COVID-19 and Social Vulnerabilities in Virginia Zip Code Tabulation Areas

Parthay Patel[1] and Bhaumik Patel[2]

[1]Henrico High School
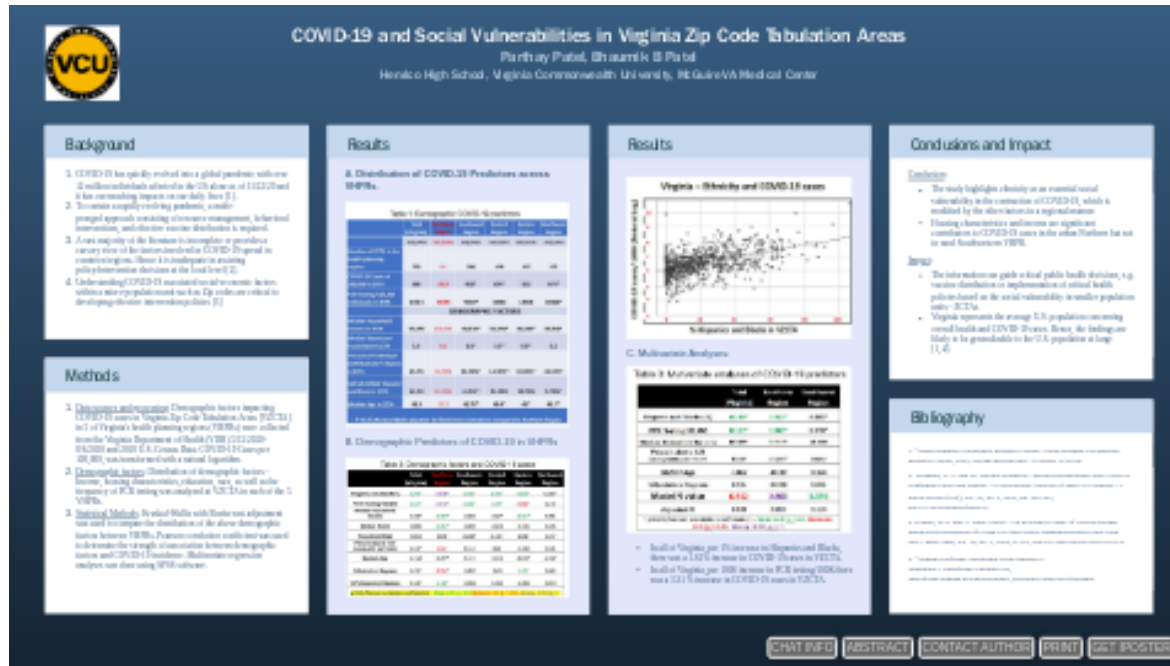[2]Virginia Commonwealth University

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Abstract

Background and Methods: The study was performed to investigate the demographic factors impacting COVID-19 cases in Virginia Zip Code Tabulation Areas [VZCTA] in 5 of the Virginia's health planning regions (VHPRs). The data was collected from the Virginia Department of Health (VDH), spanning 5/15/2020-8/6/2020 (3 months) during the state's first COVID-19 peak. Kruskal-Wallis with Bonferroni correction was used to compare the distribution of COVID-19 cases and demographic factors between the VHPRs. Pearson correlation was employed to determine correlations between COVID-19 Cases and demographic factors in VZCTA and VHPRs. Results: Incidence of COVID-19 was the highest in the suburban Northern region and the lowest in the rural-predominant southwestern region, 1017 vs. 420 per 100K population (p <0.05) (Table 1 for details). Overall state-wide and in almost all the VHPRs, the VZCTA with predominantly Hispanics and Blacks ethnicity and high PCR testing rate were strongly associated with COVID-19 incidence in the univariate analyses. Interestingly, the younger age and household crowding (> 1.5 occupants/ room) were also associated with higher COVID-19 cases state-wide and in the Northern VHPR in the univariate analyses. In the multivariate analyses, Hispanic/Black ethnicity was strongly associated with a higher COVID-19 incidence, especially in the Northern region. Considering demographic factors alone, ethnicity, median household income, and household crowding were the most important predictor of the COVID-19 incidence in Virginia ZCTA communities in multivariate analyses with a few important regional differences. The multivariate model's R-value is 0.819 in the Northern region. Conclusions: The study highlights ethnicity as an essential social vulnerability in the contraction of COVID-19, which is also modified by the other factors in a regional manner accounting for the disparity in COVID-19 incidence across VHPRs. The information can guide critical public health decisions, e.g. vaccine distribution or implementation of critical health policies based on the social vulnerability in smaller population units - ZCTAs. As Virginia represents the average U.S. population concerning overall health and COVID-19 cases, the findings are likely to be generalizable to the U.S. population at large.

