


BMJ Open Assessing the impact of the COVID-19 pandemic among Venezuelan refugees and migrants in Colombia using respondent-driven sampling (RDS)

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ABSTRACT

Objectives To determine factors associated with adherence to COVID-19 mitigation measures, related symptoms and testing, as well as pandemic-related income loss among Venezuelan refugee and migrant adults in urban and border areas of Colombia.

Design Phone-based respondent-driven sampling

Setting Bogotá and Norte de Santander, Colombia.

Participants 605 adult Venezuelan refugees and migrants residing in Bogotá (n=305) and Norte de Santander (n=300), who arrived in Colombia after 2014 and completed the survey in August and September 2020.

Primary and secondary outcome measures Full COVID-19 compliance (vs incomplete or no compliance), any COVID-19-related symptoms (vs none) and income loss due to isolation measures in Colombia (vs no income change or increase in income).

Results Older age was associated with lower odds of compliance with physical distancing measures (0.94, 0.90–0.99; p=0.01) for those in Bogotá. Nearly 15% of refugees and migrants in both locations (81 of 605) experienced at least one symptom consistent with COVID-19. Having a health condition was associated with higher odds of experiencing COVID-19-related symptoms in Bogotá (4.00, 1.22–13.06; p=0.02) and Norte de Santander (6.99, 1.95–24.99; p=0.003). Around 8% in both locations (48 of 605) were tested for COVID-19. Around 90% in both locations (537 of 605) had trouble earning an income after the introduction of isolation measures, and the median reported monthly income decreased by half in Bogotá and by 30% in Norte de Santander. A higher level of education (3.46, 1.02–11.75; p=0.05) was associated with higher odds of income loss among participants in Norte de Santander.

Conclusions Results indicate high compliance with COVID-19 mitigation measures, low testing rates and high pandemic-related income loss among Venezuelan refugees and migrants in Colombia. This study provides insights into a hard-to-reach refugee and migrant population in Colombia; additional study on the effects of the pandemic on hidden populations is warranted.

INTRODUCTION

Since 2015, approximately five and a half million refugees, 'people fleeing war or

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ A phone-based respondent-driven sampling (RDS) approach was a unique way to sample a hard-to-reach population in a context of restricted movement and travel enacted in response to COVID-19 pandemic mitigation strategies.
- ⇒ RDS network maps allow for exploration of recruitment connections among participants; in this case, with respect to those who reported COVID-19 symptoms and positive screening tests.
- ⇒ Phone RDS is advantageous over an internet approach in that it ensures that eligible respondents who do not have internet access or who are illiterate can participate.
- ⇒ Phone-based interviews, however, may exclude those who may not have access to a phone and may present challenges establishing trust and rapport with participants compared with face-to-face interviews.

persecution across an international border', and migrants, people moving for reasons not included in the legal definition of a refugee¹ have left Venezuela because of political turmoil and socioeconomic instability, representing the largest external displacement and humanitarian crisis in recent Latin America history. Venezuela is in second place after Syria for the most people displaced from their country of origin. Colombia is the top destination country for those displaced, hosting approximately 1.7 million (31%) of the Venezuelan refugees and migrants displaced worldwide.²

Colombia has been among the countries most impacted by COVID-19, ranking 11th based on the number of confirmed cases (over 2.2 million), and 12th based on deaths (nearly 60 thousand), in February 2021.³ COVID-19 has had a considerable social and economic impact on Colombia, which was already one of the countries with the

highest-income inequality and labour market informality in Latin America. In 2020, Colombia's gross domestic product fell by over 8%, with the unemployment rate reaching 17.3% at the end of 2020, leading the country into its first recession in two decades and its worst on record.^{4 5} The pandemic and resulting economic slow-down have compounded health and economic challenges facing Venezuelan refugees and migrants in Colombia.

Global evidence suggests that refugees and migrants are at elevated risk of exposure to the SARS-CoV-2 virus and infection with COVID-19 and are disproportionately represented among COVID-19 cases and deaths.⁶ This population has several characteristics and risk factors that make them susceptible to COVID-19. For one, refugees and migrants often live or work in crowded or unsanitary conditions, where they may have heightened exposure to infected individuals and limited potential to practice social distancing, self-isolate or adhere to proper hand hygiene.⁷ In addition, refugees and migrants often face administrative, financial and legal barriers to healthcare access including COVID-19 testing and treatment, lack of access to trustworthy prevention information and may have underlying health problems or pre-existing comorbidities that can increase the severity of COVID-19.^{8 9}

