

State-Level COVID-19 Mortality and its Association with Multiple Chronic Conditions

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16143 - Infectious Disease
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Presentation Disclosures

- 1. The following personal financial relationships with commercial interests relevant to this presentation existed during the past 12 months:**

Arundel Metrics' work on America's Health Rankings is entirely underwritten by United Health Foundation. This analysis was conducted as part of that project.

Abstract

- Asthma and Diabetes were independent predictors of COVID-19 mortality.
- Multiple chronic conditions was not an independent predictor when individual conditions were included in the model.

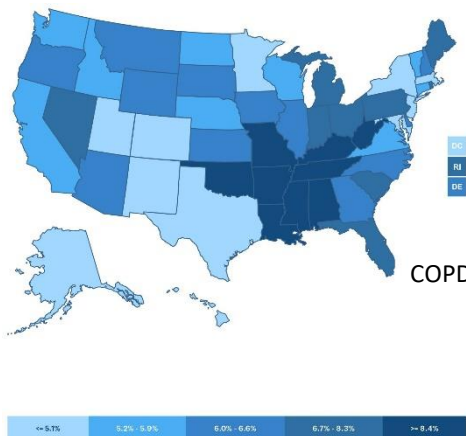
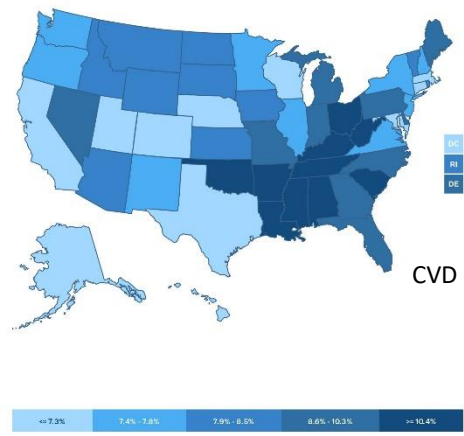
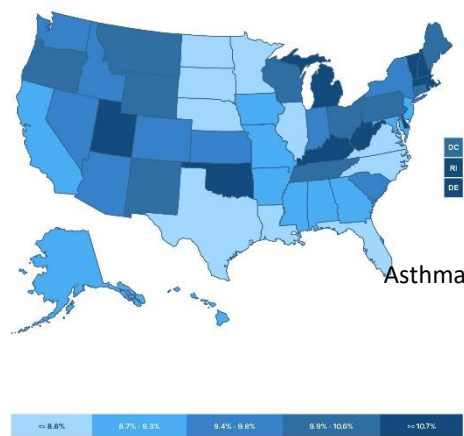
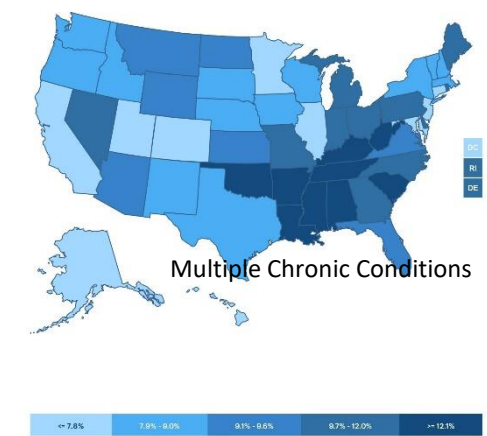
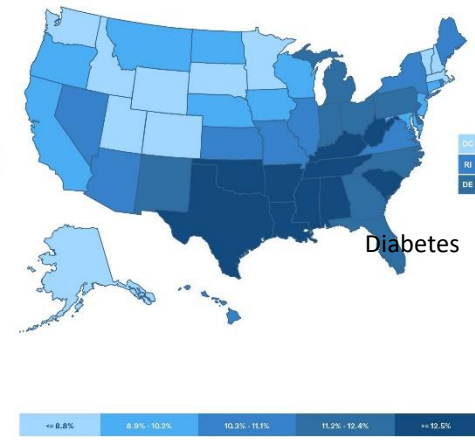
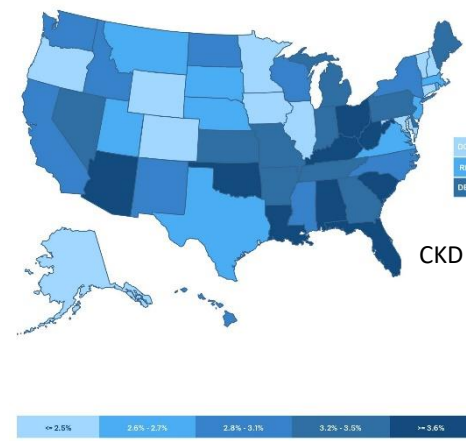
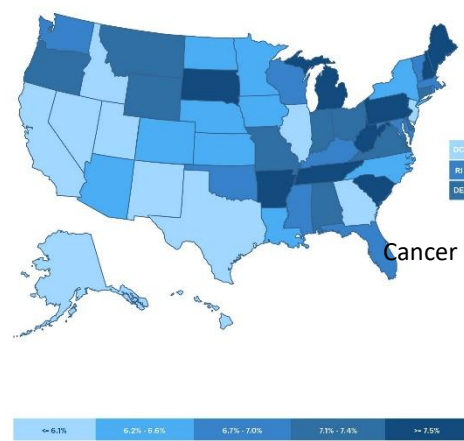
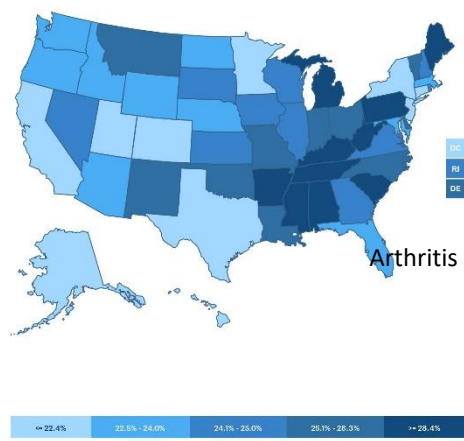
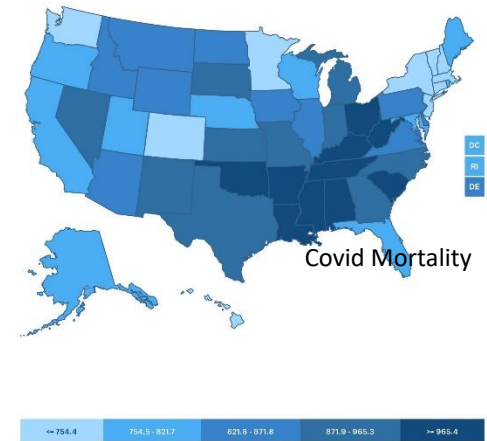
Data Sources

