

Social inequality and the syndemic of chronic disease and COVID-19: county-level analysis in the United States

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Supplementary Material

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Table S1: Characteristics of 3141 US counties, by quintiles of Social Vulnerability Index

County-level characteristics	Social vulnerability index				
	1 st quintile (least vulnerable)	2 nd quintile	3 rd quintile	4 th quintile	5 th quintile (most vulnerable)
Counties, n	629	628	628	628	628
Median (IQR) population (thousands)	16.9 (5.5-57.4)	31.2 (11.1-87.9)	31.0 (13.2-85.1)	29.9 (14.2-76.0)	23.7 (12.3-49.4)
Mean (SD) of % 65-years and above	20.6 (4.8)	19.9 (5.3)	19.4 (4.8)	18.7 (4.1)	17.7 (3.9)
Mean (SD) of % female	49.8 (1.2)	50.0 (1.6)	49.9 (2.3)	50.0 (2.5)	49.7 (3.2)
Mean (SD) of % in poverty	9.2 (2.8)	12.3 (3.1)	14.9 (3.7)	18.0 (4.0)	23.6 (6.3)
Mean (SD) of % unemployed	3.3 (1.5)	4.6 (1.6)	5.6 (1.8)	6.6 (2.3)	8.7 (3.4)
Mean (SD) of % uninsured	6.6 (3.0)	8.3 (3.8)	10.0 (4.7)	11.3 (4.4)	14.3 (5.6)
Mean (SD) of % ethnic minority	9.7 (7.8)	15.0 (11.9)	20.2 (15.6)	26.0 (18.2)	46.6 (21.0)
Median (IQR) per capita income (USD in thousands)	32.0 (28.9-35.1)	28.4 (26.3-31.3)	26.1 (23.9-28.9)	23.9 (21.8-26.3)	21.0 (18.8-23.2)

IQR= interquartile range. One county excluded from analyses due to missing social vulnerability index score. Social Vulnerability Index defined by the US Centers for Disease Control and Prevention (US CDC) with data from the 2018 American Community Survey.¹⁵

Table S2: Sensitivity analyses: association between Social Vulnerability Index and COVID-19 cases and deaths in 3141 United States counties as of 10 August 2020

	Social vulnerability index				
	1st quintile	2nd quintile	3rd quintile	4th quintile	5th quintile
	(least vulnerable)				(most vulnerable)
COVID-19 cases					
Adjusted rate ratio (95% CI), using Poisson regression models* with additional adjustment for proportion of county population aged 65 years and older	1.0 (<i>Ref.</i>)	1.25 (1.17-1.33)	1.40 (1.31-1.49)	1.66 (1.56-1.76)	2.01 (1.88-2.14)
Adjusted rate ratio (95% CI), using Negative Binomial regression models	1.0 (<i>Ref.</i>)	1.24 (1.14-1.35)	1.46 (1.34-1.60)	1.79 (1.63-1.96)	2.60 (2.36-2.87)
COVID-19 deaths					
Adjusted rate ratio (95% CI), using Poisson regression models* with additional adjustment for proportion of county population aged 65 years and older	1.0 (<i>Ref.</i>)	1.19 (1.09-1.30)	1.20 (1.10-1.32)	1.67 (1.54-1.82)	2.26 (2.06-2.47)
Adjusted rate ratio (95% CI), using Negative Binomial regression models	1.0 (<i>Ref.</i>)	1.33 (1.14-1.53)	1.43 (1.23-1.67)	1.81 (1.55-2.12)	2.76 (2.33-3.25)

Data: US Centres of Disease Control and Prevention (CDC) and USAFacts.*Models were adjusted for US States as a fixed-effect to adjust for State-level confounding factors in the Poisson regression models using the log of the population as an offset term, and a scale parameter, set as the Pearson χ^2 statistic divided by the residual degrees of freedom, to address the issue of potential overdispersion.