Refugees and migrants are also particularly vulnerable to the economic impacts of COVID-19. Even before the pandemic, Venezuelans in Colombia faced multiple barriers to economic inclusion, earning far less than their native Colombian counterparts and being more likely to work in the informal job sector.¹⁰ Other common employment barriers facing Venezuelans include difficulties in verifying credentials, high levels of discrimination and exploitation and having an irregular status, which translates to fewer work opportunities and protections against job and income loss, less job security and poor access to social safety nets.¹¹ The pandemic and Colombia's lockdown measures pushed Venezuelans even further into economic precarity. Compared with Colombians, Venezuelan refugees and migrants were likely to work in sectors that were highly impacted by the pandemic.¹¹

Displaced populations are difficult to assess through conventional probability sampling methods. Such is the case for Venezuelan refugees and migrants residing in Colombia, who are highly mobile and are not always included in comprehensive registration lists. Sampling challenges are compounded by Colombia's COVID-19 pandemic mitigation efforts, such as border closures, quarantines and social-distancing measures, resulting in this population being even harder to reach. For example, while Colombia had an open border policy before the pandemic, border closures in March 2020 drastically reduced the regular movement of Venezuelans at formal border points and led to a rise in irregular entries via informal crossings along the more than 2000 km long border Colombia shares with Venezuela. Colombia's strict social isolation and quarantine measures, especially at the onset of the pandemic, reduced the ability of assistance-providing organisations to access the population and to

assess and address their needs. In order to provide greater understanding of how the COVID-19 pandemic affected refugees and migrants, respondent-driven sampling (RDS), a chain-referral sampling method particularly adept at sampling 'hidden' populations, was used to recruit Venezuelan refugees and migrants in Colombia. A novel, phone-based approach to RDS allowed the survey to be conducted remotely to circumvent pandemic-related movement restrictions. The objective of this study was to determine factors associated with Venezuelan refugees and migrants' adherence to COVID-19 mitigation strategies, COVID-19-related symptoms and income loss.

METHODS

Study design

Venezuelan refugees and migrants were sampled between August and September 2020, at the height of Colombia's COVID-19 mitigation restrictions, in the Colombian city of Bogotá and the department of Norte de Santander. These locations were selected primarily because of their large Venezuelan refugee and migrant populations. As of September 2020, there were an estimated 339 000 Venezuelans in Bogotá and 195 000 in Norte de Santander.¹² Combined, these two locations host an estimated 30% of the Venezuelan refugee and migrant population in Colombia. Bogotá, the capital city, was selected to better understand vulnerability profiles in a major urban city, centrally located within Colombia. Norte de Santander, which directly borders Venezuela and is the department where most Venezuelan refugees and migrants enter Colombia, was selected to better understand vulnerability profiles at the border.

Given that the assumptions in RDS are that each network forms a single network component and that networks have little cross-over between the two survey locations, each location served as a separate sample.¹³ The sample size was calculated using standard methods to measure change over time and including a design effect to account for RDS not being a traditional random sample.¹⁴ The final calculation used a design effect of 2, 80% power with a two-sided test and $\alpha=0.05$ to detect an absolute 10% difference decrease of migrants in an irregular legal status, where 30% is assumed to be the percentage at time 1 (this survey) and 20% is assumed to be the percentage at time 2 (the next round of this survey). Sample sizes of 300 individuals were calculated for each survey site for a total sample size of 600 participants. Eligible participants were (1) born in Venezuela, (2) had arrived in Colombia after 2014, (3) 18 years old or older and (4) living or working in either Bogotá or Norte de Santander, Colombia, for 1 month or more before data collection.

In the context of COVID-19-related limitations to physical access, this study employed a remote phone-based RDS recruitment strategy, with peer-to-peer recruitment through phone contacts followed by a phone-based interview. RDS is described in more detail elsewhere.^{13 15}

Briefly, recruitment begins with a selection of ‘seeds’ who are known members of the target population. We interviewed nine potential seeds in Bogotá and eleven in Norte de Santander. Potential seeds were identified through United Nations High Commissioner for Refugees (UNHCR) and other local organisations who have contact with many Venezuelan refugees and migrants. The research team contacted and interviewed potential seeds using a ‘diversity recruitment grid’¹⁶ to encourage seeds to think about the characteristics of the peers they would recruit in order to ensure enrollment of a diverse mix of Venezuelan refugees and migrants in the surveys. Seeds were selected based on their ability to overcome bottlenecks among subgroups and to recruit diverse people, including those within identified vulnerable subgroups. Recruitment began with three seeds per location but was increased to six in both Bogotá and Norte de Santander in an attempt to increase participation.

