Supplementary Materials

1. Variables and Data Source

Table S1. Variables and data source

Variable	**Variable detail**	Time Frame	Original data source
Basic			
Total Confirmed Cases	The cumulative number of COVID-19 cases	21 January 2020 – 31 December 2020	Johns Hopkins University Center for Systems Science and Engineering data repository. https://coronavirus.jhu.edu/map.html
Total population	Population estimate	2018	2014-2018 American Community Survey. https://svi.cdc.gov/data-and-tools-download.html
State area	Tract area in square miles.	2018	United States (US) Census Cartographic Boundary File - U.S. Tracts 2018 at 1:500,000 resolution. https://svi.cdc.gov/data-and-tools-download.html
County-Level			
Infection rate(I)	Cumulative number of confirmed cases per 10,000 people	21 January 2020 – 31 December 2020	
Overall Social Vulnerability Index (SVI)	Social Vulnerability Index	2018	Centers for Disease Control and Prevention https://svi.cdc.gov/data-and-tools-download.html
Socioeconomic status index(SVI1)	Sub-domain index of Social Vulnerability Index	2018	Centers for Disease Control and Prevention https://svi.cdc.gov/data-and-tools-download.html
Household	Sub-domain index of Social	2018	Centers for Disease Control and Prevention

characteristics and disability index (SVI2)	Vulnerability Index		https://svi.cdc.gov/data-and-tools-download.html
Minority status and language index (SVI3)	Sub-domain index of Social Vulnerability Index	2018	Centers for Disease Control and Prevention https://svi.cdc.gov/data-and-tools-download.html
Housing type and transportation index (SVI4)	Sub-domain index of Social Vulnerability Index	2018	Centers for Disease Control and Prevention https://svi.cdc.gov/data-and-tools-download.html
State-Level			
School closure policy index (C1)	Record closings of schools and universities	1 March 2020–31 December 2020	Oxford Covid-19 Government Response Tracker https://github.com/OxCGRT/covid-policy-tracker
Workplace closure policy index(C2)	Record closings of workplaces	1 March 2020–31 December 2020	Oxford Covid-19 Government Response Tracker https://github.com/OxCGRT/covid-policy-tracker
Public transport closure index(C3)	Record closing of public transport	1 March 2020–31 December 2020	Oxford Covid-19 Government Response Tracker https://github.com/OxCGRT/covid-policy-tracker
Restrictions on internal movement policy index(C4)	Record restrictions on internal movement between cities/regions	1 March 2020–31 December 2020	Oxford Covid-19 Government Response Tracker https://github.com/OxCGRT/covid-policy-tracker

2. HLM and Full Results

Level-1 Model

I_{ij} /$M_{ij} = \beta 0j + \beta 1j*(SVI1ij) + \beta 2j*(SVI2ij) + \beta 3j*(SVI3ij) + \beta 4j*(SVI4ij) + rij$

Level-2 Model

$\beta 0j = \gamma 00 + \gamma 01*(C1j) + \gamma 02*(C2j) + \gamma 03*(C3j) + \gamma 04*(C4j) + u0j$
$\beta 1j = \gamma 10 + \gamma 11*(C1j) + \gamma 12*(C2j) + \gamma 13*(C3j) + \gamma 14*(C4j) + u1j$
$\beta 2j = \gamma 20 + \gamma 21*(C1j) + \gamma 22*(C2j) + \gamma 23*(C3j) + \gamma 24*(C4j) + u2j$
$\beta 3j = \gamma 30 + \gamma 31*(C1j) + \gamma 32*(C2j) + \gamma 33*(C3j) + \gamma 34*(C4j) + u3j$
$\beta 4j = \gamma 40 + \gamma 41*(C1j) + \gamma 42*(C2j) + \gamma 43*(C3j) + \gamma 44*(C4j) + u4j$

