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RESEARCH ARTICLE

Racial/Ethnic and Geo-clustering Differentials in SARS-CoV-2 (COVID-19) Cumulative Incidence, Mortality and Temporal Trend in Delaware State, USA

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ABSTRACT

Purpose: COVID-19, a respiratory disease caused by SARS-CoV-2 indicates subpopulation differentials in cumulative incidence (CmI) and mortality. We aimed to assess the racial/ethnic and geo-clustering in COVID-19 CmI and mortality in Delaware.
Method: A cross-sectional ecologic design was used to assess COVID-19 mortality in April, May and November 2020. The binomial and poison regression models were utilized for race/ethnic and geo-clustering risk prediction, respectively.
Results: As per late April, CmI remains to be flattened in DE, with the confirmed SARS-CoV-2, n=4575 (47.5 per 10,000), Sussex county (SC), n=2,114 (111.4 per 10,000), Kent county, n=728 (41.8 per 10,000) and New Castle county, n=1,701 (28.7 per 10,000). CmI was highest for Non-Hispanic blacks (NHB), 27% (n=1250) but lowest among Asian/Pacific Islanders, n=61 (1%). The disproportionate burden of COVID-19 CmI was highest among Hispanics, 100.2 per 10,000. COVID-19 cases were more prevalent among NHB (30%) and Hispanics (19%). Mortality was higher among NHB, 1.70 per 10,000 compared to Non-Hispanic whites (NHW), 1.34 per 10,000. COVID-19 mortality differed by race, with NHB relative to NHW 27% more likely to die, risk ratio (RR)=1.27, 95%CI, 0.85-1.89. Geo-clustering indicated a significant 50% increased mortality risk in SC compared to DE, incidence rate ratio (IRR)=1.50, 95%CI, 1.11-2.03.During November, the case fatality rate (CFR) in DE was 27 per 10,000, while in the US, the CFR was 25 per 10,000.
Conclusions: The Delaware COVID-19 CmI indicates disproportionate burden on NHB and Hispanics; case clustering disproportionate burden in SC; and the risk of dying was highest among NHB.

Introduction

The SARS-CoV-2, causative pathogen in COVID-19, remains a global pandemic, suggestive of a reliable scientific control and preventive measures response in flattening the epidemic curve and mitigating case fatality[1-4]. The utilization of what is scientifically understood about the risk of transmission, incubation period, clinical manifestations, management, and control, is needed now more than ever before in flattening the epidemic curve nationally and globally. Epidemiologic data reflects a transition from infectious disease as the leading cause of death in the 1900s to chronic disease, namely Cardiovascular diseases (CVDs) in the current era[5,6]. This scientific experience provided substantial data to epidemiology on infectious disease modeling in terms of transmission, incubation period, subclinical disease, and the period of infectivity, prognosis, and fatality. Additionally, epidemiologic approaches to infectious disease observed in the epidemic curve, which could be due to excess fatality or transmission containment and mitigation through intense screening and pathogen detection.

COVID-19, a respiratory and pulmonary disease caused by SARS-CoV-2 remains a pandemic and not fully understood with respect to viral dynamics, prognosis, mortality risk and subpopulation differentials in survival. With the onset of this condition established in the United States during early March 2020, variability in subpopulations transmission, incidence and mortality had been observed. In states with early data on socio-demographics including race, ethnicity, age and gender, disproportionate cumulative incidence (CmI) and increased case fatality had been illustrated among racial/ethnic minorities namely blacks/African Americans (AA) and Hispanics[7]. The observed disproportionate burden in these populations had been attributed to social inequity and social determinants of health, namely low SES, housing/living conditions, education, adverse neighborhood environment, health care access/utilization and food insecurity, as well as comorbidities.

Regarding viral spread, contact with the exposed individual, either symptomatic or asymptomatic as in SARS-CoV-2 increases the transmission, which explains the rationale for increased transmission and mortality among Blacks/AA[8]. Blacks/AA reside in dense population areas with crowded housing and suffer adverse environmental neighborhood factors, such as limited green spaces, recreational facilities, safe playgrounds and transportation systems. Blacks/AA relative to their White counterparts are more likely to use public transportation systems such as transit buses, which carries a higher probability of contact with infected COVID-19 cases, increasing the risk of infectivity among Blacks/AA[7]. Since a respiratory virus such as SARS-CoV-2 compromises the airways resulting in acute respiratory distress syndrome, previous exposure to environmental pollutants and toxins precipitates poor prognosis[9,10]. Such would be the case in a population associated with exposure to environmental toxins and pollutants, particular Blacks/AA[9,10].

With evidence-based data assessment from pandemics and epidemics, reflecting higher case fatality among the socially disadvantaged, such as the poor, underserved and Blacks/AA (racial minority), this study intends to examine the current experience of COVID-19 in recommending urgent equitable preparedness in addressing mortality and case fatality in Delaware. With structural or organized racism as the main predisposition of Blacks/AA to excess pandemic mortality, the application of the public health disproportionate universalism that mandates equitable allocation of resources necessary for optimal health and enhanced survival should be urgently implemented. The assessment of these variables such as income, SES, health insurance, safe neighborhood environment, access and utilization of quality healthcare, and lifestyles such as smoking, vaping, alcohol, drugs, physical inactivity, which are implicitly driven by structural racism, allow for an effective intervention mapping in addressing what is "avoidable" and "unacceptable", social inequity as an exposure function of health inequities and disparities in morbidity and mortality.

The current study aimed to assess the racial/ethnic and geo-clustering of COVID-19 confirmed cases and mortality in the state of Delaware, United Sates of America (USA). We postulated that the population with disproportionate burden of diseases in the US and in all states including DE will be disproportionately affected as well as geo-clustering of populations with disproportionate burden of socioeconomics as social gradient such as Sussex County in DE.

