District level correlates of COVID-19 pandemic in India during March-October 2020

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Introduction

India is having the highest number of overall Covid cases and covid deaths in absolute terms globally. The rate of spread of the disease was slowed down because of the early nationwide lockdown, and targeted efforts by the union and state governments on quarantine facilities and travel protocols. India has recorded over 50,000 cases every day from August 2020. Like any other health and demographic indicator, COVID-19 infection varies widely among the different states of the country. Therefore, our prime objective was to find the empirical relationship patterns between the district's socioeconomic and household infrastructural characteristics and the COVID-19 infection ratio.

Data

We used crowdsourced district-level data on COVID-19 available in the public domain from March 14, 2020, to October 31, 2020, accessed from the COVID-19 India dashboard. The time-series data on COVID-19 was available in the COVID-19 India from March 14, 2020.

For explanatory variables, we used data from the National Family Health Survey of India 2015-16 (NFHS-4). We identified hotspot and cold spot districts for COVID-19 cases and infection ratio. For all the 640 districts in the thirty-five states and eight union territories of India, we defined the outcome variable, COVID-19 Infection Ratio.
Other demographic variables considered are: percentage of population aged60 and above, percentage of population in age group 15-59, percentage of marginal worker, population density, ii) Socioeconomic variables: percentage of the literate population, percentage of Scheduled Castes (SC) population, percentage of Scheduled Tribes (ST) population, percentage of Hindu population, percentage of urban population, average number of persons that sleep in one room; iii) Household Infrastructure variables: percentage of households with availability of soap, percentage of households with water and toilet facility within the premise; iv) Health-related variables: percentage of women with Diabetes (Glucose>140mg),percentage

of women (among age18+) with Cancer, percentage of 18+aged women consuming tobacco, testing ratio per one hundred thousand population, under-five mortality rate, percentage of institutional births, percentage of full immunization among children aged 23-36 months, percentage of women aged 18 and above reporting anemia and, percentage of children with stunting and wasting. We have also carried out two sets of regression analysis to highlight the district level demographic, socioeconomic, household infrastructure facilities, and health-related correlates of the COVID-19 infection ratio.