Table 1: Demographic COVID-19 predictors

	Total (Virginia)	Northern Region	Southwest Region	Central Region	Eastern Region	Northwest Region
	MEDIAN	MEDIAN	MEDIAN	MEDIAN	MEDIAN	MEDIAN
Number of ZCTA in the health planning regions	759	91	200	139	157	172
COVID-19 Cases of 100,000 in ZCTA	669	1017	420*	694*	923	679*
PCR Testing/100,000 individuals in ZCTA	11341	12295	7833*	13816	14034	10466*
DEMOGRAPHIC FACTORS						
Median Household Income in ZCTA	56,972	123,791	43,910*	54,476*	56,250*	65,733*
Median Rooms per household in ZCTA	5.9	6.6	5.5*	5.9*	5.9*	6.2
Percent of Individual with Bachelor's Degree in ZCTA	14.4%	31.90%	10.40%*	13.30%*	14.60%*	15.10%*
Self-identified Hispanic and Black in ZCTA	16.2%	21.20%	4.45%*	31.90%	30.70%	9.70%*
Median Age in ZCTA	43.3	37.2	45.75*	43.4*	43*	43.7*

* P <0.05 (Kruskal-Wallis adjusted for Bonferroni correction) compared to Northern Region.
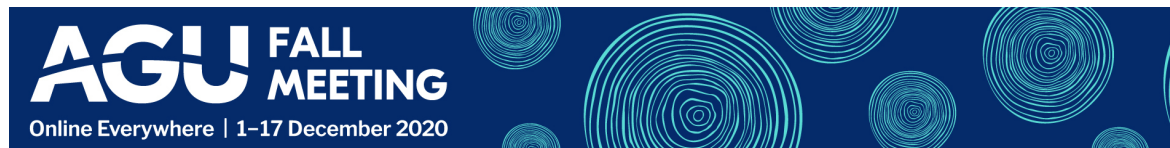
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Parthay Patel, Bhaumik B Patel

Henrico High School, Virginia Commonwealth University, McGuire VA Medical Center

PRESENTED AT:

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BACKGROUND

1. COVID-19 has quickly evolved into a global pandemic with over 12 million individuals affected in the US alone as of 11/22/20 and it has overreaching impacts on our daily lives [1].

2. To contain a rapidly evolving pandemic, a multi-pronged approach consisting of resource management, behavioral interventions, and effective vaccine distribution is required.

3. A vast majority of the literature is incomplete or provides a cursory view of the factors involved in COVID-19 spread in countries/regions. Hence it is inadequate in assisting policy/intervention decisions at the local level [2].

4. Understanding COVID-19 associated social-economic factors within a micro-population unit such as Zip codes are critical to developing effective intervention policies [3]

METHODS

1. <u>Data sources and processing</u>: Demographic factors impacting COVID-19 cases in Virginia Zip Code Tabulation Areas [VZCTA] in 5 of Virginia's health planning regions (VHPRs) were collected from the Virginia Department of Health (VDH) 5/15/2020-8/6/2020 and 2018 U.S. Census Data. COVID-19 Cases per 100,000, was transformed with a natural logarithm.

2. <u>Demographic factors</u>: Distribution of demographic factors - Income, housing characteristics, education, race, as well as the frequency of PCR testing was analyzed at VZCTA in each of the 5 VHPRs.

3. <u>Statistical Methods</u>: Kruskal-Wallis with Bonferroni adjustment was used to compare the distribution of the above demographic factors between VHPRs. Pearson correlation coefficient was used to determine the strength of association between demographic factors and COVID-19 incidence. Multivariate regression analyses was done using SPSS software.

RESULTS

A. **Distribution of COVID-19 Predictors across VHPRs**.

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* P <0.05 (Kruskal-Wallis adjusted for Bonferroni correction) compared to Northern Region.						

B. Demographic Predictors of COVID-19 in VHPRs

Table 2: Demographic factors and COVID-19 cases

	Total (Virginia)	Northern Region	Southwest Region	Central Region	Eastern Region	Northwest Region
Hispanic and Blacks%	0.492*	0.768*	0.265*	0.395*	0.463*	0.154*
PCR Testing/100,000	0.473*	0.773*	0.265*	0.38*	0.585*	0.145
Median Household Income	0.109*	-0.455*	-0.094	-0.19*	-0.331*	0.091
Median Room	0.005	-0.434*	-0.093	-0.151	-0.115	0.106
Household Size	0.052	0.049	-0.208*	-0.221*	0.008	0.077
Percent above 1.51 occupants per room	0.137*	0.56*	0.114	0.04	-0.129	0.101
Median Age	-0.194*	-0.275*	0.101	-0.122	-0.178*	-0.192*
%Bachelors Degrees	0.114*	-0.536*	-0.007	-0.03	-0.33*	0.086
%Professional Degrees	0.126*	-0.48*	-0.038	0.034	-0.099	-0.057

p<0.05, Pearson correlation coefficient (r) – Weak:0.25<|r|<0.5, Moderate: 0.5<|r|< 0.75, Strong - 0.75<|r| < 1

