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RESEARCH ARTICLE

Epidemiologic Risk Modeling of Disproportionate Burden of SARS-CoV-2 Case Positivity and COVID-19 Mortality among Blacks/African Americans in Washington DC, USA

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ABSTRACT

Background: Historically, populations with deprived optimal care, preventive health services, value-based care, and low socio-economic status with marginalized social hierarchy had been observed with poor health outcomes and excess mortality during pandemics. The current COVID-19 global pandemic mirrors the flu pandemic of 1918, where the social gradient predicted the disproportionate burden of mortality among blacks in the United States (US). The current study aimed to assess the racial differentials in SARS-Cov-2 case positivity, case fatality and mortality in Washington DC, US as well as the potential explanatory model therein.

Materials and Methods: A cross-sectional ecologic design was used to examine the COVID-19 data from the Washington DC Department of Health (https://coronavirus.dc.gov/data) by race/ethnicity, sex, ward (geographic locale), and age. This predictive model examined the pre- (November, 2020) and post-thanksgiving (December, 2020) data for trends. While the variables examined were in aggregate data format, chi square statistic and binomial regression models were used for variable characterization by race and mortality risk race prediction respectively.

Results: During late November, the SARS-Cov-2 case positivity in Washington DC was higher among Blacks/AA (n=9,441(46.7%)) relative to Whites, 4603 (22.8%). With respect to Hispanics, the SARS-Cov-2 case positivity was 4,853 (24.1%) and 13,477 (66.9%) among non-Hispanics. With respect to COVID-19 mortality, this was lowest among non-Hispanic Whites (NHW), 1.50%, intermediate among Hispanics (1.81%), and highest among non-Hispanic Blacks (NHB), 5.30%. There was sex differential in mortality cumulative incidence (Cml), with males (57.0%) compared to females (43.0%) illustrating higher mortality. The mortality Cml by age was lowest among cases, 20-29 years (6.4%), intermediate among cases, 50-69 years (36.3%) and highest among individuals, 70 years and older, 58.7%. With respect to the geographic locale (DC-Ward), the mortality Cml was higher in DC-Wards 4-6 (39.3%) and wards DC-7-8 (35.4%) but lower in DC-Wards 1-3 (22.1%). The mortality risk from COVID-19 illustrated racial/ethnic differentials. Relative to NHW in Washington DC, NHB were almost 4 times as likely to die from COVID-19 in November 2020 prior to Thanksgiving, prevalence odds ratio, (pOR)=3.62, 95%CI, 2.78-4.73, Attributable fraction of exposed (AFE),72%, while Hispanics were 25% more likely to die, Hispanics, pOR=1.25, 95%CI, 1.0-1.74, AFE(18%).

During the first week in December, post –thanksgiving period, the SARS-Cov-2 case positivity was lower among Whites (n, 5719, (23.0%)) compared to Blacks/AA, 11,218 (47%). The Cml mortality was highest among NHB, n=521 (74%), intermediate among Hispanics, n=93 (13.2%) and lowest among NHW, n=72, (10.2%). Similarly, there was racial differential in mortality risk,with increased risk observed among Blacks/AA, relative to their White counterparts in DC. Compared to Whites, Blacks/AA were 4 times as likely to die from COVID-19, pOR=4.00, 95%CI, 2.87-4.80, AFE (73%).

Conclusions: There were racial/ethnic disparities in SARS-Cov-2 case positivity, COVID-19 mortality and mortality risk, which was higher among Blacks/AA relative to their White counterparts in Washington DC. Additionally, mortality was higher in male compared to female as well as DC-ward variation by mortality.

Keyword: SARS-Cov-2 case positivity; COVID-19 Mortality; Washington DC; Racial/ethnic disparities; Social inequity.