Trained interviewers contacted selected participants by phone. Before being enrolled in the survey, participants were screened for eligibility and read an abbreviated consent form to which they were required to agree. The survey was verbally administered to consenting participants over the phone in Spanish, with the interviewer recording responses into an online KoboToolbox survey form.¹⁷ No more than five call attempts were made to contact recruits.

After finishing the survey, interviewers explained the recruitment process to participants and asked if they could recommend three peers who met the eligibility criteria who in turn were contacted by phone and enrolled if eligible. As with their recruiters, they underwent the phone-based interview and were instructed to recruit other peers and so on. Participants received an incentive in the form of a mobile phone credit worth no more than the cost of lunch in local Colombian peso currency. A primary incentive was given for completion of the survey and smaller secondary incentives of mobile credits were given for each recruit (up to three) who completed the survey.

Participant identification numbers (IDs), recruit IDs, participant status, contact information and incentive information were entered and stored in a database separately from the main survey questionnaire responses. The protocol was reviewed by both Partners Human Research Committee and Partners’ Research Information Security Office (RISO) and was ultimately deemed not human subject research, but rather a research study commissioned by UNHCR as part of an evaluation to improve UNHCR programmes implemented by an external entity. RISO provided guidance and insight for the proper collection and management of data to ensure privacy and confidentiality of participants.

Survey instrument

The survey instrument included questions about sociodemographics, health status and health conditions, COVID-19-related symptoms, COVID-19 testing and results,

adherence to public health measures, and economic impacts of COVID-19. The instrument was developed in English and translated into Spanish. After translation, the survey was pretested in two stages. In the first stage, the UNHCR expert team in Colombia (with experience and expertise in the survey topics) reviewed the surveys and validated the content, clarity and appropriateness of question wording and translation. The implementing partner was also consulted to confirm question wording and translation to finalise the survey. In the second stage, the survey was built in KoboToolbox and it was pretested by both the research team and implementing partner. It was then piloted with one seed, out to three waves of recruitment, to test feasibility. The surveys were then scaled up by adding the additional two seeds to each study.

Patient and public involvement

The objective of the evaluation was to assess the response and draw lessons learnt to strengthen UNHCR services provided to the population of concern. The objective of this RDS study was to collect data to better understand the situation, needs and vulnerabilities of Venezuelan refugees and migrants in Colombia and to expand UNHCR’s capacity to develop and conduct novel RDS approaches to assess the vulnerability of hidden and hard-to-reach displaced populations. The UNHCR staff and other key stakeholders were interviewed to inform and refine the study design and survey instrument. Refugees not involved in the study were further consulted during the pilot phase to assess the instrument and provide feedback. During data collection, as detailed in the methodology, participants played an active role in enrolling participants, as per the RDS protocol. Results of the evaluation are available publicly.¹⁸ RDS materials and findings were shared and an RDS analysis workshop was held with UNHCR key stakeholders remotely due to the COVID-19 pandemic. Results presented in this article will be similarly disseminated among key stakeholders.

Analysis

Univariate analysis with population estimates and 95% CIs were conducted using the Giles successive sampling estimator in RDS Analyst.¹⁹ Data were weighted inversely by each participant’s social network size comprising the number of eligible people they know who also know them and with whom they had contact in the previous 2 weeks.

Weighted ORs and 95% CIs used exported network weights and bootstrap weighting in the survey package in R (V.4.0.4). Binary logistic regression models were used to assess the associations of sociodemographic factors with the outcomes of full compliance with COVID-19 measures (vs incomplete or no compliance), any COVID-19-related symptoms (vs none) and income loss since introduction of COVID-19 isolation measures in Colombia (vs no income change or increase in income). Missing data were excluded and survey weights were used in the regression analysis. Sociodemographic variables included age, civil status, gender and education level. Vulnerable

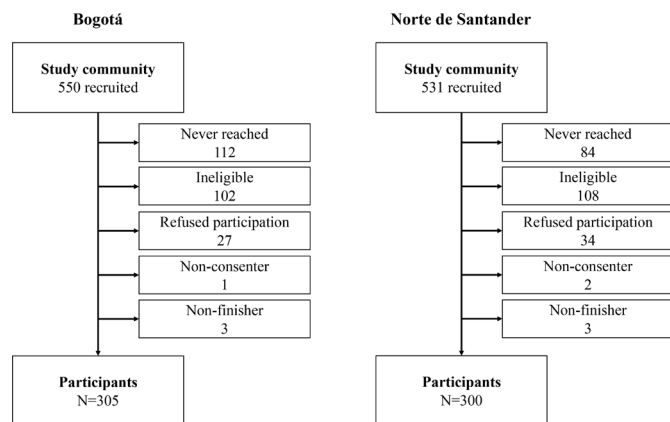


Figure 1 Study recruitment and participation in Bogotá and Norte de Santander.