Mixed Model

$Iij = \gamma 00+ \gamma 01*C1j+ \gamma 02*C2j+ \gamma 03*C3j+ \gamma 04*C4j+ \gamma 10*SVI1ij+ \gamma 11*C1j*SVI1ij+ \gamma 12*C2j*SVI1ij+ \gamma 13*C3j*SVI1ij+ \gamma 14*C4j*SVI1ij+ \gamma 20*SVI2ij+ \gamma 21*C1j*SVI2ij+ \gamma 22*C2j*SVI2ij+ \gamma 23*C3j*SVI2ij+ \gamma 24*C4j*SVI2ij+ \gamma 30*SVI3ij+ \gamma 31*C1j*SVI3ij+ \gamma 32*C2j*SVI3ij+ \gamma 33*C3j*SVI3ij+ \gamma 34*C4j*SVI3ij+ \gamma 40*SVI4ij+ \gamma 41*C1j*SVI4ij+ \gamma 42*C2j*SVI4ij+ \gamma 43*C3j*SVI4ij+ \gamma 44*C4j*SVI4ij + u0j + u1j*SVI1ij + u2j*SVI2ij + u3j*SVI3ij + u4j*SVI4ij+ rij$

The abbreviations of all variables are referred to in Table 1.

Table S2. Final estimation of fixed effects for COVID-19 infection rate

Fixed Effect	Coefficient	Standard error	*t*-ratio	Approx. *d.f.*	*p*-value
For INTRCPT1, $\beta 0$					
INTRCPT2, $\gamma 00$	-0.8757	0.104715	-8.362698754	46	<0.001
C1, $\gamma 01$	-0.296268	0.076103	-3.892987136	46	<0.001
C2, $\gamma 02$	-0.701596	0.111095	-6.315279716	46	<0.001
C3, $\gamma 03$	-0.226485	0.110359	-2.052256726	46	0.023
C4, $\gamma 04$	-0.664316	0.112879	-5.885204511	46	<0.001
For SVI1 slope, $\beta 1$					
INTRCPT2, $\gamma 10$	1.716044	0.156417	10.97095584	46	<0.001
C1, $\gamma 11$	0.008166	0.164279	0.049708119	46	0.287
C2, $\gamma 12$	0.915024	0.197581	4.63113356	46	<0.001
C3, $\gamma 13$	-0.103452	0.137526	-0.752235941	46	0.081
C4, $\gamma 14$	-0.680492	0.149777	-4.543367807	46	<0.001
For SVI2 slope, $\beta 2$					
INTRCPT2, $\gamma 20$	-0.60522	0.095264	-6.353081962	46	<0.001
C1, $\gamma 21$	0.132807	0.097779	1.358236431	46	0.053
C2, $\gamma 22$	-0.297438	0.135259	-2.199025573	46	0.008

C3, *γ23*	-0.251744	0.078439	-3.209423884	46	<0.001
C4, *γ24*	0.26968	0.088039	3.063187905	46	<0.001
For SVI3 slope, *β3*					
INTRCPT2, *γ30*	3.162272	0.124247	25.45149581	46	<0.001
C1, *γ31*	0.194877	0.123614	1.57649619	46	0.052
C2, *γ32*	-0.091188	0.123587	-0.737844595	46	0.087
C3, *γ33*	-0.168267	0.115242	-1.460118707	46	0.059
C4, *γ34*	0.40756	0.16138	2.52546784	46	<0.001
For SVI4 slope, *β4*					
INTRCPT2, *γ40*	1.4475	0.082305	17.58702387	46	<0.001
C1, *γ41*	-0.618696	0.108987	-5.67678714	46	<0.001
C2, *γ42*	0.488716	0.10917	4.476651095	46	<0.001
C3, *γ43*	-0.132444	0.070898	-1.868092189	46	0.053
C4, *γ44*	-0.049917	0.096406	-0.517778976	46	0.086

Where *p*-value is the significance of influence,*Coefficient* is the regression coefficient of influence.On the premise of significant p-value results, the greater the regression coefficient, the greater the degree of influence.In Table 2, for example,for SVI1 slope, INTRCPT2 represents the influence of SVI1 on the COVID-19 infection rate.A significant correlation is shown by a p value<0.001. Its regression coefficient value is 19.137. Among the four state-level variables, C2 and C4 had p-values< 0.001, indicating that state-level C2 and C4 had a significant moderation impact on the relationship between SVI1 and COVID-19 infection rate. The regression coefficients are 0.915 and -0.68, showing that C2 has a little greater influence than C4. The interpretation of other results is consistent with the above.