Introduction

The SARS-CoV-2, causative pathogen in COVID-19, remains a pandemic, suggestive of a reliable scientific control and preventive measures in flattening the epidemic curve, mitigating case fatality and mortality reduction [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 as well as mortality reduction. Epidemiologic data reflects a transition from infectious disease, as the leading cause of death in the 1900s, to chronic disease in the current era, namely Cardiovascular Diseases (CVDs) [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, through intense screening and pathogen detection processes, epidemiologic approaches to infectious disease, as observed in the epidemic curve, could be due to excess fatality or transmission, containment and mitigation.

COVID-19, a respiratory and pulmonary disease caused by SARS-COV-2, remains a pandemic; yet, the viral dynamics, prognosis, mortality risk and subpopulation differentials in survival are not fully understood. 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, social gradient 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 (Rotheet al., 2020). 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 [9,11]. Such would be the case in a population associated with exposure to environmental toxins and pollutants, particularly Blacks/AA [9,11].

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 the United States. 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 implemented in a timely matter. The assessment of these risk factors, such as income, SES, health insurance, safe neighborhood environment, access/utilization of quality healthcare, and lifestyles such as smoking, vaping, alcohol, drugs, and physical inactivity allow for an effective intervention mapping in addressing the disproportionate burden of this pandemic among the populations of color. These risk variables are driven by structural racism, social inequity and social gradient.

The current study aimed to assess the racial/ethnic variability in SARS-Cov-2 positivity and COVID-19 mortality in the District of Columbia, Washington DC. Washington DC size reflects the highest population among Blacks/AA, intermediate among Whites and lowest among Hispanics, American

Indians/Alaska natives, etc. We postulated that the population with lower social hierarchy, socioeconomically marginalized, lower optimal health care as well as marginalized preventive health services in Washington DC will be disproportionately affected with respect to SARS-Cov-2 case positivity, case fatality and mortality.

Materials & Method

Design

Cross-sectional ecologic design was used to assess the COVID-19 cases and mortality in the state of Washington DC during the last week of November and the first week of December, 2020. A novel research methodologic approach for reliable and valid evidence discovery termed Signal Application and Risk Specific Stratification (SARSS-m) model was used [10]. 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 Washington DC Department of Health (https://coronavirus.dc.gov/data). To assess trends and the direction as either positive or negative in pattern, the last week in November and the first week in December, 2020 data were examined.

Variables Ascertainment: The variables examined were confirmed or positive cases, deaths, age, gender, race/ethnicity and wards as geographic, zip codes and county. The US census data, 2020 were used to determine the population size of Washington DC by race/ethnicity prior to the computation of the disproportionate burden of SARS-Cov-2 case positivity and mortality.

Statistical Analyses

We estimated the fatality proportion using the number of death/confirmed cases, multiplied by 100 (Fatality Percentage (%) or proportion). Line graphs and the linear model with the coefficient of determination (R^2) were used to illustrate the case fatalities and transmission. While Chi square statistic (X^2) was used to test independence by race/ethnicity. The binomial regression model was utilized for risk stratification modeling, but could not address and control for the confounding due to limited data on social determinants of health and population health dynamics.

Case Fatality Modeling

To determine the daily percent change (DPC) in case fatality modeling for upward (positive) or downward (negative) trend, we utilized the formula D2-D1/D1*100, implying case fatality in the end result or End Result Case Fatality (ERCF) or (D2) – Baseline Case Fatality (BCF) * 100. Therefore, DPC = ERCF-BCF/BCF * 100.

Mortality Predictive Risk Modeling

The binomial regression model (BRM) was used to determine the risk of dying from COVID-19 by race/ethnicity. This model is adequate in predicting COVID-19 mortality risk as well as mortality risk stratification by race/ethnicity. The BRM is based on the probability of dying in the populations of interest, namely Black and with White mortality as the selected population in the referenced group for the relative risk assessment, as the risk ratio point estimate or magnitude of effect.

With this model, we predicted the risk of dying, given the race of the confirmed COVID-19 case. The response, outcome or dependent variable 'y' (COVID-19 deaths), with each value in the independent variable (nation) representing the number of success (k-deaths) observed in 'm' trials. Assuming the probability of success (death) = p, and the probability of failure (alive) = 1 – p, we used the link function to relate the risk of dying to a linear combination of the regression variable, including the constant or intercept on the y axis: ln (pr (success (death) = 1/pr (success (death) = 0), implying, $\beta 0$ (constant/intercept) $+\beta 1$ (nations) [10].