- Behavioral Risk Factor Surveillance System 2019 and 2020
- NCHS Vital Statistics Rapid Release Quarterly Provisional Estimates for 2020 Q2 and 2021 Q1
- U.S. Census Bureau, Population Estimates Program 2019 and 2020

Background

- The risk of COVID-19 mortality is increased by several factors
 - Chronic conditions including cancer, chronic kidney disease, chronic lung disease, diabetes, heart conditions and stroke.
 - Older age
 - Race (as a proxy for other factors)
- State-level prevalence estimates are readily available
 - Mortality: NCHS Vital Statistics Rapid Release Quarterly Provisional Estimates
 - Chronic conditions: Behavioral Risk Factor Surveillance System
 - Age and race: U.S. Census Bureau, Population Estimates Program

Maps



Overview

- The outcome was quarterly crude mortality rates by state.
- State prevalence's of chronic conditions were calculated.
- State demography characterized by single race groups and Hispanic origin.
- State proportions of adults ages 65 years and older, and children under 18 years, were calculated.
- Data was joined by state and year.
- Multiple linear regression was performed using quarterly crude mortality, chronic conditions, race/ethnicity, age, and year.

Methods

- Provisional Mortality
 - 2020 Q2 crude mortality rates were used for data year 2020
 - 2021 Q1 crude mortality rates were used for data year 2021
 - Provisional data generally contain greater than 98% of the deaths in a given time period

Methods

- BRFSS
 - 2019 BRFSS data is matched with 2020 mortality data
 - 2020 BRFSS data is matched with 2021 mortality data
 - Chronic conditions monitored by BRFSS
 - Arthritis
 - Asthma
 - Cancer (excluding skin cancer)
 - Cardiovascular disease
 - Chronic kidney disease
 - Chronic obstructive pulmonary disease
 - Diabetes
 - Multiple chronic conditions is defined as have 3 or more chronic conditions

Methods

- PEP
 - 2019 PEP data is matched with 2020 mortality data
 - 2020 PEP data is matched with 2021 mortality data
 - Proportions of a states population that is 65 and older and 18 and younger
 - Proportions of a states population estimated to be a race/ethnicity

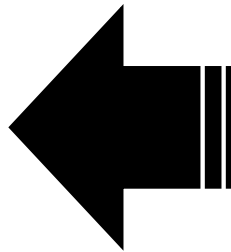
Methods

- Regression
 - Multiple linear regression performed in R 4.1.3 and RStudio 2022.02.0+443
 - Four models run
 - Model 1: COVID-19 crude mortality ~ Chronic conditions + Multiple chronic conditions + Age + Race/ethnicity + Year
 - Model 2: All-cause crude mortality ~ Chronic conditions + Multiple chronic conditions + Age + Race/ethnicity + Year
 - Model 3: COVID-19 crude mortality ~ Chronic conditions + Multiple chronic conditions + Age + Race/ethnicity
 - Model 4: COVID-19 crude mortality ~ Chronic conditions + Year
 - Primary results from Model 1