outcomes of interest were health condition and irregular status. Respondents were categorised as having a health condition if they reported having chronic health issues (eg, cardiopulmonary disease, diabetes mellitus, hypertension, chronic kidney disease, etc), having disabilities (assessed using the Washington Group Short Set)²⁰ or were experiencing pregnancy. Respondents were categorised as having an irregular status if they selected ‘irregular situation (undocumented)’ as their self-reported legal status (other options included having refugee status, seeking asylum or being in a regular situation with legal documents such as a visa, temporary stay permit, etc). Full compliance with COVID-19 measures was defined as having engaged in all six preparation measures (washing hands regularly, keeping distance from sick people, keeping physical distance from everyone that is not a member of your household, stopped going to social gatherings, wearing a face mask, changing/cancelling travel plans) presented in a survey question.

RESULTS

Overall, 305 respondents in Bogotá and 300 in Norte de Santander completed the phone survey over a period of 4–5 weeks, respectively, (figure 1). Response rates were 80% in Bogotá and 84% in Norte de Santander. The majority of those who participated also recruited participants (75% in Bogotá and 74% in Norte de Santander).

The median age was 29 years in Bogotá (mean 31.7) and 31 years old in Norte de Santander (mean 32.5). Few (2% or less) refugees and migrants were 60 years of age or older, and most were single/unmarried (63% in Bogotá and 69% in Norte de Santander), female (58% and 56%, respectively), and lived with a partner (60% and 52%, respectively).

Almost all adult refugees and migrants (99% or more) had some form of formal education and two-thirds had completed high school or higher levels of education, 81% in Bogotá and 63% in Norte de Santander. About one in ten Venezuelan refugees and migrants had completed college or postgraduate education. Roughly

45% of Venezuelan refugees and migrants had irregular legal status and just over 10% (13% in Bogotá and 11% in Norte de Santander) had chronic health conditions (table 1).

Excluding members of their household, refugees and migrants in Bogotá had close contact with a median of one person the previous day, whereas those in the Norte de Santander had close contact with a median of two people the previous day (table 2). Just under 15% of refugees and migrants in both locations experienced difficulties complying with physical distancing measures. Among refugees and migrants in Bogotá, older age was associated with lower odds of full compliance to COVID-19 (table 3).

Most Venezuelan refugees and migrants reported adopting common COVID-19 safety measures, with almost all reporting regular hand washing (table 2). Keeping distance from sick people, wearing a mask and avoiding social gatherings were also common measures taken. About 14% of refugees and migrants in Bogotá and Norte de Santander experienced at least one symptom consistent with COVID-19 within 2 weeks prior to the survey. The most reported symptom was fatigue (7%). Having a health condition was associated with higher odds of experiencing common COVID-19-related symptoms among refugees and migrants in Bogotá and Norte de Santander (table 3).

Around 8% of refugees and migrants had ever been tested for COVID-19 (SARS-CoV-2) prior to the survey. In Bogotá, 40% of tests taken (n=24) were positive (n=7), whereas none of the tests taken in Norte de Santander (n=24) were positive.

Figure 2 presents recruitment graphics based on reporting at least one symptom consistent with COVID-19 disease and reporting having received a positive COVID-19 screening test. As illustrated, 5% of the migrants and refugees in Bogotá and 2% in Norte de Santander were directly connected to someone with symptoms. The three individuals who reported positive test results were directly connected to somebody who reported a positive COVID-19 test result or had at least one symptom consistent with COVID-19.

Almost all refugees and migrants had trouble earning income since the introduction of COVID-19 isolation measures in Colombia (table 4) and reported earning lower monthly incomes at the time of the survey than before isolation measures. The median reported monthly income decreased by half in Bogotá and by 30% in Norte de Santander. A higher level of education and being married were both associated with higher odds of experiencing a loss in income after the introduction of COVID-19 isolation measures among refugees and migrants in Norte de Santander (table 3).