For example, the risk of dying from COVID-19 among Black cases was compared to the risk of dying among White cases for the risk ratio estimation using 2 X 2 tabulation (A/AB)/(D/CD), A = Confirmed cases and COVID-19 mortality among Blacks, B = Confirmed cases with recovery/survival among Black cases, C = confirmed cases and COVID-19 mortality among White cases, while D was the confirmed cases with recovery/survival among White cases. A/AB was the risk in the exposed, Blacks, divided by the risk in the unexposed, White COVID-19 cases, D/CD. In terms of the interpretation, if the two

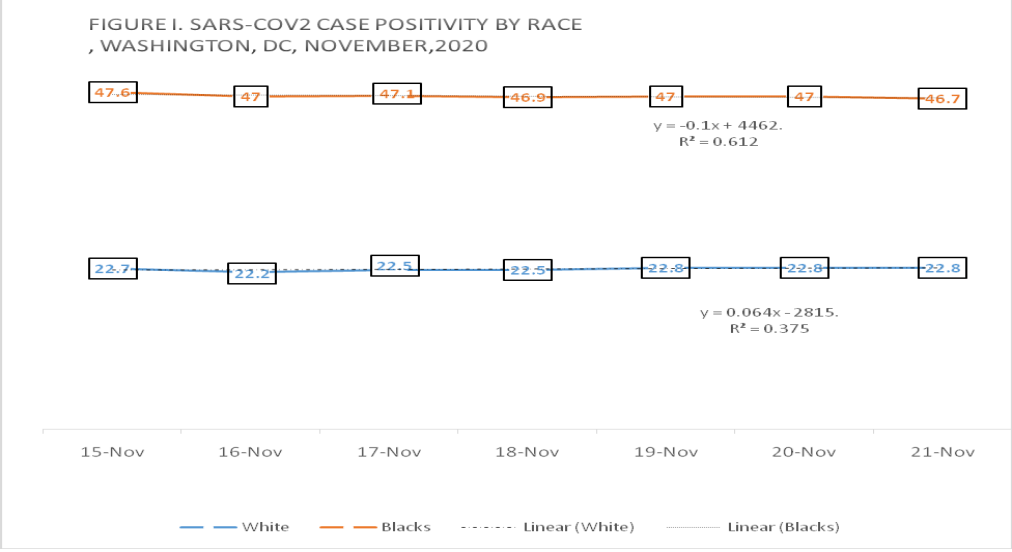
populations were comparable with respect to the mortality risk, the risk ratio (RR) = 1.00, and if the risk was higher among Black cases, the RR was >1.0, but if the risk of COVID-19 was lower among Black cases, the RR was <1.0 [10] (Holmes, 2018). The type I error tolerance was set at 0.05 (95% CI) and all tests were two tailed. The entire analyses were performed using STATA, Version 16.0 (Stata Corp, College Station, TX, USA).