Materials & Method

Design

Cross-sectional ecologic design was used to assess the COVID-19 cases and mortality in the state of DE during the last week of April and the first week of May, 2020 as well as the mid- week in November for trends and patterns assessment. A novel research methodologic approach for reliable and valid evidence discovery termed Signal Application and Risk Specific Stratification (**SARSS-m**) model was used[11]. This model allows for sampling from sample, given "big data", noise elimination from the data by assessing for missing variables, outliers, biologic/clinical relevance of an observed data, confounding and effect measure modification prior to model specification and building.

Data Source

The aggregate data utilized in this assessment were from the Delaware Department of Health and
Social Services[12]. To assess trends and the direction as either positive or negative in pattern, the November 2020 data during 14th through 20th were used for the case positivity, while the case fatality and mortality utilized the cumulative incidence data between 7th and 13th, November, 2020.

Variables Ascertainment

The variables examined were confirmed or positive cases, deaths, age, gender, race/ethnicity, zip codes and county. The US census data, 2020 were used to determine the population size of DE by race, ethnicity and sex prior to the computation of the disproportionate burden of SARS-CoV-2 case positivity and COVID-19 case fatality and mortality.

Statistical Analyses

The pre-analysis screening was performed for missing data and outliers. We estimated the fatality proportion using the number of death/confirmed cases, multiplied by 100 (Fatality Percentage (%) or proportion). The line graphs as linear visual model were used to illustrate the case fatalities and transmission with temporal trends.

The assessment of geo-clustering of mortality and transmission was performed with Poisson regression model. This model utilized the DE as there reference and estimated the parameters for the observed zip codes in New Castle, Kent and Sussex counties. The type I error tolerance was set at 0.05 (5%) while the parameter's precision was determined with 95% Confidence Interval (CI). All tests were two tailed. The entire analyses were performed using STATA, Version 16.0 (Stata Corp, College Station, TX, USA).

Results

With respect to the last week in April, 2020, the cumulative incidence remains to be flattened in DE, with the confirmed SARS-CoV-2, n= 4575 (47.5 per 10,000), Sussex county, n=2,114 (111.4 per 10,000), Kent county, n=728 (41.8 per 10,000) and New Castle county, n=1,701 (28.7 per 10,000). Although not on the table, throughout the state, SARS-CoV-2 case positivity was higher among females, n=2456 (54%) relative to males, n=2083 (46%).

SARS-CoV-2 Case Positivity by Counties

Table 1A illustrates the cumulative incidence (cml) of SARS-CoV-2 case positivity rate per 10,000 in DE by counties during the last week in April 2020. The rate was highest in Sussex County, 2.3 per 10,000, intermediate in Kent County, 1.7 per 10,000 and lowest in New Castle County, 1.2 per 10,000. While the rate in the state of DE was, 1.8 per 10,000, Sussex County reflected the epicenter of SARS-CoV-2 transmission in the state (1.8 versus 2.3 per 10,000). Table 1B demonstrates the cumulative incidence (cml) of SARS-CoV-2 positivity during the first week of May 2020. Fig 1 visualizes SARS-CoV-2 case positivity rate per 10,000 during April, May and November 2020 by counties. Regardless of the geographic locale, and the time period positive linear trends were observed.

Table 1A: Cumulative Incidence and mortality of COVID-19, Stratified by County, State of Delaware, April, Last week, 2020

Geographic locale	Confirmed Cases (+ve)	Rate per 10,000	Mortality	Rate per 10,000
	Number (%)		Number (%)	
New Castle (north)	1903 (36.5)	34.1	65 (36.7)	1.16
Kent (Mid Central)	821 (15.8)	15.5	30 (16.9)	1.66
Sussex (South)	2461 (42.3)	105.1	55 (30.1)	2.26
Delaware State	5208	53.5	177	1.80

Notes: The rates were computed based on the US Census population size of DE and the counties based on the 2018 projection. DE population, n=973,764, New Castle County, n=558,753, Kent County, n=180,786 and Sussex County, n=234,225.

Table 1B: Cumulative Incidence and mortality of COVID-19, Stratified by County, State of Delaware, May, First Week, 2020

Geographic locale	Confirmed Cases (+ve)	Rate per 10,000	Mortality	Rate per 10,000
	Number (%)		Number (%)	
New Castle (north)	1979 (36.8)	33.5	70(44.3)	1.25
Kent (Mid Central)	847 (16.3)	48.6	30(19.0)	1.66
Sussex (South)	2520 (46.9)	132.3	58(36.7)	2.50
Delaware State	5371	55.8	---	1.80

Notes and abbreviation: There were 25 cases without County identification. The rates were computed based on the US Census population size of DE and the counties based on the 2018 projection. Delaware State (DE) population, n=973,764, New Castle County, n=558,753, Kent County, n=180,786 and Sussex County, n=234,225.