DISCUSSION

Principal findings

This study explored factors associated with adherence to COVID-19 mitigation measures, COVID-19-related

Table 1 Characteristics of Venezuelan refugees and migrants in Colombia, 2020

Variable	Bogotá			Norte de Santander		
	Mean (SD)	Median (IQR)		Mean (SD)	Median (IQR)	
Age	31.7 (9.9)	29 (10)		32.5 (10.8)	30 (14)	
Variable	n	%	95% CI	n	%	95% CI
60 years or older	7	2	(0 to 4.1)	3	1.7	(0 to 5.1)
Civil status						
Single/unmarried	196	62.9	(55.2 to 70.7)	207	69.3	(61.6 to 77.0)
Married/civil union	92	33.8	(25.8 to 41.8)	73	24.7	(16.5 to 32.9)
Divorced/separated	12	3.2	(0.0 to 7.9)	13	4	(0.4 to 7.5)
Widowed	0	–	–	5	2	(0 to 11.2)
Living with a partner	181	60.4	(51.5 to 69.3)	164	51.8	(44.5 to 59.1)
Gender						
Male	127	41.6	(31.1 to 52.1)	137	43.4	(33.7 to 53.0)
Female	178	58.4	(47.9 to 68.9)	160	56.1	(46.5 to 65.7)
Other	0	–	–	3	0.5	(0.1 to 0.9)
Had any kind of schooling	305	100	–	297	98.9	(97.2 to 100)
Education level						
Any primary education	13	3.1	(0.1 to 6.0)	42	16.1	(10.4 to 21.9)
Secondary school completed	52	15.6	(9.0 to 22.2)	42	11.2	(6.4 to 16.0)
High school completed	144	47.7	(37.7 to 57.8)	158	55	(46.2 to 63.8)
Technical	65	24.8	(16.0 to 33.6)	16	4.7	(1.6 to 7.9)
College/university completed	22	7.8	(2.2 to 13.3)	34	11.8	(5.9 to 17.6)
Postgraduate degree	9	1	(0.3 to 1.7)	4	1.2	(0.0 to 2.7)
Has irregular status	131	45.5	(35.8 to 55.2)	118	43.6	(33.7 to 53.5)
Has any health issues or chronic conditions	33	12.8	(6.8 to 18.9)	46	10.5	(2.1 to 18.8)

Tables do not present results for the response options 'don't know' and 'prefer not to answer' and this the sum of the n for response options of any given variable may not add up to the full study size.
n, number of participants in response category.

symptoms and testing, as well as pandemic-related income loss among Venezuelan adult refugees and migrants in Colombia. This study also sought to explore whether there were differences in outcome measures in two different locations by comparing Venezuelan refugees and migrants in the capital city of Bogotá and the border area of Norte de Santander. This study found no major differences between Bogotá and Norte de Santander in terms of demographics, health status or COVID-19 mitigation compliance or symptoms. Our findings did, however, find differences with regard to testing results and pandemic-related income change. Compared with refugees and migrants in Norte de Santander, those in Bogotá had more positive test results and greater income loss. We explore each of these outcome measures and associated factors below.

Most refugees and migrants in our study did not experience difficulties complying with physical distancing measures and nearly all reported adopting common COVID-19 safety measures. Older age was associated with

lower odds of full compliance to COVID-19 measures among refugees and migrants in Bogotá. The relationship between age and compliance with preventive COVID-19 measures is not clearly established, with varied results in the literature. Some studies have reported results similar to ours, wherein increasing age of respondents was associated with lower compliance with preventive measures.²¹ However, other studies have reported the opposite, including a US-based study (n=979), where being older was associated with a higher chance of adopting preventive behaviours and in Saudi Arabia (n=1232) where older respondents were more likely to adhere to good practices than their younger counterparts during the pandemic.^{22 23} Besides age, we did not find significant associations between compliance and other factors considered.

Few refugees and migrants experienced common symptoms consistent with COVID-19 within 2 weeks prior to the survey. Our results showed that chronic health conditions were positively associated with reported

**Table 2** Compliance with COVID-19 mitigation measures, symptoms and testing among Venezuelan refugees and migrants in Colombia, 2020