Table S3: County-level adult prevalence of major chronic conditions in 3141 US counties

	Social vulnerability index				
	1st quintile (least vulnerable)	2 nd quintile	3 rd quintile	4 th quintile	5 th quintile (most vulnerable)
Obesity					
Mean (SD) of county-level prevalence	32.6 (4.3)	33.5 (4.0)	34.4 (3.9)	36.2 (3.7)	38.5 (4.0)
Adjusted prevalence ratio	1.00 (<i>Ref.</i>)	1.03 (1.02-1.05)	1.08 (1.06-1.10)	1.15 (1.13-1.16)	1.24 (1.22-1.26)
Diabetes					
Mean (SD) of county-level prevalence	10.9 (1.6)	11.8 (2.0)	12.8 (2.1)	14.0 (2.1)	15.9 (2.5)
Adjusted prevalence ratio	1.00 (<i>Ref.</i>)	1.07 (1.05-1.09)	1.14 (1.12-1.16)	1.25 (1.23-1.27)	1.41 (1.39-1.43)
Chronic obstructive pulmonary disease					
Mean (SD) of county-level prevalence	7.4 (1.5)	8.4 (2.0)	9.2 (2.2)	10.1 (2.4)	10.3 (2.2)
Adjusted prevalence ratio	1.00 (<i>Ref.</i>)	1.07 (1.04-1.09)	1.14 (1.12-1.17)	1.20 (1.17-1.23)	1.32 (1.28-1.35)
Heart disease					
Mean (SD) of county-level prevalence	7.7 (1.4)	8.1 (1.7)	8.6 (1.7)	9.1 (1.7)	9.5 (1.6)
Adjusted prevalence ratio	1.00 (<i>Ref.</i>)	1.05 (1.02-1.07)	1.10 (1.08-1.13)	1.13 (1.10-1.15)	1.25 (1.22-1.28)
Chronic Kidney disease					
Mean (SD) of county-level prevalence	3.1 (0.4)	3.2 (0.5)	3.4 (0.5)	3.6 (0.5)	4.0 (0.5)
Adjusted prevalence ratio	1.00 (<i>Ref.</i>)	1.05 (1.04-1.07)	1.12 (1.10-1.13)	1.18 (1.17-1.20)	1.32 (1.30-1.35)

Prevalence estimates are among adults aged ≥ 18 years. Prevalence ratios adjusted for US States as a fixed-effect to adjust for State-level confounding factors in the Poisson regression models using the log of the population as an offset term, and a scale parameter, set as the Pearson χ^2 statistic divided by the residual degrees of freedom, to address the issue of potential overdispersion. Data: US CDC, 2018 Behavioral Risk Factor Surveillance System (BRFSS) and the US Census population.

Table S4: Characteristics of US counties with and without the syndemic of chronic disease and severe COVID-19

County-level characteristics	Counties <u>with</u> the syndemic of chronic disease and severe COVID-19*	Counties <u>without</u> the syndemic of chronic disease and severe COVID-19†
Counties, n	603	566
Median (IQR) population (thousands)	22.9 (12.3-44.6)	18.8 (6.5-47.8)
Mean (SD) of % 65-years and above	18.8 (4.1)	19.8 (5.1)
Mean (SD) of % female	50.1 (2.8)	49.3 (2.2)
Mean (SD) of % in poverty	21.3 (6.7)	11.9 (4.7)
Mean (SD) of % unemployed	7.6 (3.1)	4.2 (2.2)
Mean (SD) of % uninsured	13.1 (5.3)	8.2 (4.2)
Mean (SD) of % ethnic minority	38.4 (22.6)	14.5 (13.2)
Median (IQR) per capita income (USD in thousands)	22.2 (19.9-24.5)	29.3 (26.2-32.6)

Data: US CDC, 2018 Behavioral Risk Factor Surveillance System (BRFSS), the US Census population, and USAFacts. *Counties with both high prevalence of any chronic disease (highest two quintiles for any chronic condition listed in table S3) and high COVID mortality (highest two quintiles for COVID mortality as in Table 1). †Counties with both low prevalence of any chronic disease (lowest two quintiles for any chronic condition listed in table S3) and low COVID mortality (lowest two quintiles for COVID mortality as in Table 1).