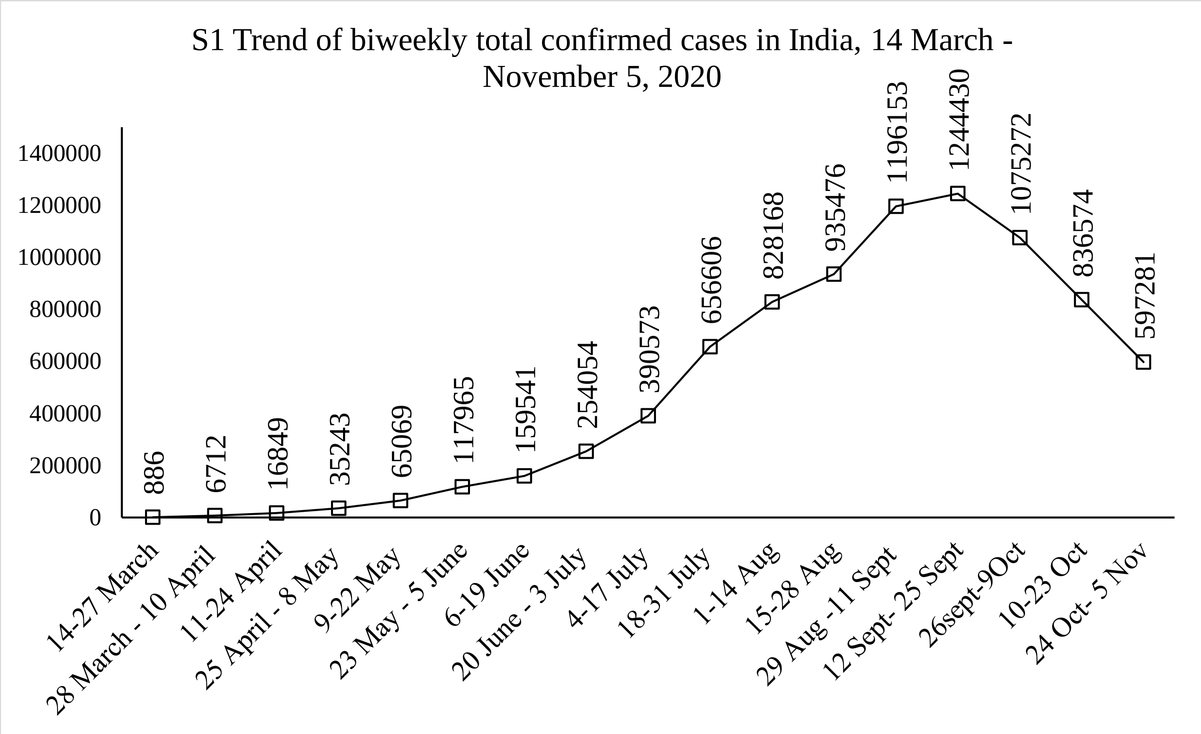
Results

The results showed on October 31, 2020, the IR in India was 42.85 per hundred thousand population, with the highest in Kerala (259.63) and lowest in Bihar (6.58). About 80 percent infected cases and 61 percent deaths were observed in nine states (Delhi, Gujarat, West Bengal, Uttar Pradesh, Andhra Pradesh, Maharashtra, Karnataka, Tamil Nadu, and Telangana). Moran's- I showed a positive yet poor spatial clustering in the COVID-19 IR over neighboring districts. Our regression analysis demonstrated that percent of 15-59 aged population, district population density, percent of the urban population, district-level testing ratio, and percent of stunted children were significantly and positively associated with the COVID-19 infection ratio. The regression analysis of infection ratio (presented in Table 2) displays both unadjusted and adjusted coefficients of the exploratory variables for two time periods. Districts with higher levels of household infrastructure facilities (such as soap or toilet facility) reported higher levels of IRs. Among the health-related variables, percentage of women with diabetes (glucose > 140), testing ratio, institutional births, percentage of children immunized were significantly positively correlated with IR in October in the unadjusted model.

Conclusion and Discussion

The COVID-19 infection ratio was found to be more rampant in districts with a higher working-age population, higher population density, a higher urban population, a higher testing ratio, and a higher level of stunted children. More tests are required to classify patients with asymptomatic conditions. India has a population of over 1.3 billion, but till October 31, approximately 1087.9 million (only 8.04percent) tests have been carried out. As of April 1, 2021, India has 552,566 active infection cases while 11,434,301 patients have recovered and 162,468 have succumbed to COVID-19.

Appendix S1 Fig Trend of bi weekly total confirmed cases in India, 14 March – November 5, 2020



Source: Author’s calculations

Table 2. Regression analysis of district correlates and Infection ratio (IR) across 640 districts of India[1]