Results

Model 1: COVID-19 crude mortality ~ Chronic conditions + Multiple chronic conditions + Age + Race/ethnicity + Year

Variable	Estimate	Standard Error	p value
Asthma	32.5	11.9	0.00789
Diabetes	30.6	13.9	0.0307



Variable	Estimate	Standard Error	p-value
Year	41	22.3	0.06931
Arthritis	-8.3	8.6	0.34027
Asthma	32.5	11.9	0.00789
Cancer	12.4	21.6	0.56796
CVD	-10	22.1	0.65214
CKD	-9.6	29.9	0.75006
COPD	2.7	15.7	0.86382
Diabetes	30.6	13.9	0.0307
MCC	-3.3	25.3	0.89503
American Indian/Alaska Native	50.8	119.7	0.67222
Asian	58.3	120.2	0.62871
Black	46.5	119.6	0.69857
Hawaiian/Pacific Islander	30.1	127.2	0.81367
Hispanic	44.1	119.8	0.71408
Multiracial	17.2	119.5	0.88608
White	44.2	119.9	0.71336
65 and older	2.2	12.6	0.86029
18 and younger	-1.5	10.5	0.88609

CVD: cardiovascular disease, CKD: chronic kidney disease, COPD: chronic obstructive pulmonary disease, MCC: multiple chronic conditions (3+).

Results

- Models 1 vs. 2
 - All-cause crude mortality instead of COVID-19 mortality
 - Same relationships
 - Diabetes becomes more significant: p -value 0.006
 - Proportion of the population above the age of 65 becomes significant

Variable	Estimate	Standard Error	p -value
Year	70.1	28.8	0.01716
Arthritis	-0.9	11.2	0.93763
Asthma	38.2	15.4	0.01534
Cancer	4.3	27.9	0.87672
CVD	0.9	28.6	0.9762
CKD	-34.2	38.7	0.37859
COPD	23.5	20.4	0.25238
Diabetes	50.5	18	0.00629
MCC	-7.2	32.7	0.82544
American Indian/Alaska Native	12	154.8	0.93831
Asian	15.2	155.5	0.92243
Black	9.1	154.7	0.95338
Hawaiian/Pacific Islander	-9.9	164.6	0.9523
Hispanic	3.9	155	0.98003
Multiracial	-20.6	154.6	0.89418
White	4.5	155.1	0.97689
65 and older	27.9	16.3	0.09055
18 and younger	-4.7	13.6	0.7305

Results

- Model 1 vs. 3
 - Year removed as a predictor
 - Same relationships

Variable	Estimate	Standard Error	p-value
Arthritis	-12.2	8.5	0.1531
Asthma	31.2	12.1	0.0116
Cancer	-8.4	18.7	0.6556
CVD	-14.2	22.3	0.5254
CKD	-16.4	30.1	0.5876
COPD	-0.3	15.9	0.9838
Diabetes	28.6	14.1	0.0451
MCC	10.3	24.5	0.6744
American Indian/Alaska Native	12.9	119.6	0.9144
Asian	21.3	120.2	0.8599
Black	8.9	119.5	0.9408
Hawaiian/Pacific Islander	-19.5	126.1	0.8773
Hispanic	5.8	119.7	0.9614
Multiracial	-17.3	119.7	0.8852
White	6.4	119.9	0.9575
65 and older	12.5	11.4	0.2771
18 and younger	2.1	10.5	0.8443

Results

- Model 1 vs. 4
 - Only including individual chronic conditions as predictors
 - Same relationships
 - Asthma and diabetes are stronger predictors
 - Arthritis becomes an independent predictor

Variable	Estimate	Standard Error	p-value
Year	41.6	20	0.04039
Arthritis	-16	6.3	0.01218
Asthma	26.8	9.6	0.00657
Cancer	25.5	17.7	0.15173
CVD	-11.2	18.4	0.54409
CKD	-30.3	25.2	0.23149
COPD	4.3	15.7	0.78671
Diabetes	42.9	10.2	6.07E-05

Discussion

- Clear relationship between asthma, diabetes, and COVID-19 mortality at the state level
 - Asthma¹
 - Long history of being associated with respiratory disease
 - Different kinds and severity of asthma convolute research
 - Treatment types may affect association
 - Diabetes²
 - Disrupts the immune system
 - Associated with obesity
 - Causes other health conditions that may interact with COVID-19

Limitations

- Ecological data and conclusions
- Population at risk may not be consistent
- Survey accuracy during pandemic lockdowns

References

- 1) Adir, Yochai et al. “Asthma and COVID-19: an update.” *European respiratory review : an official journal of the European Respiratory Society* vol. 30,162 210152. 15 Dec. 2021, doi:10.1183/16000617.0152-2021
- 2) Berbudi, Afiat et al. “Type 2 Diabetes and its Impact on the Immune System.” *Current diabetes reviews* vol. 16,5 (2020): 442-449. doi:10.2174/1573399815666191024085838

Thank you for listening to this presentation.
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