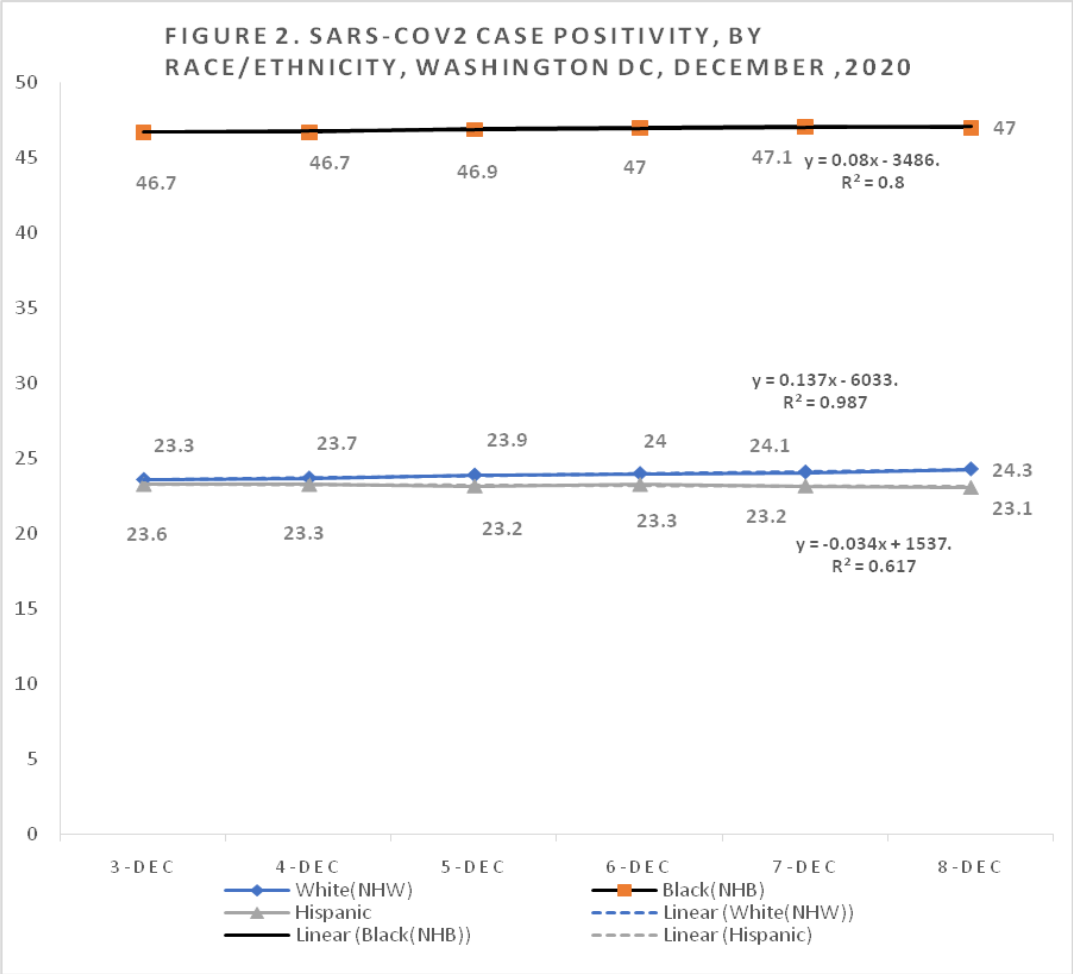
Results

These data represent the SARS-Cov-2 case positivity and COVID-19 mortality by race/ethnicity, sex, ward as geographic locale and age. With the study focus being race/ethnicity, patterns with respect to temporal trends, comparing last week in November and the first week in December, 2020 were examined, indicative of a positive trend in SARS-Cov-2 positivity and COVID-19 mortality during this period. Similarly, COVID-19 mortality illustrated a positive across all race/ethic groups, especially among Blacks/African Americans (AA).

SARS-Cov-2 Case Positivity and COVID-19 Morality Cumulative Incidence (CmI) by Race/ethnicity, Sex, Age and Geographic Locale (Ward)