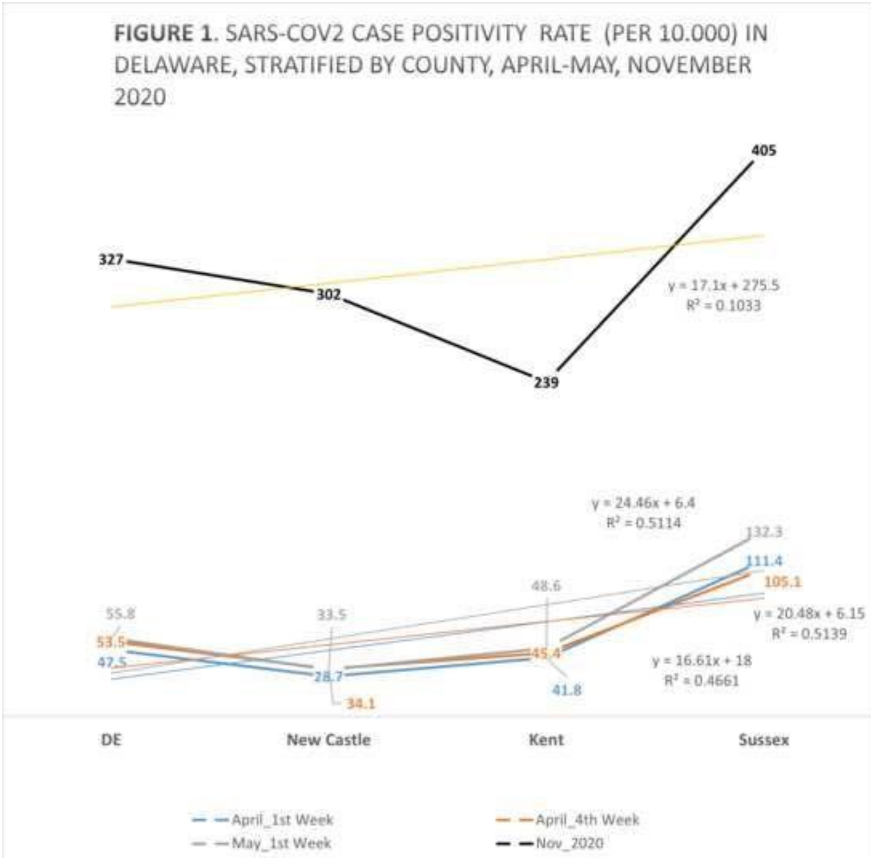

Figure 1: SARS-CoV-2 case positivity rate (per 10.000) in Delaware, stratified by County, April-May, November 2020

SARS-CoV-2 Cumulative Incidence by Race/ethnicity

The cumulative incidence (Cml) during April, 2020 was highest for Non-Hispanic blacks (NHB) 27% (n=1250), intermediate among non-Hispanic whites (NHW), n=1145 (25%) and Hispanics, n=865 (19%) but lowest among multiracial, n=234(5%) and Asian/Pacific Islanders, n=61 (1%). The unidentified race Cml was relatively higher, n=1020 (22%). Most confirmed cases in Hispanics were in Sussex county, n=628 (30%), while most confirmed cases for NHB and NHW were in New Castle county, n=678 (41%) and n=556 (33%) respectively.

SARS-CoV-2 Case Positivity Rate by Race/Ethnicity Stratified by Counties

Although not on the table, there were racial and geo-clustering differentials in cumulative incidence of SARS-CoV-2. The rate was highest among Hispanics in Sussex County, 479.5 per 10,000. With respect to New Castle County, the rate was highest among Hispanics, 145.6 per 10,000, intermediate among NHB, 72.7 per 10,000 and lowest among NHW, 21.6 per 10,000. Regarding Kent County, the rate was highest among Hispanics, 91.1 per 10,000, intermediate among NHB, 21.8 per 10,000 and NHW, 22.2 per 10,000. **(Fig 2)** shows the SARS-CoV-2 case positivity by race/ethnicity and geographic locale as geo-coding or geo-clustering. The Sussex County, the south of DE exhibits excess case positivity relative to the state and other counties.

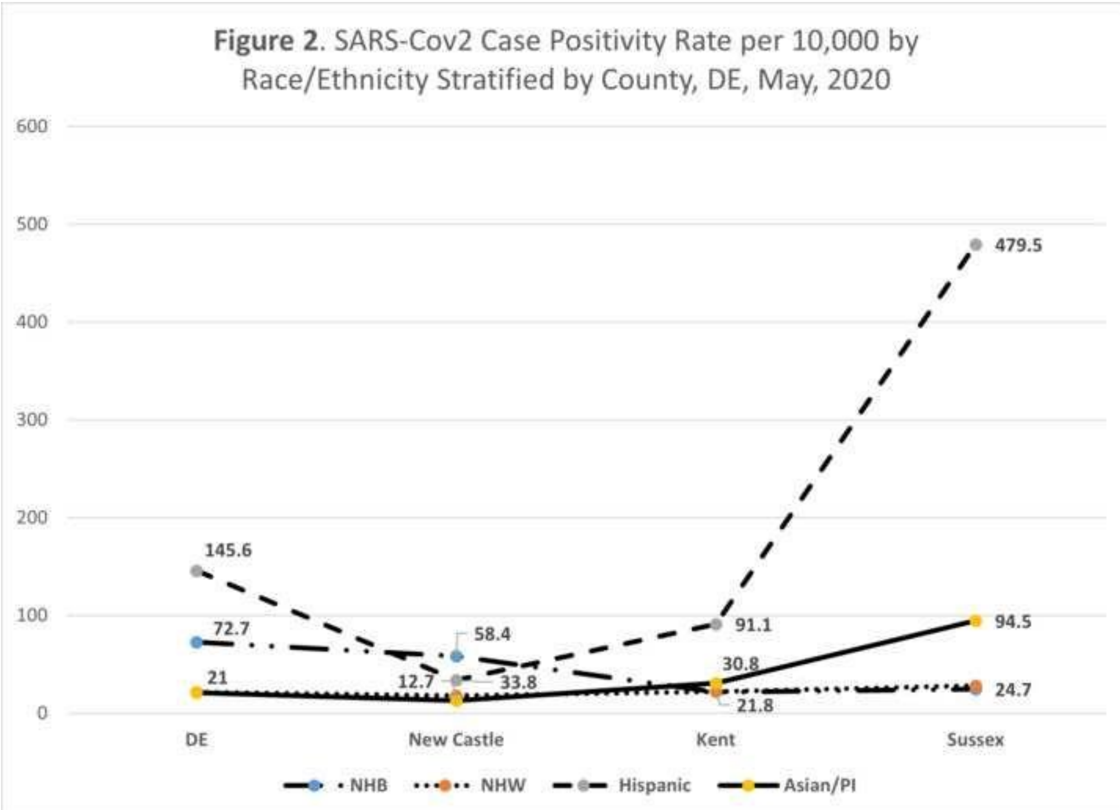

Figure 2: SARS-CoV-2 Case Positivity Rate per 10,000 by Race/Ethnicity Stratified by County, DE, May 2020

