

Ethnicity as a Risk Factor for the Novel Coronavirus Disease 2019 (COVID-19)

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ABSTRACT

Since its emergence in 2019, 2019-nCoV affected all human races on different continents by different rates based on different factors. It is highly essential to explore ethnicity variation and genetic background that might be predisposing factors in increasing susceptibility to being infected by this viral highly communicable disease. Thus, the objectives of this study are to review the current incidence and death rate for various ethnic groups and to develop risk factors list to be utilized for the management and treatment of patients suffering from COVID-19. The review carried out using global databases, including google scholar, the web of sciences, Scopus, PubMed. In this study, all reports classified into five ethnic groups, including Hispanic, African, Caucasian, and Asians. The current data showed that White (not Caucasians), Hispanic, African, and Asians have an incidence factor of 3.8, 2.3, 1.8 higher compared to White (Caucasians), respectively. Although the incidence depends on other factors such as the type of profession, it also indicates variation in incidence according to ethnic group. The current literature showed that even if people live in the same geographical region and with the same economic level, they will have different responses to the COVID-19. Some also suffered from adverse healthcare affects more than white community members. In-country levels, the death rate seems to be independent of ethnicity within Asian and African countries have the least death rate. A risk factors score developed for effective patient management.

Key words: Coronavirus disease, COVID-19, Ethnicity, Risk factors

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organization (WHO) Coronavirus Disease (COVID-19) Dashboard 4 November 2021, number of confirmed cases is 247,968,227 and the number of deaths is 5,020,204 [1, 2].

INTRODUCTION

The pandemic of novel coronavirus disease 2019 (COVID-19) first diagnosed in the city of Wuhan, Hubei province, China, since December 2019. The virus outbreaks and continues to affect humans in all aspects of life all over the globe. Referring to the world health

Because of fact, this disease was diagnosed in almost all human races on different continents by different rates based on different factors. It is highly essential to explore ethnicity variation and genetic backgrounds that might be predisposing factors in increasing susceptibility to being infected [3].

SARS-COV & SARS-COV-2 are sharing the identical receptor of angiotensin-converting enzyme 2 (ACE2), which was found more predominant in Asian men accumulated in the lungs, especially in type2 alveolar cells (AT2). It is associated with an abnormal genetic expression suggesting increased susceptibility to the disease due to epigenetic dysregulation of ACE2 and interferon-regulated genes [2,4,5,6].

SARS-CoV-2 can cause serious respiratory system illnesses and could lead to death. Individuals who have a compromised immune system are found more susceptible to severe disease status [3]. These subgroups suffer a higher prevalence of COVID-19 than in women and patients of other ethnicities [4]. In general, effective management and treatment outcome of COVID-19 patients depends on many factors including age, chronic diseases (illness profile), immunocompromised patients (cancer, HIV) health care resources and preparedness level of the intensive care unit [4].

Patients with different ethnic backgrounds are varying in morbidities, risk of infection, and immune profiles. It was noticed that Black ethnicity show increased morbidity and mortality in previous pandemics. Differences in regard to morbidity and mortality between Chinese and Italian populations are indicative of the important role of ethnicity in disease outcome. Ethnicity is considered a complex factor that included genetics, social composition, behavioural and cultural patterns.

Ethnicity used to identify genetic and other differences among populations. In both the U.K. and the USA, it was observed that minor ethnicity is linked with an increased prevalence of COVID-19 morbidity and mortality, which indicates genetics, economics, cultural and behavioural links.

[5,6]. Blacks have a higher severity of COVID-19 than other populations [20]. Recent reports from different countries showed that Blacks are more vulnerable to COVID-19 than Caucasian (whites) up to four times in death rate [11,18]. For example, data from the USA reported that in Chicago, where blacks make up only 30% of the population, they represent about 50% of COVID-19 patients and about 70.0 % of COVID-19 deaths.

In Louisiana, Blacks are 32.2% of the total state population but contribute up to 70% of COVID-19 victims. In Michigan, Blacks are 14% of the population but represent one third of COVID-19 patients and 40% of mortality [11,18]. Thus, the objectives of this study were to review the current incidence and death rate for various ethnic groups and to develop risk factors scale to be used for the management and treatment of COVID-19 victims.