Although not on the tables, during the late November month, 2020, the SARS-Cov-2 case positivity in Washington DC was higher among Blacks/AA (n=9,441(46.7%) relative to Whites, 4603 (22.8%). With respect to Hispanics, the SARS-Cov-2 case positivity was 4,853 (24.1%) and 13,477 (66.9%) among non-Hispanics. Regarding COVID-19 mortality, this was lowest among non-Hispanic Whites (NHW), 1.50%, intermediate among Hispanics (1.81%), and highest among non-Hispanic Blacks (NHB), 5.30%. Regardless of temporality, there was sex differential in mortality cumulative incidence (CmI), with males (57.0%) compared to females (43.0%) illustrating higher mortality. The mortality CmI by age was lowest among cases, 20-29 years (6.4%), intermediate among cases, 50-69 years (36.3%) and highest among individuals, 70 years and older, (58.7%). With respect to the geographic locale (DC-Ward), the mortality CmI was higher in wards DC-4-6 (39.3%) and wards DC-7-8 (35.4%) but lower in wards DC-1-3 (22.1%). During the first week in December, post – thanksgiving period, the SARS-Cov-2 case positivity was lower among Whites (n, 5719, (23.0%) compared to Blacks/AA, 11,218 (47%). **Figure 1** illustrates SARS-Cov-2 case positivity by race/ethnicity during November, 2020. This linear graph presents NHB with the highest case fatality while Hispanics and NHW indicated intermediate and lowest case fatality respectively. Similarly, **figure 2** exhibits case fatality by race/ethnicity during December, 2020 with highest case fatality observed among NHB, and was intermediate among Hispanics but lowest among NHW.





SARS-COv-2 Case Positivity by Race/Ethnicity

Table 1 illustrates SARS-Cov-2 positivity stratified by race/ethnicity between December 3rd and 8th, 2021 in Washington DC. Despite the observed SARS-Cov-2 confirmed cases, which plateaued during this period among Hispanics, marginal positive trends were observed among Blacks/AA and Whites. The SARS-Cov-2 Cml was higher among Blacks/AA relative to whites, as well as higher among non-Hispanics compared to their Hispanic counterparts. Concerning the burden of SARS-Cov-2 case positivity in Washington DC, Blacks/AA and Hispanics were observed with the disproportionate burden SARS-Cov-2 transmission and infectivity.

Table 1: SARS-Cov-2 Case Positivity by Race/Ethnicity, December 2020, Washington, DC

Variable	SARS-Cov-2 Case Positivity, December 2020					
	3-Dec	4-Dec	5-Dec	6-Dec	7-Dec	8-Dec
Race/Ethnicity	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
White(NHW)	5,311(23.6)	5,426(23.7)	5,531(23.9)	5,589(24)	5,653(24.1)	5,719(24.3)
Black(NHB)	10,353(46.7)	10,670(46.7)	10,846(46.9)	10,951(47)	11,077(47.1)	11,218 (47)
Hispanic	5,241(23.3)	5,313(23.3)	5,364(23.2)	5,420(23.3)	5,473 (23.2)	5,515(23.1)

Notes and Abbreviations: The SARS-Cov-2 case positivity percentage or proportion was estimated using all those who were tested for SARS-Cov-2 the COVID-19 causing pathogen divided by the total number of those tested positive. n=number or frequency, % = percentage, Dec=December, NHW = Non-Hispanic White, NHB= Non-Hispanic Blacks. Data Source: Washington DC Department of Health

