RESEARCH LETTER

Prevalence of SARS-CoV-2 in Karnataka, India

Low- and middle-income countries contain the majority of confirmed cases of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). India has the second highest number of reported cases, but most seroprevalence estimates come from cities. Cities, with denser population, are more vulnerable to SARS-CoV-2. However, millions of city workers fled to rural India where lockdown was less stringent.

Supplemental content

We assessed SARS-CoV-2 prevalence among volunteers from population-representative households in urban and rural areas of the state of Karnataka (population, 67.5 million).

Methods | This study was approved by the Indian government and institutional review boards at participating institutions. Written informed consent was obtained from all participants (orally if respondents were unable to read or write). The sample was drawn from a population-representative panel survey, the Consumer Pyramids Household Survey[1] (CPHS) (details in the eAppendix in the Supplement). The primary sampling units were towns (urban) or villages (rural); the ultimate sampling units were households. From the CPHS's 9717 Karnataka households, we randomly selected 2912 to represent urban and rural areas of 5 state regions. We surveyed consenting household members aged 12 years or older between June 15 and August 29, 2020 (during partial lockdown). We requested 5 mL of blood and a nasopharyngeal swab from 1 volunteer per household. We compared the sex and age distribution of volunteers with the CPHS and the 2021 projection from the 2011 census.

We tested for IgG antibodies to SARS-CoV-2 receptor binding domain using an enzyme-linked immunosorbent assay with 84.7% sensitivity and 100% specificity.[2] The test result is positive when the ratio of IgG titer in a sample to a negative control exceeds 1.5. We conducted reverse transcriptase–polymerase chain reaction tests targeting the *N* gene using the R-Gene assay (BioMérieux). Cycle threshold values less than 34 indicate a positive test result. The test has 100% sensitivity and specificity.[3]

We estimated the adjusted proportions of positive test results in locations (defined by regions and urban status) using weights to account for sampling probabilities and random nonresponse. Inadequate samples were treated as missing in the analysis. When aggregating across locations, we reweighted adjusted proportions by the location's population. We estimated 95% CIs using bootstrap methods with 1000 replications per location. We calculated adjusted seroprevalence from adjusted proportions using the Rogan-Gladen[4] formula to correct for test inaccuracy (eAppendix in the Supplement). Analyses were conducted in Stata version 16.1 (StataCorp).

Results | We received survey consent from members of 1907 households (65.5% of 2912 sampled households), blood samples from 1386 persons (47.6% of sampled households; 72.7% of surveyed households) and swabs from 1397 persons (48.0% of sampled households; 73.3% of surveyed households), and results from 1197 blood samples and 1341 swabs. The primary reasons for missing results were insufficient blood and bad viral transport medium. Persons aged 40 to 59 years were overrepresented among participants contributing specimens relative to the census (**Table**).

The adjusted proportion of positive IgG test results ranged from 22.8% to 53.1% across rural and 30.9% to

Table. Sex and Age Distribution of Sample That Contributed Biosamples Compared With the Source of the Sampling Frame and Census Data

	No. (%)[a]		
	COVID-19 study sample[b]	CPHS panel in Karnataka[c]	Census projection, 2021[d]
Sex			
Female	721 (51.2)	12 908 (46.9)	32 954 (49.3)
Male	687 (48.8)	14 615 (53.1)	33 889 (50.7)
Age, y			
12-24 or 15-24	192 (13.6)	6269 (22.8)	14 171 (21.2)
25-39	363 (25.8)	7204 (26.2)	22 192 (33.2)
40-59	742 (52.7)	12 620 (45.9)	20 654 (30.9)
≥60	111 (7.9)	1430 (5.2)	9826 (14.7)

Abbreviations: COVID-19, coronavirus disease 2019; CPHS, Consumer Pyramids Household Survey.