During April, the disproportionate burden of SARS-CoV-2 among Hispanics in DE was 100.2 per 10,000,with highest burden among Hispanics in Sussex county, 313.0 per 10,000, while this was intermediate among NHB in DE, 59.6 per 10,000 and was similar in terms of geo-clustering to Hispanics in Sussex county, NHB, 104.5 per 10,000. Whereas the population size of Hispanics is 9.3% in DE, this population represents an estimated 19% of SARS-CoV-2 case positivity, implying 2.04 times as likely for Hispanics to be positive for SARS-CoV-2, relative to its population contribution.

Similarly, while NHB constitutes 21.5% of the total population of DE, a disproportionate burden of SARS-CoV-2 case positivity was observed, 1.30, implying a 30% disproportionate burden of this pandemic.

COVID-19 Case Fatality and Mortality Risk

There were racial/ethnic differentials in the cumulative mortality, and was higher among NHB, 1.70 per 10,000 compared to NHW, 1.34 per 10,000. In terms of univariable binomial modeling of population at risk and the outcome, COVID-19 mortality, NHB relative to NHW were 27% more likely to die from COVID-19, unadjusted risk ratio (uRR)=1.27, 95%CI, 0.85-1.89, with attributable fraction of the exposed, (AFE) = 20.9, 95%CI, -18 – 47.0, and population attributable fraction of 6.0%. **(Figure 3)** demonstrates COVID-19 mortality by race/ethnicity and time period. Regardless of the time period for COVID-19 mortality, NHB indicated excess mortality relative to NHW in DE.

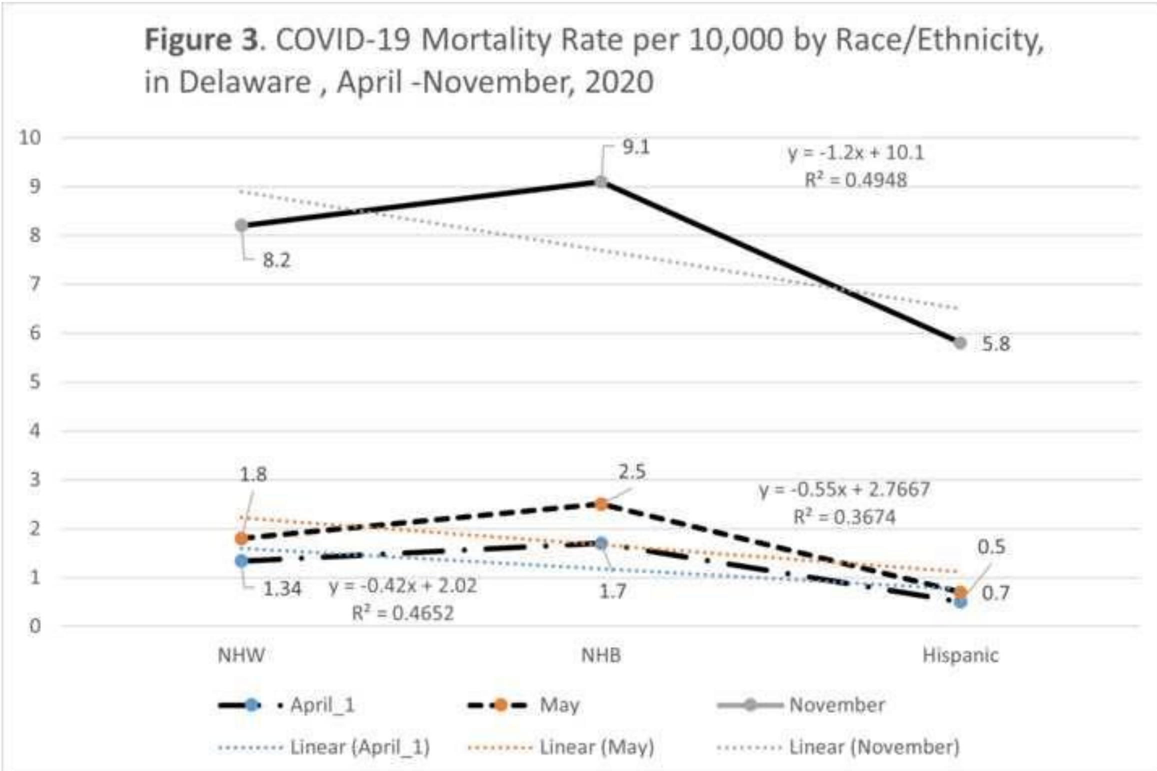

Figure 3: COVID-19 Mortality Rate per 10,000 by Race/Ethnicity, in Delaware, April -November, 2020

In addition, **Figure 4** exhibits COVID-19 mortality rate by county and race/ethnicity. With respect to NHB, the mortality rate in the state of DE was higher compared to their NHW counterparts (2.5 per 10,000 vs 1.8 per 10,000). Regardless of the county, the mortality from COVID-19 among NHB was higher relative to their NHW counterparts. In New Castle County the rate was marginally higher among NHB to (1.6 per 10,000 vs 1.5 per 10,000). Similarly, in Kent County, there was an increased mortality among NHB relative to NHW (3.3 per 10000 vs 1.5 per 10000). Likewise, in Sussex County NHB illustrated excess mortality to NHW (5.9 vs 2.6). In the state of DE as well as all the 227 counties, mortality was higher among NHB (upper curve) relative to their NHW counterparts (lower 228 curve).