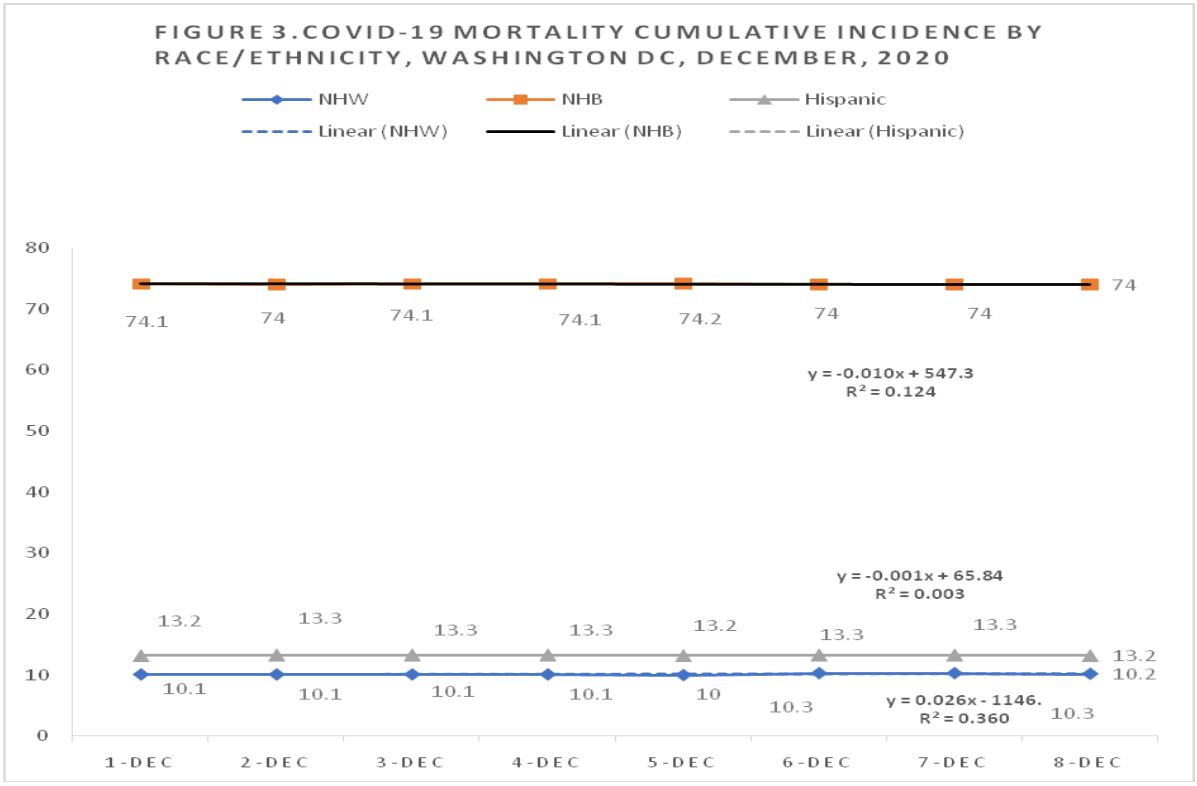
COVID-19 Mortality by Race/Ethnicity

Table 2 demonstrates the COVID-19 mortality Cml by race/ethnicity during the first week in December, 2020 in Washington DC. The Cml for NHW ranged from 10.0% to 10.3%, while the range for NHB was 74.0% to 74.2%, and ranged from 13.2% to 13.3%. The COVID-19 Cmlmortality was highest among Blacks/AA as NHB, intermediate among Hispanics and lowest among white as NHW. Racial/ethnic minorities demonstrate the disproportionate burden of COVID-19 based on the population size The Cml mortality was highest among NHB, n=521 (74%), intermediate among Hispanics, n=93 (13.2%) and lowest among NHW, n=72, (10.2%).. While Blacks represent an estimated 48% to 49% of the Washington DC population, the COVID-19 mortality was 74% among them, indicative of the disproportionate burden of COVID-19 mortality. In the same vein, while Hispanics account for 8.8% of the Washington DC population, COVID-19 mortality among them was 13.0%, indicative of excess mortality in this minority population. **Figure 3** presents COVID-19 Cml by race/ethnicity during December 2020. There were racial/ethnic mortality differentials, with the highest mortality Cml observed among Blacks/AA, while intermediate and lowest mortality Cml were observed among Hispanics and Whites respectively.

Table 2: COVID-19 Mortality Prevalence by race/ethnicity, December 2020, Washington DC

Variable	COVID-19 Mortality prevalence, December 2020							
Race/Ethn	1-Dec	2-Dec	3-Dec	4-Dec	5-Dec	6-Dec	7-Dec	8-Dec
	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)
NHW	70(10.1)	70(10.1)	70(10.1)	70(10.1)	70(10)	72(10.3)	72(10.3)	72(10.2)
NHB	511(74.1)	512(74)	513(74.1)	515(74.1)	517(74.2)	518(74)	518(74)	521(74)
Hispanic	91(13.2)	92(13.3)	92(13.3)	92(13.3)	92(13.2)	93(13.3)	93(13.3)	93(13.2)