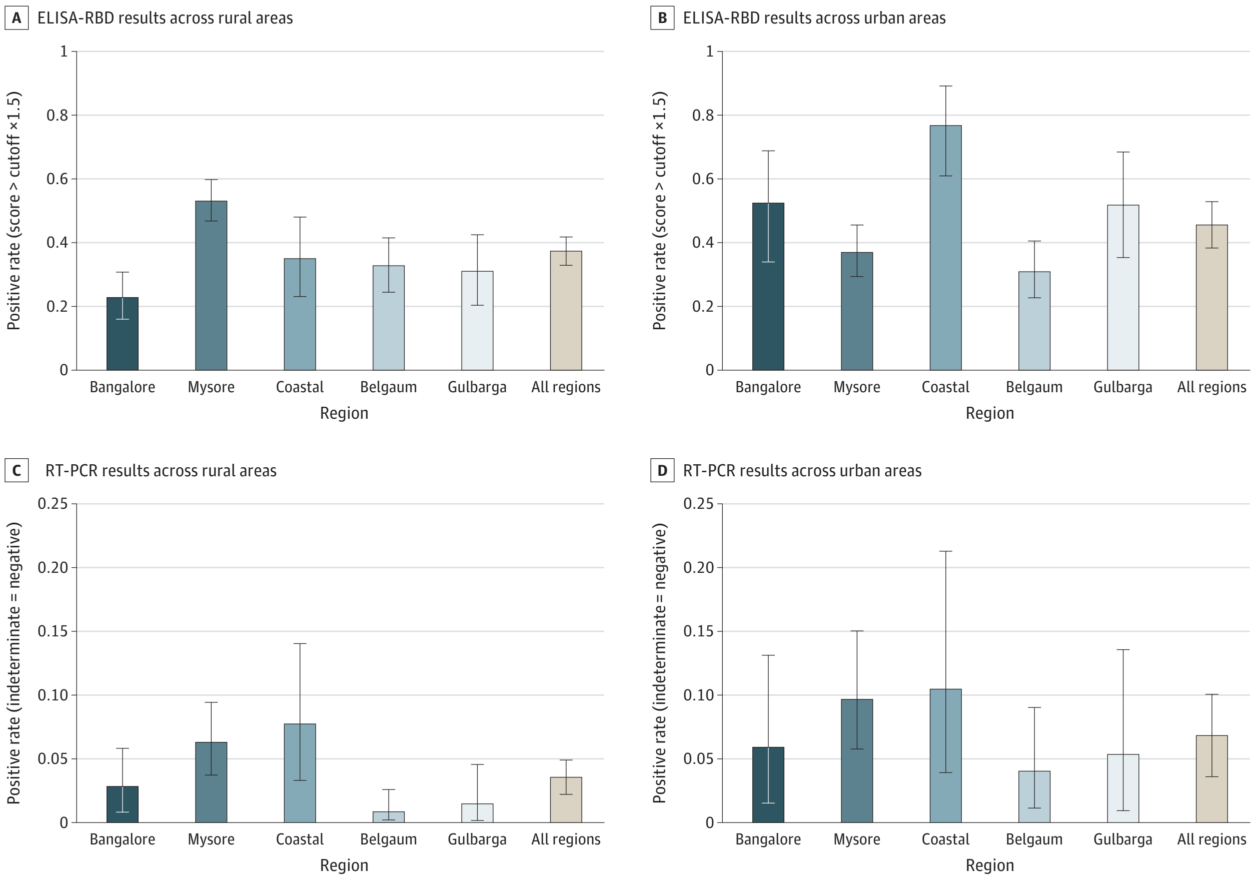
[a] Each column sums to 100%.

[b] The COVID-19 study sample includes individuals who consented to providing biosamples. Observations are weighted to be state population representative in the same manner as in calculations of adjusted proportions of positive test results; the lowest age category includes everyone aged 12 to 24 years.

[c] The CPHS panel in Karnataka is drawn from the September-December 2019 round. Observations are weighted to be state population representative; the lowest age category includes individuals aged 15 to 24 years.

[d] The last census in India was in 2011; therefore, we use the 2021 projection produced by the Census Department. The census projection for 2021 is unweighted; the youngest age category includes those aged 15 to 29 years because the census provides only 5-year age bins.

Figure. Adjusted Proportion of Positive Test Results on Enzyme-Linked Immunosorbent Assay–Receptor Binding Domain (ELISA-RBD) and Reverse Transcriptase–Polymerase Chain Reaction (RT-PCR), by Region and Urban Status



The figure plots the mean (bar) and 95% CI (whisker) for the fraction of ELISA-RBD tests (A and B) and RT-PCR tests (C and D) that yielded positive results (y-axis) at each location, defined as the urban or rural portion of the labeled region. Test results for rural and urban locations are shown on separate plots.

76.8% across urban areas (**Figure**). Overall rural-, urban-, and statewide-adjusted proportions were 37.4% (95% CI, 32.9%-41.8%), 45.6% (95% CI, 38.1%-53.1%), and 39.6% (95% CI, 35.7%-43.4%), respectively.