Table 2: Cumulative Incidence of COVID-19, Stratified by race/ethnicity, State of Delaware, May (First Week), 2020

Race/ethnicity	Confirmed Cases (+ve)			
	Delaware	New Castle	Kent	Sussex
	Number (%)	Number (%)	Number (%)	Number (%)
Non-Hispanic Black	1526 (28.4)	809 (53.0)	332 21.8)	377 (24.7)
Non-Hispanic white	1412 (26.3)	642 (45.5)	257 18.2)	509 (36.0)
Hispanics	1257 (23.4)	183 (14.6)	111 (8.8)	962 (76.5)
Multi-racial	283 (5.3)	87 (30.7)	33 (11.7)	160 (56.5)
Asian/PI	78 (1.5)	39 (50.0)	11(14.1)	27 (34.6)

Notes and abbreviations: The unknown race/ethnicity represented an estimated 15% of the confirmed cases (n=815).

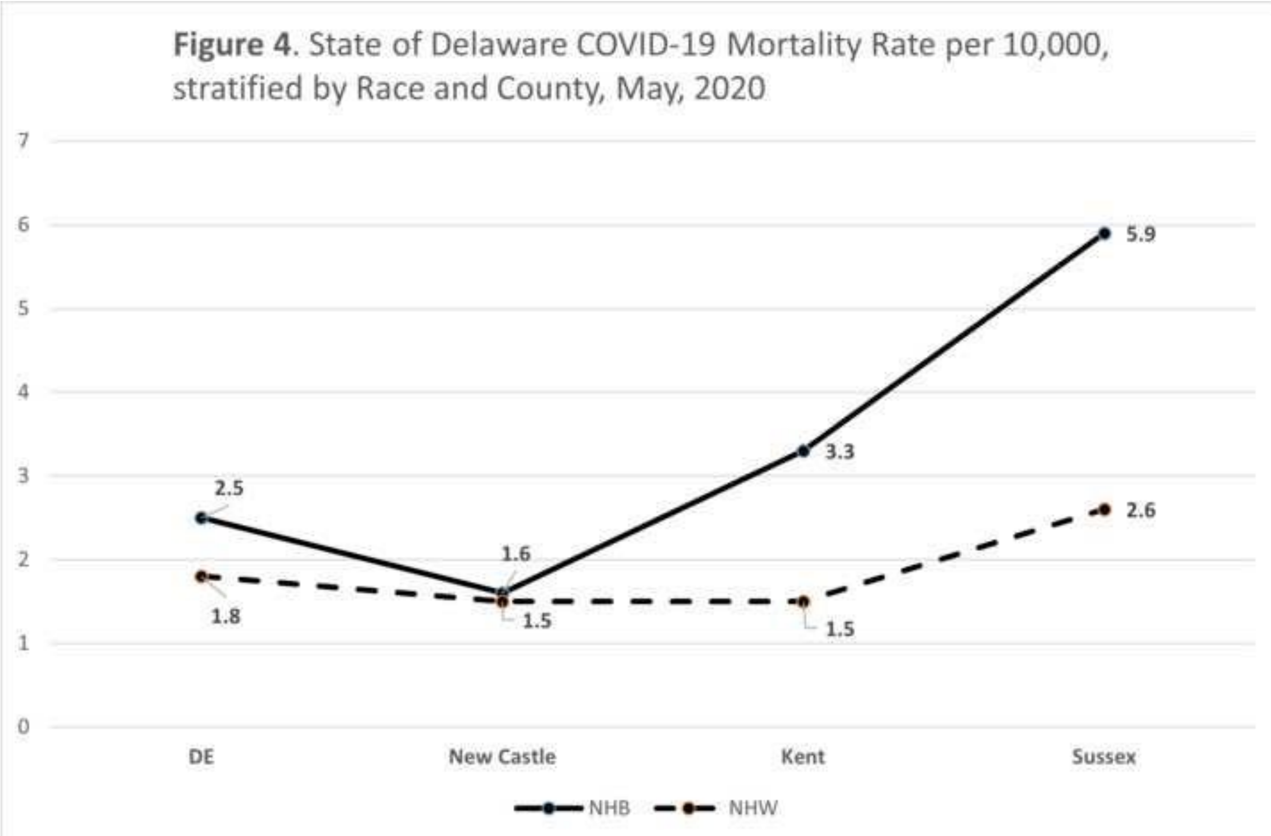

Figure 4: State of Delaware COVID-19 Mortality Rate per 10,000, stratified by Race and County, May 2020

SARS-CoV-2 Case Positivity and COVID-19 Mortality Rate by Selective Zip Codes

Table 3 represents the mortality incidence of SARS-CoV-2 by geographic locale. With respect to geo-clustering, there was a significant 50% increased risk of dying from COVID-19 in Sussex county compared to the state of DE, incidence rate ratio (IRR)=1.50, 95%CI, 1.11-2.03. The zip codes with relatively higher mortality were 19720 (New Castle City), 19963 (Milford), 19966 (Millsboro) and 19901 (Dover). The mortality estimates followed this pattern with a slight increase during the first week in May. **(Fig 5)** shows the DE SARS-CoV-2 case positivity and mortality by selective zip codes. The Sussex zip codes as geo-clustering indicated the highest case positivity as well as mortality.