Notes and abbreviations: The mortality prevalence as cumulative mortality was estimated using subpopulation mortality divided by the total daily mortality. n=number or frequency, % = percentage, Dec=December, NHW = Non-Hispanic White, NHB= Non-Hispanic Blacks. Data Source: Washington DC Department of Health



COVID-19 Case Fatality Proportion, stratified by race/ethnicity

Table 3 exhibits COVID-19 case fatality in Washington DC during December 2020, stratified by race/ethnicity. Commencing December 1st to the 8th of December, 2020, there were racial /ethnic differentials in case fatality. The case fatality proportion was highest among NHB, ranging from 4.64% to 5.00%, intermediate among Hispanics, ranging from 1.69% to 1.73%, and lowest among NHW, 1.26% to 1.35%. The case fatality stratified by race/ethnicity during December 2020 is illustrated in **figure 4** as a linear graph. The case fatality was highest among NHB, intermediate among Hispanics but lowest among NHW.

Table 3: COVID-19 Case Fatality Proportion by Race/Ethnicity, December 2020, Washington, DC

Variable	COVID-19 Case fatality , December 2020							
Race/ethnicity	1-Dec	2-Dec	3-Dec	4-Dec	5-Dec	6-Dec	7-Dec	8-Dec
	%	%	%	%	%	%	%	%
NHW	1.35	1.33	1.32	1.3	1.27	1.29	1.29	1.26
NHB	5	4.95	4.9	4.81	4.8	4.73	4.68	4.64
Hispanic	1.76	1.77	1.76	1.73	1.72	1.72	1.71	1.69

Notes and abbreviations: The case fatality proportion or prevalence was estimated using the total mortality in a specific subpopulation divided by the total case positivity in that subpopulation. % = percentage, Dec=December, NHW = Non-Hispanic White, NHB= Non-Hispanic Blacks

COVID-19 Mortality Risk Model

Although not on the tables, the mortality risk from COVID-19 illustrated racial/ethnic differentials. Relative to NHW in Washington DC, NHB were almost 4 times as likely to die from COVID-19 in November 2020 prior to Thanksgiving, prevalence odds ratio, (pOR)=3.62, 95%CI, 2.78-4.73, Attributable fraction of exposed (AFE),72%, while Hispanics were 25% more likely to die, Hispanics, pOR=1.25, 95%CI, 1.0-1.74, AFE(18%). Similarly, there was racial differential in mortality risk, with increased risk observed among Blacks/AA, relative to their White counterparts in DC. Compared to Whites, Blacks/AA were 4 times as likely to die from COVID-19, pOR=4.00, 95%CI, 2.87-4.80, AFE (73%).

Discussion

With the current COVID-19 pandemic, and 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 in the Washington DC and propose feasible recommendations in racial/ethnic gap narrowing in SARS-Cov-2 infectivity and COVID-19 mortality. Aggregate data were utilized from the Washington DC where demographic information were available to determine the racial/ethnic 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 Cml case positivity and mortality risk. This study applied an epidemiologic risk modeling based on binomial regression to determine the mortality risk by race/ethnicity in Washington DC. There are a few relevant findings based on this model. First, SARS-Cov-2 Cml varied by race, ethnicity, DC-ward and sex. Secondly, there was a disproportionate burden of COVID-19 mortality among NHB and Hispanics. Thirdly, the case fatality was higher among NHB relative to NHW. Fourthly, NHB relative to NHW regardless of DC-Ward presented with excess mortality and increased COVID-19 mortality risk.

We have demonstrated that SARS-Cov-2 Cml varied by race, ethnicity, DC-Ward 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 [13], as well as a stressful environment in Washington DC.

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 in some DC-Wards as well as disproportionate burden between NHB and Hispanics in these wards. The observed COVID-19 mortality differences by DC-ward is due to the increasing population density of NHB and Hispanics in these wards, as well as the type of employment which predisposed these subpopulations to increased exposure to environments with exponential viral spread such as, sanitation job, maids, and restaurant and hotels housekeeping [15,16]. In addition, the workplace segregation as well as uncompensated sick time may explain the excess SARS-Cov-2 among NHB and Hispanics in Washington DC.

