-CoV-2 infected cases in Bogotá from 6 March 2020 to 19 April 2020. For the analyses, the open dataset of communicable diseases provided by the Bogotá Health Observatory was used.[15] This dataset has daily level information on the clinical status of the registered cases: deceased, critical, severe, moderate or recovered, from the 19 urban localities of the city. During the period included in these analyses, the public health surveillance strategy emphasised the search for symptomatic individuals. For this reason, those who required hospital care were prioritised for diagnosis with RT(real time)-PCR. Individuals with history of international travel or contact with a traveller were also prioritised for screening. Until 19 April 2020, the daily per cent positive rate was between 8% and 23% according to National Institute of Health registries available at http://wwwinsgovco/Noticias/Paginas/coronavirus-pcraspx.

For this study, severity of SARS-CoV-2 infection allowed to classify the individuals into severe and non-severe cases. A severe case was considered if in the official reports the individual was receiving hospital care or had died. It includes individuals with dyspnoea or risk factors such as comorbidities and aged over 60 years, and hospitalised in intensive care units.[16] Individuals without symptoms or with mild symptoms at home and the recovered were classified as non-severe cases. Individual variables of age, sex and type of case: imported (from another country) case, related (with an imported case), under study case or case of unknown origin, were included. The patient's location at the data cut-off date (home or hospital) and the number of serious cases recorded the previous day were also assessed anticipating a linear trend in the number of cases.

Area-level variables

Some of the differential aspects of localities can be verified from the variations observed in direct or indirect indicators of economic and social activity within each locality. Variables included in this study were the proportion of households that lived in deficient dwellings, that is, in overcrowded conditions, cohabitation, unstable structure of walls and floors and with difficulties in accessing public services for 2017.[17] Further, the average number of persons per household

for the same year,[18] the prevalence of chronic undernutrition in children under 5 years of age in 2017[19] and the proportion of companies with commercial activities in 2019.[20] This last one, as a measure of the potential effect that pandemics produced in the reduction of population's income given the greater impact on commercial areas during confinement. In Bogotá, the confinement began in 20 March and was maintained throughout the period studied; only workers involved in essential activities continued in-person work.

The percentage of people with multidimensional poverty for each locality in 2017 was also used.[21] The Multidimensional Poverty Index was developed by the Colombian government and based in the so-called Alkire-Foster method Oxford,[22] by counting multiple deprivations that individuals experience in different dimensions: (1) health (including health insurance and access to social care services), (2) education (including literacy and years of education), (3) access to public utilities and housing conditions (including access to water, adequate floor and wall materials as well as coverage of sewer waste), (4) labour (including long-term unemployment and access to the formal job market) and (5) childhood and youth conditions (including children's school attendance, access to early childhood care services and child labour).[23] The available most recent data were used in this study.

Statistical analysis

Study sample characteristics description was performed using frequencies with 95% CIs for categorical variables and means and SD for continuous ones. A preliminary evaluation of the effect of individual-level and area-level variables was developed using Wald tests in the crude analysis. Crude comparison between localities regarding the frequency of serious cases was performed using a χ^2 test. The correlation between variables at locality level was measured using the Pearson correlation coefficient. Random effects hierarchical logistic regression models were used in order to generate adjusted estimates of the individual-level and area-level effects associated with the possibility of reporting a serious case derived from COVID-19 infection. For the comparison of the ORs between localities, the median OR was used.[24] All regression analyses were carried out using a stepwise variable selection methodology considering as candidates to the initial model those effects with crude levels of significance of at least $p < 0.2$ and for the final model of $p < 0.05$. Statistical analyses were implemented in Stata software V.16.

Research ethics approval

Our study corresponds to an analysis of datasets that only involved information freely available in public domains, in which the information is properly anonymised and informed consent was obtained at the time of original data collection. No further ethics approval was required.

RESULTS

During the study period, a total of 1684 COVID-19 cases were diagnosed in Bogotá. The average age was 43 (SD: 18.5) years, in which 50.4% (95% CI 48.0% to 52.8%) were women. For 63.4% (95% CI 61.1% to 65.7%) of the records, the origin of the transmission was unknown or was under study. A percentage of 4.2% (95% CI 3.2% to 5.1%) of the patients were registered as dead at the cut-off date. Among reported cases, 217 (12.9%; 95% CI 11.3 to 14.5) were identified as serious, of which 32.6% (95% CI 26.4% to 38.8%) were deceased. Sample characteristics are shown in table 1.