Rural, urban, and statewide seroprevalences adjusted for test sensitivity were 44.1% (95% CI, 40.0%-48.2%), 53.8% (95% CI, 48.4%-59.2%), and 46.7% (95% CI, 43.3%-50.0%), respectively.

The adjusted proportion of positive polymerase chain reaction test results ranged from 1.5% to 7.7% across rural areas and 4.0% to 10.5% across urban areas (Figure). Overall rural-, urban-, and statewide-adjusted proportions were 3.6% (95% CI, 2.2%-4.9%), 6.8% (95% CI, 3.5%-10.1%), and 4.3% (95% CI, 3.1%-5.7%), respectively.

Discussion | The adjusted seroprevalence of SARS-CoV-2 across Karnataka was 46.7%, suggesting approximately 31.5 million residents were infected, far greater than the 327 076 cases reported by August 29, 2020.[5] This discrepancy may be due to low testing rates (approximately 4000 per 1 million population)[5] and a large proportion of infections in Karnataka being asymptomatic.[6]

The main study limitation is that testing volunteers may produce selection bias because volunteers may not be representative of the population. Because asymptomatic people may not know their disease status, their status may not influence participation. Moreover, fear of quarantine may discourage participation, while free testing to determine immunity may encourage participation.

The findings have implications for infection containment measures.

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Association Between Changes in Social Distancing Policies in Ohio and Traffic Volume and Injuries, January Through July 2020

To minimize transmission of coronavirus disease 2019 (COVID-19), most US states in spring 2020 passed policies promoting social distancing through stay-at-home orders prohibiting nonessential travel.[1] While vehicle miles traveled in the US decreased by 41% in April 2020 compared with 2019,[2] the effect of this mobility decrease on motor vehicle crashes (MVCs) is poorly understood. We estimated associations between COVID-19–related social distancing policies, traffic volume, and MVC-related outcomes in Ohio.

Methods | Our observational study compared MVCs and traffic volume data from two 7-month periods: January 1, 2020, through July 31, 2020, and January 1, 2019, through August 1, 2019 (accounting for the leap-year day in 2020). Motor vehicle crash data were obtained from the Ohio Department of Public Safety's Electronic Crash Submission database.[3] Traffic volume data were obtained from the Ohio Department of Transportation through permanent count stations positioned on interstate, state, and US routes.[4]

Three state-level policies demarked 4 study periods in 2020: period 1, January 1 through March 8; period 2, March 9 (state-of-emergency declaration) through March 22; period 3, March 23 (stay-at-home order) through May 11; and period 4, May 12 (retail reopening) through July 31. Mean daily counts were calculated and compared across periods for 3 types of crash-related outcomes: (1) number of people (motor vehicle drivers and passengers, pedestrians, motorcyclists, and bicyclists) involved in MVCs (MVC involvements), (2) number of people having any injuries in an MVC (MVC injuries), and (3) number of people having a severe or fatal injury in an MVC (MVC severe or fatal injuries), along with (4) traffic volume.

Daily interrupted time-series analyses with ordinary least-squares linear regression and Newey-West standard errors were used to estimate slope changes. All outcome variables were log transformed. Crash month, weekday or weekend occurrence, gasoline price, and unemployment rate were included in the analysis to control for seasonality and confounding. Statistical significance was defined as a 95% CI that excluded 0. As this study used publicly available, deidentified secondary data reported on an aggregated level, it did not undergo institutional review board review per institutional guidelines.

Results | From January 1 through July 31, 2020, MVCs were experienced by 284 128 individuals, with 27 809 having some level of injury and 3719 having severe injuries; there were 621 fatalities. These numbers were compared with MVCs during the 2019 study period, in which 382 098 individuals were involved in MVCs, 33 365 had some level of injury, 4243 had severe injuries, and there were 619 fatalities. When separated by period during 2020, all outcomes substantially declined during period 2 and reached their lowest levels directly following the stay-at-home order before gradually increasing through periods 3 and 4 (**Figure**).

Comparing slopes across periods, period 2 saw significantly larger daily changes than any other period of 2020 across all outcomes: for MVC involvements, −7.08% (95% CI, −8.31% to −5.82%); for MVC-related injuries, −5.08% (95% CI, −6.48% to −3.65%); for MVC-related severe or fatal injuries, −5.61% (95% CI, −8.19% to −2.95%); and for traffic volume, −4.07% (95% CI, −5.14% to −2.99%) (**Table**).

Relative to the same 2019 period, period 3 showed the largest difference: a −55% (95% CI, −62% to −49%) change in MVC