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Table 3: COVID -19 Cases confirmation and Mortality by Geo-clustering, Delaware Counties

Geo-clustering-Zip Code	**Confirmed cases (n)**	**Rate per 10,000**	**Mortality (n)**	**Rate per 10,000**
New Castle County				
05/05/20				
19720	277	42.6	13	2.0
19801	73	46.9	---	---
19805	159	42.5	---	---
19713	104	31.6	---	---
05/06/20				
19720	294	45.2	13	2.0
19801	76	48.4	---	---
19805	175	46.4	---	---
19713	113	34.4	---	---
Kent County	891	51.0	33	1.6
Dover/19901	230	67.9	11	2.9
Sussex County	2764	145.1	75	2.2
19963*	307	141.4	22	6.7
19966	327	139.2	11	2.8
19973	362	155.6	---	---

Notes and abbreviations: 19963 Milford, Slaughter beach, Frederica and Houston. 19973- Seaford and 19963 -Millsboro

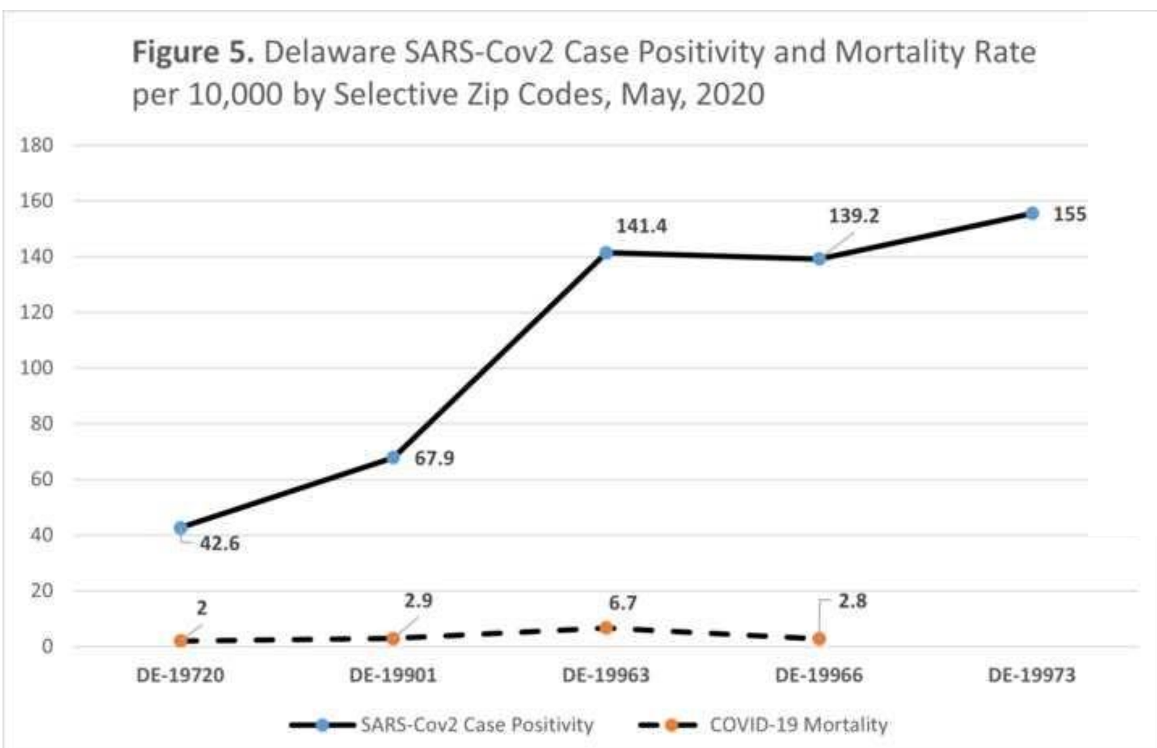

Figure 5: Delaware SARS-CoV-2 Case Positivity and Mortality Rate per 10,000 by Selective Zip Codes, May 2020

SARS-CoV-2 Case Positivity and COVID-19 Mortality by Race/Ethnicity and Counties, November 2020

The cumulative SARS-CoV-2 case positivity, case fatality and mortality trends for potential positive or negative trend was assessed using the November 2020 data, implying the pandemic assessment at the beginning and during the cold /winter season, November 2020, where the viral dynamics is suggestive of exponential spread. Although not on the table, the SARS-CoV-2 case positivity was 30,816 (327 per 10,000) in DE, while New Castle County observed case positivity frequency of 16,900 (302 per 10,000), and Kent County n= 4,324 (239 per 10,000), and 9,493 (405 per 10,000) case positivity in Sussex County. The disproportionate burden of the SARS-CoV-2 Cml was observed in Sussex County. While this county represents 24.0% of the total DE population size, it accounted for 30.8% of the confirmed cases, indicative of 6.8% excess case positivity in Sussex County. While New Castle County accounts for 57.4% of the total DE population size, SARS-CoV-2 case positivity was 54.8%, indicative of 2.6% decreased burden of transmission and infectivity in this county. Similarly, there was no disproportionate burden of SARS-CoV-2 Cml in Kent County, indicative of 14.0% case positivity, with a population size of 18.6% of the total DE population, implying 4.6% decreased burden of SARS-CoV-2 Cml.

Although not on the table, the mortality as per 11/20/2020 for the state of Delaware was 746 cases, with a fatality rate of 6.2 per 10,000. The cumulative mortality by race/ethnicity was 492 (66%) for non-Hispanic whites, 187 (25%) for non-Hispanic blacks, 52 (7%) for Hispanics, and 12 (2%) for multiracial. NHB illustrate the disproportionate burden of COVID-19 mortality in DE relative to their white counterparts. Specifically, while the population size of NHB is 21.9% as per the US Census 2018 data, mortality was 25%, indicative of excess mortality of 3.1% as disproportionate burden of dying from COVID-19 in this population. In contrast, while the population size of NHW is 69.1%, the mortality Cml or period prevalence was 66% indicative of 3.1% decreased burden of COVID-19 mortality among NHW.