At locality level (table 2), significant differences were identified in the frequency of serious cases (p<0.001). The proportion of non-serious cases ranged from 50% to 100%, whereas the

Table 2 Cases of COVID-19 according severity and main characteristics of localities in Bogotá

Localities	Non-serious cases		Serious cases				Multidimensional poverty	Commercial companies	Persons per household*	Deficient dwellings	Chronic undernutrition†
			Deceased		Non-deceased						
	N	%	N	%	N	%					
01 Usaquén	203	91.0	9	4.0	11	4.9	2.6	14.1	2.6	1.8	16.6
02 Chapinero	104	96.3	0	0.0	4	3.7	2.2	10.6	2.1	3.5	17.2
03 Santa Fe	8	72.7	0	0.0	3	27.3	6.6	12.0	2.5	8.2	20.9
04 San Cristóbal	28	80.0	2	5.7	5	14.3	7.8	22.9	3.2	9.7	24.4
05 Usme	17	89.5	0	0.0	2	10.5	10.9	22.4	3.4	7.7	21.2
06 Tunjuelito	29	87.9	2	6.1	2	6.1	5.0	26.1	2.9	8.4	21.1
07 Bosa	82	85.4	2	2.1	12	12.5	5.3	20.6	3.3	3.8	17.4
08 Kennedy	166	78.7	16	7.6	29	13.7	5.0	20.1	3.1	3.1	15.6
09 Fontibón	88	90.7	4	4.1	5	5.2	4.9	16.6	2.9	2.2	13.7
10 Engativá	178	88.1	7	3.5	17	8.4	2.7	19.9	3.1	4.6	14.7
11 Suba	216	87.8	10	4.1	20	8.1	3.2	17.0	2.9	2.6	14.8
12 Barrios Unidos	32	88.9	2	5.6	2	5.6	2.4	18.6	2.7	6.1	14.4
13 Teusaquillo	98	91.6	3	2.8	6	5.6	0.6	13.5	2.4	1.8	15.5
14 Los Mártires	7	50.0	1	7.1	6	42.9	3.1	19.5	2.7	5.6	19.2
15 Antonio Nariño	17	100.0	0	0.0	0	0.0	2.6	26.3	3.2	2.4	16.9
16 Puente Aranda	48	90.6	3	5.7	2	3.8	2.7	23.3	2.9	2.9	15.4
17 La Candelaria	6	85.7	0	0.0	1	14.3	3.4	14.2	–	7.6	18.0
18 Rafael Uribe Uribe	43	82.7	3	5.8	6	11.5	6.8	25.2	3.1	9.8	21.5
19 Ciudad Bolívar	71	86.6	3	3.7	8	9.8	8.9	22.3	3.2	7.6	21.2
Outside Bogotá	18	78.3	1	4.3	4	17.4					
No data	8	66.7	2	16.7	2	16.7					

*Average people per household.
†Chronic undernutrition in infants under 5 years.

locality with the highest percentage of deaths reported a 42.9% of deceased patients. For 14 localities (73.7%), at least one death case was registered. From the total of cases, 8 individuals did not report a locality of residence and 18 resided outside Bogotá. Other characteristics of localities regarding the evaluated area-level variables are shown in table 2 .

Among deprivation variables, moderate to strong correlations were observed with most of the Pearson coefficients values above 0.30 (table 3). However, crude comparisons according to severity groups showed significant effects only for the indicators of people per household, proportion of companies with commercial activities, percentage of deficient dwellings and multidimensional poverty variables (table 4). The adjusted analysis, controlling by the individual effects of age, sex, type of case and the number of serious cases recorded the previous day, the

only effect that remained in the multilevel model was multidimensional poverty. Observed correlations among this indicator and others measured at locality level can explain some similarity in the information domains. Since observed associations correspond to a specific moment of the pandemic, the epidemic curve with cumulated cases, stratifying by the level of multidimensional poverty, is observed in figure 1.

DISCUSSION

The findings of this study suggest the association between poverty and the more severe clinical expressions of COVID-19 at the end of the second month of the pandemic in Bogotá. These results reinforce the idea that this association does exist in pandemics, since for years there has been a debate on this issue, where the analysis example is the Spanish influenza pandemic.

Table 3 Correlation between area-level variables

	Commercial companies	Persons per household*	Deficient dwellings	Chronic undernutrition†
Multidimensional poverty	0.61	0.65	0.68	0.66
Commercial companies	1.00	0.85	0.63	0.37
Persons per household*		1.00	0.41	0.15
Deficient dwellings			1.00	0.78

*Average people per household.
†Chronic undernutrition in infants under 5 years.