Variable	Bogotá			Norte de Santander		
	Median (IQR)			Median (IQR)		
Median number of people outside household in close contact (<2m) on previous day	1 (4)			2 (4)		
Variable	n	%	95% CI	n	%	95% CI
Experienced difficulties complying with physical distancing measures						
No difficulty	269	88.7	(78.9 to 98.6)	248	85.5	(79.4 to 91.6)
Some difficulty	21	7.6	(0.0 to 17.6)	33	8.5	(4.3 to 12.6)
A lot of difficulty	14	3.7	(0.0 to 10.7)	19	6	(1.4 to 10.7)
Actions taken in response to COVID-19						
Washing hands regularly	301	99.5	(98.9 to 100)	297	99.7	(99.3 to 100)
Keeping distance from sick people	301	98	(95.4 to 100)	293	97.7	(94.5 to 100)
Keeping physical distance from anyone that is not a member of your household	280	94.4	(91.1 to 97.6)	261	89.3	(83.7 to 94.9)
Stopped going to social gatherings	293	95.3	(91.7 to 98.9)	278	95.4	(92.6 to 98.2)
Wearing a face mask	293	94.1	(89.7 to 98.4)	293	97	(93.6 to 100)
Changing/cancelling travel plans	265	85.9	(79.4 to 92.4)	252	78.9	(71.3 to 86.4)
Other	36	10.4	(5.1 to 15.8)	49	14.2	(8.6 to 19.8)
None of the above	0	–	–	0	–	–
Symptoms experienced in last 2 weeks						
Fever	3	1.9	(0.0 to 4.5)	5	1.3	(0.0 to 3.0)
Dry cough	11	6.1	(1.3 to 10.8)	3	1.7	(0.0 to 4.4)
Tiredness	22	6.9	(3.0 to 10.8)	20	7.2	(2.5 to 11.8)
Shortness of breath	7	2.4	(0.0 to 5.0)	7	1.2	(0.1 to 2.4)
Decreased or loss of smell and/or taste	6	2.5	(0.0 to 5.0)	8	3.8	(0.3 to 7.3)
Other flu-like symptoms	16	4.5	(1.4 to 7.6)	12	4	(0.3 to 7.7)
None of the above	261	85.5	(79.5 to 91.6)	263	85.6	(79.1 to 92.0)
Reported at least one symptom	44	14.5	(9.4 to 21.6)	37	14.4	(9.0 to 22.5)
Directly connected to someone with symptom	11	4.6	(2.2 to 9.5)	4	2.4	(0.6 to 8.9)
Indirectly connected (one degree removed) with someone with symptom	3	1.3	(0.3 to 5.5)	5	0.9	(0.3 to 3.0)
Ever tested for COVID-19						
Yes	24	8.4	(2.6 to 14.2)	24	7.5	(2.3 to 12.6)
No	281	91.6	(85.8 to 97.4)	276	92.5	(87.4 to 97.7)
Self-reported result of COVID-19 test among those tested (n=24)						
Positive	7	39.8	(11.9 to 67.7)	0	–	–
Negative	15	56.5	(29.3 to 83.7)	23	99	(95.6 to 100)
Inconclusive	0	–	–	1	0.9	(0.0 to 4.4)
Results not received	2	3.7	(0.0 to 9.3)	0	–	–
Directly connected to someone who reported positive COVID-19 test or had symptoms	3	0.3	(0.1 to 1.1)	0	–	–

Tables do not present results for the response options 'don't know' and 'prefer not to answer' and thus the sum of the n for response options of any given variable may not add up to the full study size.

COVID-19-related symptoms, which is also consistent with other respiratory infections and chronic non-infectious health conditions. These results are consistent with the literature, which suggests that underlying health conditions are risk factors for symptomatic COVID-19 infection.^{24 25} Other factors considered were not significantly associated with symptoms.

Only around 8% of refugees and migrants had ever been tested for COVID-19 prior to the survey, which is low compared with the general population. In Bogotá, 40% of tests taken were positive, which was nearly double the positive test rate among the general population in Bogotá in September 2020 (21%).²⁶ This could be due to two possible factors: (1) refugees and migrants in

Table 3 Adjusted ORs for COVID-19 compliance, COVID-19-related symptoms and income loss since introduction of COVID-19 isolation measures in Colombia among Venezuelan refugees and migrants in Colombia, 2020