Discussion

With the current COVID-19 pandemic, and the USA with the highest confirmed cases and mortality globally as well as the disproportionately observed mortality in some subpopulations, there remains an urgent need to examine these data, provide a possible explanation to the observed racial/ethnic disparities and geo-clustering in DE and propose feasible recommendations in racial/ethnic and geo-clustering or geo-environmental gap narrowing in SARS-CoV-2 infectivity and COVID-19 mortality. Aggregate data were utilized from the Delaware Department of Health and Social Services (DHSS) where demographic information was available to determine the racial variances in the confirmed SARS-CoV-2 cases and mortality as well as risk differentials, comparing the NHW, NHB and Hispanics subpopulation deaths, as well as geo-variances in Cml case positivity and mortality. There are a few relevant findings to epidemic curve flattening and case fatality mitigation in the communities of color, namely NHB, Hispanics and Sussex County in DE. First, SARS-CoV-2 Cml varied by race, ethnicity, county, and sex. Secondly, there was a disproportionate burden of COVID-19 mortality among NHB and Sussex County residents. Thirdly, the case fatality was higher among NHB relative to NHW. Fourthly, NHB relative to NHW regardless of geographic locale presented with increased case fatality and mortality risk in COVID-19 in the state of Delaware.

We have demonstrated that SARS-CoV-2 Cml varied by race, ethnicity, geographic locale and sex. The Cml was highest among NHW, intermediate among NHB and Hispanics, but lowest among Asian/Pacific Islanders. However, NHB and Hispanics illustrated the disproportionate burden of SARS-CoV-2. Previous literature had observed a comparable pattern of transmission in different settings[7].

The observed burden of SARS-CoV-2 Cml among NHB is explained by workplace segregation, where NHB are employed in jobs with fewer or no benefits, but with more adverse conditions, such as buildings with no fire exit, as well as a stressful environment in DE[13]. Specifically, NHB and Hispanics who are employed as public transit drivers have an increased risk of contracting viral microbes, which also explains the COVID-19 racial and ethnic burden differentials.

This study has also observed an increased SARS-CoV-2 disproportionate burden of Cml among residents of Sussex County as well as disproportionate burden among Hispanics in this County. The observed geo-clustering is due to the increasing population density of Hispanics in this county as well as the type of employment which predisposed this subpopulation to increased exposure to environments with exponential viral spread such as meat factory, sanitation job, maids, and restaurant and hotels housekeeping[14-16]. In addition, the workplace segregation as well as uncompensated sick time may explain the excess SARS-CoV-2 among Hispanics in this County.

This study clearly observed higher case fatality among NHB relative to NHW. Previous studies in the flu pandemic of 1918 and 2009 clearly implicated the socially disadvantaged individuals and populations in survival disadvantage following infectivity[7]. The excess case fatality among NHB is explained in part by the higher prevalence of chronic diseases, namely hypertension and other cardiovascular diseases, diabetes and cancer, as well as aberrant epigenomic modulation in COVID-19 prognosis and mortality[7]. NHB are more likely, compared to their NHW counterparts, to be diagnosed with type II diabetes, primary HTN, stroke and malignant neoplasm and have higher mortality from these conditions[17,18]. The higher incidence of these conditions among NHB had been associated with a lack of access to healthcare as well as decreased healthcare utilization due to several obstacles and barriers[18].

Secondly, the social determinants of health which reflect the needed resources to benefit from optimal health are not equitably available for NHB[17,18]. These determinants are characterized by the social gradient upon which the socially disadvantaged individuals or populations are less likely to benefit from early education, quality education through college and a good paying job. The social determinants of health, namely education, socio-economic status, income, employment, food security, racism, safe environment, insurance, transportation, and living conditions, adversely impacts the outcome of morbidity and mortality among NHB in the US[19-21].

Since NHBs are predisposed to more environmental pollutants and toxins, psychosocial stressors, a dangerous job environment and incarceration, these environments interact with the gene, implying impaired gene expression and increased disease development, poorer prognosis, increased mortality and survival disadvantage. In addition, because social gradient reflects environmental neighborhood characteristics, the understanding of gene and environment interaction, such as living conditions, may provide an additional strategic approach in intervention mapping for disease management and prevention. In effect, examining the gene and environment interaction, observed as epigenomics, will provide substantial data on intervention in narrowing the gaps between NHB and NHW in DE with respect to COVID-19 mortality.

The gene and environment interaction as epigenomic modulations that commence at gametogenesis are transgenerational but reversible. The social signal transduction that is evoked from the stress placed on NHB and Hispanics has a substantial effect on the sympathetic nervous system and provokes the beta-adrenergic receptors. This response has been shown to involve the Conserved Transcriptional Response to Adversity (CTRA) gene expression and the consequent elaboration of pro-inflammatory cytokines, due to the impaired gene expression of the transcription factors and the inhibition of gene expression with respect to anti-inflammatory response[22]. In understanding these pathways of genomic stability and their role in disease causation as well as mortality, epigenomic studies are necessary in determining whether or not Black individuals, relative to White individuals, have an increased mean deoxyribonucleic acid (DNA) methylation index with respect to the genome-wide analysis. Such initiative will involve the utilization of the bisulfite pyrosequencing that is very specific in differentiating between the methyl group (CH3) and hydroxyethyl group, as well as the binding of these groups to the Cytosine-phosphate-Guanine (CpG) region of the gene, inhibiting transcription and the messenger ribonucleic acid (mRNA) sequencing, leading to impaired gene expression and abnormal cellular functionality. The reference to epigenomics investigation reflects the inability of a COVID-19 case to respond to treatment modalities due to the drug receptors unavailability, resulting from impaired gene expression (mRNA translation dysregulation) reflecting decreased response to COVID-19 treatment among racial/ethnic minorities namely NHB and Hispanics[23]. The observed epigenomic aberration clearly illustrates treatment effect heterogeneity in which some subpopulations respond differentially to a given therapeutic agent in the phase of epigenomic lesion, explaining in part racial risk differentials in COVID-19 case fatality.