	31-Jul-20						31-Oct-20					
Models	**Unadjusted model (1)**			**Adjusted model (2)**			**Unadjusted model (3)**			**Adjusted model (4)**		
	β-Coeff.	**p-value**	**95% CI**	**β-Coeff.**	**p-value**	**95% CI**	**β-Coeff.**	**p-value**	**95% CI**	**β-Coeff.**	**p-value**	**95% CI**
Demographic variables												
Percent of 15-59 aged population	21.29	0.000	(15.31,27.27)	16.91	0.000	(5.27,28.55)	90.38	0.000	(72.51,108.25)	75.73	0.000	(39.71,111.74)
percent of 60 years and above population	-1.42	0.840	(-15.58,12.74)	-6	0.570	(-26.93,14.93)	39.12	0.080	(-4.28,82.52)	39.6	0.220	(-23.85,103.04)
Percent of marginal workers	-13.08	0.000	(-18.15,-8.01)	3.13	0.350	(-3.44,9.69)	-41.54	0.000	(-57.16,-25.93)	15.7	0.130	(-4.67,36.07)
Population density	0.06	0.000	(0.06,0.07)	0.05	0.000	(0.04,0.06)	0.18	0.000	(0.15,0.2)	0.12	0.000	(0.09,0.15)
Socio-economic variables												
Percent of literate population	7.15	0.000	(4.44,9.85)	-0.54	0.830	(-5.46,4.38)	29.39	0.000	(21.17,37.61)	-12.84	0.090	(-27.86,2.18)
Percent of SC population	0.43	0.790	(-2.76,3.62)	2.93	0.130	(-0.9,6.77)	-4.13	0.410	(-13.96,5.7)	3.33	0.590	(-8.67,15.34)
Percent of ST population	-1.22	0.030	(-2.29,-0.14)	-0.27	0.750	(-1.98,1.44)	-2.53	0.140	(-5.86,0.8)	2.98	0.270	(-2.34,8.31)
Percent of Hindu population	-0.09	0.870	(-1.18,1)	-0.24	0.760	(-1.81,1.32)	-0.12	0.940	(-3.49,3.24)	3.05	0.220	(-1.8,7.89)
Percent of Urban population	7.27	0.000	(6.01,8.53)	2.45	0.020	(0.39,4.51)	24.63	0.000	(20.79,28.48)	12.71	0.000	(6.37,19.04)
Average number of persons sleeping in a room	-28.21	0.300	(-81.04,24.62)	10.95	0.780	(-66.95,88.85)	-341.62	0.000	(-502.28,-180.96)	-86.52	0.480	(-327,153.95)
Household infrastructure variables												
Percent of households with soap availability	3.5	0.000	(2.04,4.96)	0.38	0.740	(-1.84,2.59)	11.72	0.000	(7.24,16.2)	4.01	0.250	(-2.76,10.78)
Percent of households with water availability within the premise	-0.17	0.750	(-1.27,0.92)	-0.28	0.640	(-1.46,0.9)	0.11	0.950	(-3.27,3.48)	2.09	0.260	(-1.52,5.7)
Percent of households with Toilet facility within the premise	2.41	0.000	(1.38,3.45)	-0.14	0.900	(-2.31,2.04)	9.61	0.000	(6.47,12.75)	-2.33	0.490	(-9.01,4.35)
Health-related variables												
Percent of women with Diabetes (Glucose>140mg)	21.05	0.000	(8.06,34.05)	0.41	0.950	(-13.2,14.03)	89.86	0.000	(49.94,129.78)	-5.6	0.800	(-47.94,36.74)
Percent of women (among age18+) who reported having Cancer Disease	25.6	0.440	(-39.49,90.68)	29.19	0.300	(-26.53,84.9)	28.47	0.780	(-171.57,228.51)	39.5	0.650	(-130.98,209.98)
Percent of 18+aged women consuming Tobacco	-2.68	0.020	(-4.87,-0.49)	0.24	0.860	(-2.36,2.84)	-8.54	0.020	(-15.39,-1.68)	1.9	0.650	(-6.31,10.1)
Testing ratio per 100000	0.03	0.000	(0.02,0.04)	0.03	0.000	(0.01,0.04)	0.04	0.000	(0.02,0.05)	0.03	0.000	(0.02,0.04)
Under-5 mortality rate	-2.59	0.000	(-3.84, -1.33)	-0.99	0.210	(-2.54,0.55)	-12.59	0.000	(-16.37,-8.82)	-3.7	0.130	(-8.44,1.05)
Percent of institutional births	2.94	0.000	(1.28,4.6)	-0.72	0.570	(-3.24,1.79)	13.36	0.000	(8.29,18.43)	-4.12	0.290	(-11.79,3.56)
Percent of full immunization among children aged 23-36 months	0.81	0.340	(-0.86,2.48)	-1.27	0.170	(-3.07,0.53)	8.32	0.000	(3.22,13.42)	-0.62	0.830	(-6.16,4.92)
Percent of women reporting anemia among women aged18+	0.39	0.750	(-1.98,2.77)	0.18	0.890	(-2.29,2.64)	-2.55	0.490	(-9.85,4.75)	-3.01	0.430	(-10.56,4.55)
Percent of children with stunting	-4.58	0.000	(-7.49,-1.67)	4.46	0.050	(-0.04,8.96)	-25.28	0.000	(-34.11,-16.46)	12.12	0.080	(-1.62,25.86)
Percent of children with wasting	-1.17	0.550	(-4.97,2.63)	1.88	0.380	(-2.31,6.06)	-5.74	0.340	(-17.43,5.96)	4.29	0.510	(-8.53,17.12)

[1] All variables are computed at the district level