Variable	COVID-19 compliance				COVID-19-related symptoms				Income loss since introduction of isolation measures in Colombia			
	Bogotá (n=300)		Norte de Santander (n=294)		Bogotá (n=300)		Norte de Santander (n=294)		Bogotá (n=211)		Norte de Santander (n=231)	
	OR (95% CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value
Age (1-year increase)	0.94 (0.90 to 0.99)	0.01	1.00 (0.96 to 1.05)	0.92	1.02 (0.96 to 1.08)	0.61	0.96 (0.90 to 1.02)	0.16	1.04 (0.97 to 1.12)	0.31	0.97 (0.91 to 1.03)	0.31
Civil status (married vs single/divorced/widowed)	1.06 (0.43 to 2.62)	0.90	0.58 (0.22 to 1.51)	0.26	1.18 (0.36 to 3.87)	0.79	1.69 (0.35 to 8.24)	0.52	0.77 (0.21 to 2.84)	0.70	4.45 (1.15 to 17.21)	0.03
Gender (male vs female)	0.64 (0.24 to 1.73)	0.38	1.49 (0.62 to 3.57)	0.37	0.84 (0.16 to 4.28)	0.83	1.98 (0.56 to 7.00)	0.29	1.45 (0.43 to 4.91)	0.55	1.08 (0.38 to 3.08)	0.88
Education level (high school or more vs secondary school or less)	1.53 (0.60 to 3.93)	0.37	2.08 (0.88 to 4.96)	0.10	1.35 (0.30 to 6.08)	0.69	0.44 (0.11 to 1.76)	0.25	2.56 (0.73 to 9.05)	0.14	3.46 (1.02 to 11.75)	0.05
Health condition (vs none)	0.66 (0.22 to 1.97)	0.46	0.91 (0.29 to 2.88)	0.88	4.00 (1.22 to 13.06)	0.02	6.99 (1.95 to 24.99)	0.003	2.96 (0.84 to 10.52)	0.09	0.52 (0.10 to 2.64)	0.43
Irregular status (vs regular situation/asylum/refugee)	0.39 (0.14 to 1.09)	0.07	2.25 (0.96 to 5.30)	0.06	1.69 (0.47 to 6.09)	0.42	0.34 (0.09 to 1.30)	0.12	1.37 (0.42 to 4.51)	0.61	1.13 (0.37 to 3.46)	0.83

Odds ratios were adjusted for the variables listed in the table: age, civil status, gender, education level, health condition and irregular status.

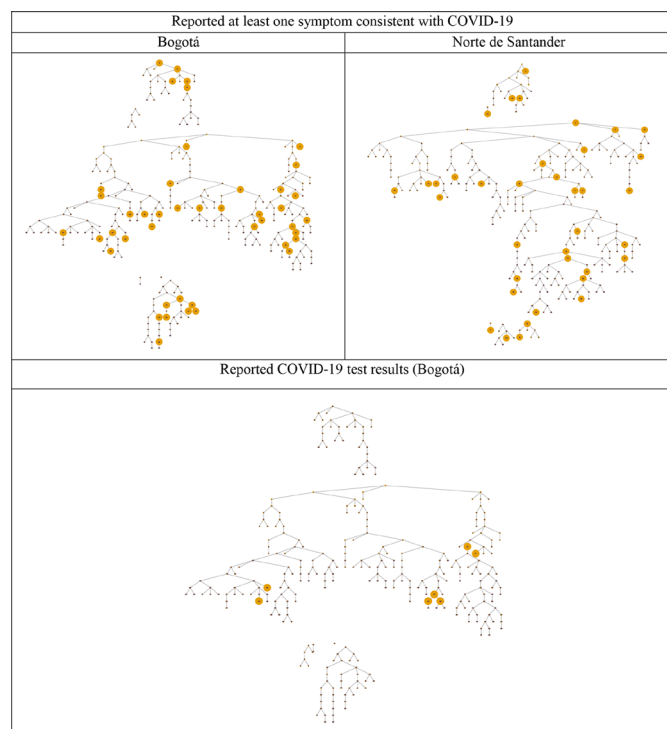


Figure 2 Participation recruitment-based COVID-19 self-reported symptoms and positive COVID-19 screening test.

urban centres may be particularly susceptible to infection, perhaps owing to risk factors (ie, overcrowded living conditions, front-line service sector jobs, etc) related to exposure and (2) testing is limited among refugee and migrant population and hence those who actually are tested have clearer symptoms (signs) of COVID-19 compared with the general population. The network map shown in [figure 2](#) also offers a potential explanation for this finding, as those who tested positive for COVID-19 appear to be connected in clusters such as might be found in an infectious outbreak, suggesting possible pathways for the spread of the virus. This also illustrates the potential use of RDS as a way to identify clusters of outbreaks within a hidden or difficult to access population.²⁷ None of those tested in Norte de Santander had positive test results. It is possible that those who had been sick with COVID-19 disease were less likely to participate in the survey.