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]. Specifically, the SARS-Cov-2 entry to the host cell is mediated by its spike glycoprotein (S-glycoprotein) and the angiotensin converting enzyme II (ACE-II) as the receptor. This S-glycoprotein on virion surface mediates the ACE II recognition as well as membrane fusion. The hypertensives (HTN) on ACE Inhibitors have been observed with increased risk of SARS-Cov-2 infectivity and poorer prognoses and excess mortality. 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.

Secondly, the social determinants of health which reflect the needed resources to benefit from optimal health are not equitably available for NHB [17]. 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 good paying employment. The social determinants of health, namely education, low socio-economic status (SES), low income, unemployment, food insecurity, racism, unsafe environment, insurance, transportation, and living conditions, adversely impacts the outcome of morbidity and mortality among NHB in the US including Washington DC [19,20].

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 epigenomic modulations, will provide substantial data on intervention mapping in narrowing the gaps between NHB and NHW in Washington DC 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, provoking 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 (transcriptomes) and the inhibition of gene expression with respect to anti-inflammatory response [21]. 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 Blacks/AA, relative to Whites, 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 hydroxymethyl 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 [22]. 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. Further, if DNA hypermethylation facilitates the host cell SARS-Cov-2 spike glycoprotein binding to ACE-II as well as the membrane fusion, therefore subpopulations with aberrant epigenomic modulations characterized by DNA hypermethylation.

Despite the rigorous methodology utilized in this racial/ethnic mortality risk 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 Hispanics in Washington DC 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 and Hispanics is driven solely by these unmeasured confounders [23].

Conclusions and Recommendations

The Washington DC SARS-Cov-2 case positivity, case fatality and mortality risk indicate a disproportionate burden of COVID-19 on the communities of color, namely NHB and Hispanics. 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. These findings are indicative of the need to examine sub-populations health and social needs, namely NHB and Hispanics for intervention mapping for SARS-Cov-2 transmission reduction, racial/ethnic case fatality and mortality gap narrowing. With these findings, we recommend:

(1) An urgent and increasing need for adherence to preventive and control measures in these subpopulations at risk for transmission reduction, mainly Hispanics and NHB, 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 and Hispanics as well as an explanation for the increased risk of transmission among Hispanics and NHB in DC-Wards.

a. The application of these recommendations will enhance Washington DC in curve flattening and down drifting as well as case fatality mitigation especially among the marginalized and most vulnerable populations, namely NHB, American Indian/Alaska Natives and Hispanics.

b. Since health equity is essential in subpopulations risk and health outcomes marginalization, this study clearly recommends the Washington DC to utilize disproportionate benefit for NHB and Hispanics 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 Washington DC 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 to Blacks/AA and Hispanics

who are socially disadvantaged with low SES in Washington DC. In addition, since history is relevant to human health and survival, we must continue to maintain appointment with history. However history of the Tuskegee Syphilis Experiment of the 1930s should not determine our destiny on SARS-Cov-2 vaccination.

(6) The education of the NHB and Hispanic communities on the health consequences of COVID-19 through ePublic Health Intervention program and the provision of assistance and encouragement for testing, case identification and isolation will flatten the epidemic curve in the Black/AA communities. This initiative will not only reduce social inequities but also 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 Washington DC through the Center for Disease Control and Prevention (CDC) to increase testing throughout the DC, especially in the most vulnerable COVID-19 population, namely NHB and Hispanics.

(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) As the mRNA vaccine for SARS-Cov-2 host "spike" protein generation for antibodies production, the administration of this novel technology vaccine must be widely available 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 in Washington DC.

With these data on racial/ethnic differentials in COVID-19 mortality risk, 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 Washington DC, by educational opportunity, equitable employment opportunity and the departure from structural racism, will render the NHB and Hispanics in DC more vulnerable to public health and healthcare crises in this pandemic and the current surge with the new SARS-Cov-2 variants. 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 and Hispanics, since human life remains a primary value.

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