RESULTS

Virginia – Ethnicity and COVID-19 cases

y=6.08+0.02*x

C. Multivariate Analyses:

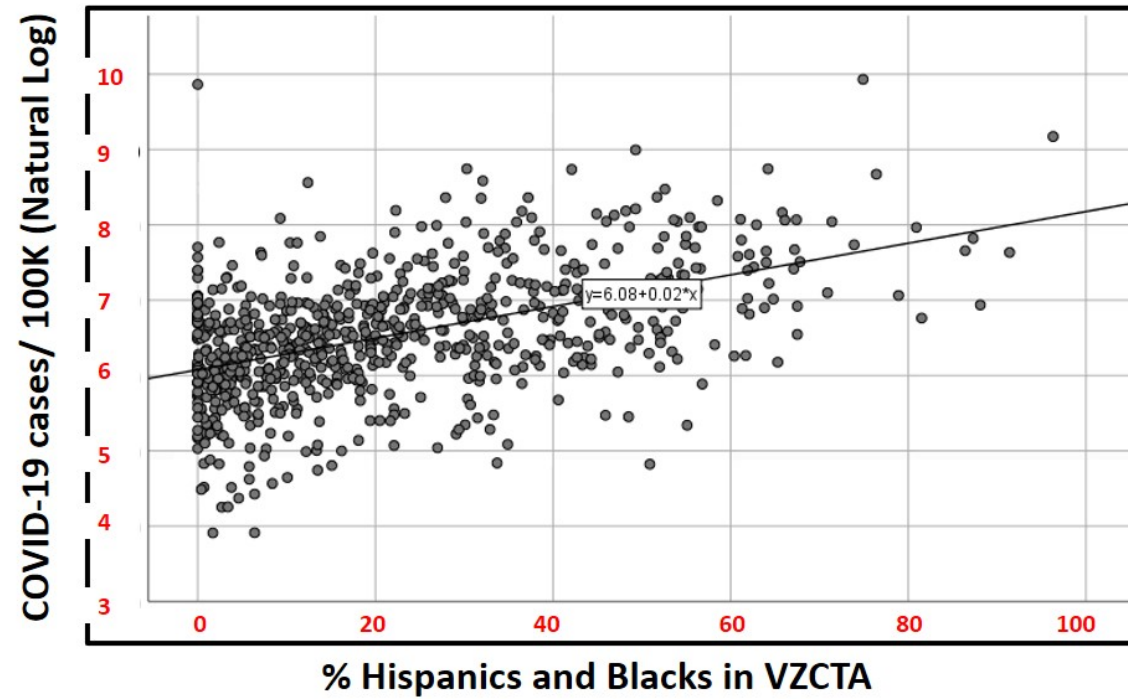## Table 3: Mutivariate analyses of COVID-19 predictors

	Total (Virginia)	Northern Region	Southwest Region
Hispanic and Blacks (%)	0.314*	0.263*	0.205*
PCR Testing/100,000	0.321*	0.380*	0.178*
Median Household Income	0.079*	0.113*	-0.070
Percent above 1.51 occupants per room	0.047	0.125*	0.027
Median Age	-0.027	-0.032	0.164
%Bachelors Degrees	0.021	-0.008	0.041
Model R value	0.612	0.903	0.376
Adjusted R²	0.369	0.802	0.114
* p<0.05, Pearson correlation coefficient (r) – Weak:0.25<⌊r⌋<0.5, Moderate: 0.5<⌊r⌋< 0.75, Strong - 0.75<⌊r⌋ < 1			

- In all of Virginia, per 1% increase in Hispanics and Blacks, there was a 1.61% increase in COVID-19 cases in VZCTA.

- In all of Virginia, per 1000 increase in PCR testing/100K there was a 3.31 % increase in COVID-19 cases in VZCTA.

CONCLUSIONS AND IMPACT

<u>Conclusion</u>:

- The study highlights ethnicity as an essential social vulnerability in the contraction of COVID-19, which is modified by the other factors in a regional manner.

- Housing characteristics and income are significant contributors to COVID-19 cases in the urban Northern but not in rural Southwestern VHPR.

<u>Impact</u>:

- The information can guide critical public health decisions, e.g. vaccine distribution or implementation of critical health policies based on the social vulnerability in smaller population units - ZCTAs.

- Virginia represents the average U.S. population concerning overall health and COVID-19 cases. Hence, the findings are likely to be generalizable to the U.S. population at large [1, *4*].

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