Our findings show that nearly all refugees and migrants had trouble earning income since the introduction of

COVID-19 isolation measures in Colombia, with considerable reported loss of income across populations. The percentage of participants reporting these difficulties was similar across both locations (around 90%). The differences in median monthly income before the isolation measures and at the time of the survey, however, suggest that participants in Bogotá may have suffered greater losses of income than their counterparts in Norte de Santander. The difference in median income between the two time points was 390k Colombian Pesos (COP) in Bogotá, more than double that of the 150k COP difference in Norte de Santander. This could be attributed to a number of factors, such as differences in the strictness and duration of isolation measures, degree of informal labour participation and employment opportunities among participants in each location. Both higher levels of education and being married were associated with higher odds of experiencing a loss in income after the introduction of COVID-19 isolation measures among refugees and migrants in Norte de Santander. Though this may seem counter intuitive and run contrary to what we may see in other contexts,^{28 29} those who have a higher education could have earned higher wages prior to COVID-19 and could experience comparatively more income to loss during COVID-19 movement restriction. Also, those who are married are more likely to have children who are not able to go to school or another family to care and therefore be at higher risk of losing an income compared to those who are not married.

Strengths and limitations

Given that the study was conducted during physical contact restrictions due to the COVID-19 pandemic, in-person interviews were not feasible. Remote phone-based RDS provided a viable alternative, yielding reliable data on a hidden population that is difficult to access, especially during the pandemic. Phone RDS is advantageous over an internet approach in that it ensures that eligible respondents who do not have internet or who are illiterate can participate. Phone RDS, however, does have some limitations. First, the study by default excludes those who may not have access to a phone. According to 2018 figures, 72.2% of individuals owned a smartphone in Colombia, with rates differing by area: 76.4% of those in capital cities of municipal districts owned a smartphone compared with 57.6% in populated rural areas.³⁰

Table 4 Income among Venezuelan refugees and migrants impacted by COVID-19 isolation measures, 2020

Variable	Bogotá			Norte de Santander		
	n	%	95% CI	n	%	95% CI
Difficulty earning income since introduction of COVID-19 isolation measures in Colombia	268	91.5	(86.9 to 96.0)	269	88.7	(83.2 to 94.2)
Variable	Median (IQR)			Median (IQR)		
Median monthly income (COP) before isolation measures	790 000 (400 000)			450 000 (300 000)		
Median monthly income (COP) at time of survey	400 000 (450 000)			300 000 (300 000)		

COP, Colombian Pesos.

While phone-based RDS may not convey the same trust and rapport as face-to-face interviews and requires that participants provide the names and phone numbers of their recruits, which may be uncomfortable for some, interviewers received extensive training on techniques to establish rapport and gain trust with the participants. Of all (potential) participants contacted, only 7% in Bogotá and 9% in Norte de Santander refused to participate, consent or finish the survey.

Policy implications and conclusions

Results from this study indicate that interventions aimed at the prevention, detection and treatment of COVID-19 among migrants and other displaced populations need to be strengthened and further integrated into the government of Colombia's national and local COVID-19 response. Despite high documented levels of compliance with COVID-19 mitigation measures, prevention efforts must better target specific segments of this population, such as elderly people who showed lower levels of compliance, and those with chronic health conditions who are at greater risk of COVID-19 infection and serious illness. More generally, considering the importance of testing in mitigating the spread of COVID-19, actions aimed at reducing barriers to testing among Venezuelan refugees and migrants are warranted. In addition, the high pandemic-related income loss reported among Venezuelan refugees and migrants in this study is grounds for further research on the economic impact of the pandemic on this population. It also calls for consideration of this population's needs in post-COVID-19 economic recovery strategies.

More generally, this study illustrates the feasibility of obtaining timely data on this population in the context of the complex dynamics of the COVID-19 pandemic. Such data can serve to monitor outcomes and adjust COVID-19 response as needed. RDS has been used effectively to sample populations that are difficult to access. To date, most RDS studies conducted in Latin America are related to HIV and substance use and do not explore displacement or the impact of the COVID-19 pandemic.³¹ This study shows that RDS can effectively be implemented remotely among migrants and other displaced populations to study the impact of the COVID-19 pandemic. This approach should be replicated in other complex displacement situations.

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Contributors PNP secured funding, developed the study design, supervised protocol implementation, interpreted data and cowrote first draft of the manuscript. KK developed the study design, supervised protocol implementation, monitored data collection, interpreted data and cowrote first draft of the manuscript. LGJ developed the study design, analysed and interpreted data and cowrote the first draft of the manuscript. JR oversaw data collection. MAR oversaw data collection. CW conducted the data analysis and interpreted data. PV secured funding, analysed

and interpreted data and contributed to the drafting of the manuscript. PNP, KK, LGJ, and PV take full responsibility for the work and/or the conduct of the study, had access to the data, and controlled the decision to publish. All authors reviewed and approved the final manuscript.

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