Table 4 Individual-level and area-level effects

	OR	95% CI	P value	Adjusted OR	95% CI	P value
Individual level						
Age (years)	1.07	1.06 to 1.08	<0.001	1.07	1.05 to 1.08	<0.001
Sex (female)	0.53	0.38 to 0.73	<0.001	0.51	0.36 to 0.71	<0.001
Type of COVID-19 case Imported case	1			1		
Related case	1.62	0.80 to 3.30	0.181	2.42	1.13 to 5.18	0.023
Under study case	4.43	2.52 to 7.77	<0.001	3.99	2.12 to 7.50	<0.001
Unknown origin case	7.14	3.62 to 14.07	<0.001	5.83	2.74 to 12.42	<0.001
Serious cases previous day	2.11	1.42 to 3.12	<0.001	1.93	1.28 to 2.91	0.002
Area level				**MOR**	**95% CI**	**P value**
Multidimensional poverty	1.11	1.04 to 1.18	0.002	1.72	1.56 to 1.87	0.015
Commercial companies	1.06	1.02 to 1.11	0.001			
Persons per household*	2.53	1.52 to 4.22	<0.001			
Deficient dwellings	1.08	1.01 to 1.14	0.018			
Chronic undernutrition†	1.05	0.99 to 1.11	0.108			
ICC (%)				8.9		

*Average people per household.
†Chronic undernutrition in infants under 5 years.
ICC, intraclass relations; MOR, median OR.

Most authors indicate that the pandemic is socially neutral and affects all types of individuals equally. The explanation is that the infectious agent is a new virus against which the population has no immunity to defend.[25] In more recent studies, authors such as Mamelund[26] using complex statistical analysis were able to identify manifestations of poverty (apartment size) associated with mortality during the Spanish influenza pandemic. In Colombia, there are some historical studies that point to poverty and overcrowding as determining factors for the worst outcomes in the same pandemic.[27]

A point that deserves special analysis is that the most severe cases of COVID-19 throughout the world are specifically those with comorbidities.[28] Data of Colombian cases and evidence obtained from various studies conducted during the current pandemic noted that chronic conditions such as hypertension, cardiovascular disease, chronic kidney disease and diabetes are associated with increased mortality.[29] Therefore, the COVID-19 pandemic can also be considered as a syndemic, in which, the infection plus one or more diseases have a co-occurrence in time and place,[30] reason why for the adequate control, it is required to act on the common determinants.

Findings of this study must consider some limitations. This study used public data from the pandemic in Bogotá, so potentially confounding variables could not be included in the analyses, and there may be residual confusion. As in all similar epidemics, the cases analysed are not complete; there must be many asymptomatic and presymptomatic cases that could not be identified, especially early in the pandemic. According to some studies, from 10%–23% of COVID-19 infected individuals are asymptomatic and about a half could be presymptomatic.[31] If we consider the syndemic phenomena, the results obtained here could be underestimated.

In conclusion, to the best of our knowledge, this study is the first one in Latin America that explored the association between COVID-19 severity and social determinants. The evident association between multidimensional poverty and severity suggests that a syndemic effect is present during the COVID-19 epidemic in Bogotá, and this quickly and mainly affects the poor
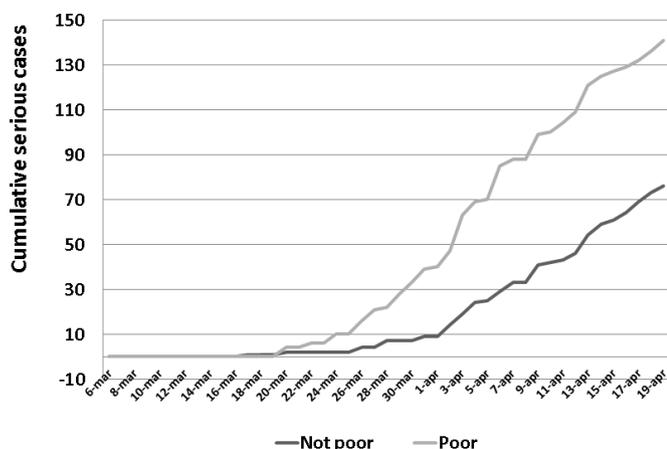
Figure 1 Cumulative number of serious cases of COVID-19 over time, according to poor or non-poor localities.

What is already known on this subject

► Studies on Spanish influenza pandemic (1918–1919) are non-consistent on the consequences among different social groups.
► It is not clear whether pandemics by emerging agents as COVID-19 are socially neutral, affecting all individuals in a society, or they have a major impact over more vulnerable groups.

What this study adds

► The findings indicate that COVID-19 cases from the poorest localities in Bogotá, Colombia, have a higher risk of being severe and dying than those from the non-poor localities.

population. Perhaps at the end of the pandemic, the affectations will be homogeneous to all social groups; however, the first affected will be the poor.

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