Despite the rigorous methodology utilized in this racial/ethnic and geo-clustering model for SARS-CoV-2 and COVID-19, there are some limitations. First this study utilized pre-existing data as secondary data which are subject to information, selection and misclassification biases. However, the observed disproportionate burden of SARS-CoV-2 Cml among NHB and Sussex County in DE is not driven solely by these biases. Secondly since risk do not occur in isolation, requiring an application of explanatory model namely confounding adjustment, it is unlikely that the predictive mortality risk in this study which implicated increased COVID-19 mortality and case fatality among NHB, Hispanics in Sussex County is driven solely by unmeasured confounders[24].

Conclusions

The Delaware SARS-CoV-2 case positivity indicates disproportionate burden on the communities of color, namely NHB and Hispanics as well as case clustering disproportionate burden in Sussex
County, while COVID-19 increased case fatality and mortality was observed among NHB and Sussex County residents. In addition, there was a positive trend in SARS-CoV-2 transmission as well as comparable case fatality and mortality risk characterization by race/ethnicity and geo-clustering in the state of DE comparing the initial period of the pandemic with the cold/flu season, 2020. These findings are indicative of the need to examine sub-populations needs, namely NHB and Hispanics for intervention mapping for SARS-CoV-2 risk reduction and racial/ethnic as well as county mortality gap narrowing from COVID-19. These findings indicate the following recommendations in DE COVID-19 case and mortality marginalization by race/ethnicity and geo-clustering:

(1) With these data there is an urgent and increasing need for adherence to preventive and control measures in these subpopulations at risk for transmission reduction, mainly Hispanics, NHB and Sussex County residents, including testing, contact tracing, tracking, social and physical distancing as well as non-surgical and non-medical face mask utilization while outside home.

(2) Further, these findings are suggestive of the need to examine the social gradient that may be associated with the disproportionate burden of mortality among NHB as well as an explanation for the increased risk of transmission among Hispanics, especially in Sussex County.

a. The application of these recommendations will enhance the state of DE in curve flattening and down drifting as well as case fatality mitigation especially among the marginalized and most vulnerable populations. In effect, the second wave is inevitable unless the state implements successfully all the measures recommended for spread mitigation, based on the ongoing scientific data on pandemics.

b. Since health equity is essential in subpopulations risk and health outcomes marginalization, this study clearly recommends the state of Delaware through the counties, to utilize disproportionate benefit for NHB, Hispanics and Sussex county residents for equitable outcome of SARS-CoV-2 transmission and COVID-19 case fatality and mortality.

(3) Social and physical distancing until the epidemic curve is flattened in DE prior to return to normal economic life, will prevent a significant resurgence of COVID-19 with altered SARS-CoV-2 antigenicity or different serotypes.

(4) Facemask application throughout the state, especially among COVID-19 positives and symptomatic individuals to marginalize the spread of the virus.

(5) The immune system potentiation by providing equitable resources namely balanced lifestyle to food material to Blacks/AA and Hispanics who are socially disadvantaged with low SES in DE, especially those in Sussex County.

(6) The education of the NHB and Hispanic communities on the health consequence of COVID-19 through ePublicHealth [B12 session via zoom] Intervention program and the provision of assistance and encouragement for testing, case identification and isolation will flatten the epidemic curve in the Black communities influencing epidemic curve flattening and down drifting in the epidemic curve nationally, thus enhancing the overall US economy and return to normal life style and coping. This initiative will not only reduce social inequities but the social inequities burden for future disease and pandemics.

(7) Since the disproportionate burden of pandemics fundamentally reflects health disparities, addressing this disproportionate burden in future epidemics and pandemics will require subpopulations, especially NHB, American Indians/Alaska Native and Hispanics to be provided with the resources necessary for optimal health. Therefore, adherence to the World Health Organization's recommendation of social justice and peace as conditions necessary for health is essential in narrowing health disparities in pandemics by addressing now social injustice and

systemic and structural racism, thus transforming health equity.

a. The State of Delaware through the Center for Disease Control and Prevention (CDC) and the DHSS to increase testing throughout the state, especially in the most vulnerable COVID-19 population, namely NHB and Hispanics in Sussex County.

(8) The development of surveillance and monitoring systems for data availability on the social determinants of health and race/ethnicity in transforming pandemic health equity is essential in intervention mapping in marginalizing the COVID-19 outcomes among the communities of color.

(9) Establishment and implementation of a rapid health equity transformation taskforce and evaluation matrix for risk mitigation among racial and ethnic minorities, namely Blacks/AA and Hispanics.

(10) The state, county and local health departments collect socio-demographic data for a better understanding of exposures and confounding in viral spread and case fatality.

(11) As we anticipate the mRNA vaccine for SARS-CoV-2 host "spike" protein generation for antibodies production, the administration of this novel technology vaccine must be initiated among the most vulnerable populations, especially the socially disadvantaged population, namely NHB and Hispanics for herd immunity in these subpopulations prior to other communities' immunizations.

As emergency preparedness, health equity resources are required through disproportionate universalism, which is the public health lens in the provision of health services more to the racial/ethnic minorities prior to the non-vulnerable populations. The failure to address the socially disadvantaged individuals and populations' needs in our society namely the state of Delaware, by educational opportunity, equitable employment opportunity and the departure from structural racism, will render the Delawareans more vulnerable to public health and healthcare crises in this pandemic and the current surge. In effect, as clinicians, researchers, health officers, epidemiologist, infectious disease specialist, and public health experts, it is our moral responsibility regardless of our race/ethnicity, gender or age, to rapidly respond to the disproportionate mortality burden of this pandemic in the communities of color, especially NHB, since human life remains a primary value.

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