MATERIALS AND METHODS

In this review study, the data obtained from published scientific literature, which including journal articles, World Health Organization (WHO) reports that published in English languages. The review carried out using the global databases, including google scholar, the web of

sciences, Scopus, PubMed using the keywords "COVID-19," and "Coronavirus," combined with "ethnicity," "risk factor," or "incidence and death rate.

In this study, all reports classified into five ethnic groups, including White (not Caucasians), Hispanic, African, Caucasian, and Asians. Only previous studies that were relevant to this work included in this review. COVID 19 data analyzed from 12 countries across the globe.

Three countries selected from Europe (the U.K., Italy, and Greece), as well as three from Latin and South America, are Brazil, Mexico, and Peru, from Africa, Nigeria, South Africa. Ethiopia and Asia were Japan, Sri Lanka, and Indonesia to have representative data based on population and population density, obesity, half-life, COVID-19 incidence, and percentage death.

RESULTS AND DISCUSSION

Data is compelling for different prevalence by ethnicity

The data from the US show that COVID-19 is killing African Americans at a rate of 7% to 193% higher than the general population [11,18]. Thus, not everybody is at equal risk of COVID-19 of incidence and death probability. The infection and death rate in certain counties with African American inhabitants have three times and six times higher rates of infections and deaths rate compared to counties with white residents [12].

In the United Kingdom (U.K.), data showed that while U.K. Blacks comprise approximately 3% of the U.K. population, they represent 12% of COVID-19 ICU patients. By contrast, Blacks only accounted for 3% of non-COVID-19 viral pneumonia ICU admissions.

Blacks were also disproportionately represented among those with COVID-19 who required ventilators; ventilation associated with a 67% mortality rate [18]. In the U.S. history of the pandemic in the last century (Spanish influenza), Blacks had a higher mortality rate compared to whites' populations.

Also, the admission of Blacks and Hispanic pediatric and children to hospitals for the respiratory syncytial virus, seasonal influenza, and parainfluenza viruses are higher compared to their Whites counterparts [19].

The high current risks of ethnic minorities in the U.S. due to the SARS-CoV2 pandemic are comparable to the risks during the 2009 H1N1 novel influenza disease. An estimated 60.8 million cases of H1N1 with 274,304 hospital admissions and 12,469 deaths occurred in the US from April 2009 to April 2010 [48]. The present SARS-CoV-2 pandemic has caused more mortality in the U.S. in under three months (104 242 deaths as of May 29, 2020) [1,9].

Among 305 patients hospitalized with COVID-19 in area of Atlanta, ethnicity and race data were existing only for 97.4% COVID-19 cases (297 patients), from them, Black was 83.2% (247 patients) , non-Hispanic whites were 10.8% (32 patients), non-Hispanic Asian or Pacific

Islander was only 2.7% (8 patients). Hispanic were 3.4% (10 patients).

Mean age showed very little difference as a disadvantage for blacks since black patients were (60 years), while nonblack patients were (64.5 years). Regarding insurance, private insurance was available for (40.1%), Medicare was available for (33.4%); Medicaid was available for 10.9%, and 14.9% were uninsured [20].

On April 10, 2020, 3883, COVID-19 infected patients distributed as 486(14%) Asian and 402(12%) Black. This incidence is massive because the minority ethnic population is only 14% of the population in the U.K. Moreover, most medical doctors who have died from this virus belong to these ethnic minorities [8].

On April 24, 2020, 6720, COVID-19 infected patients were distributed as Black, Asian, and Minority Ethnic (BAME) patients represent about 34.3% need intensive care (IC), and 34.4% need advanced respiratory support. Furthermore, the death rate was more in BAME patients than Caucasian whites (55.3% vs. 48.4%) in IC [21].

On May 1, 2020, 6770, severely COVID-19 infected patients were distributed as 2300(34%) were from minority ethnic/racial groups. In the USA, the data from certain states show that COVID-19 deaths arise amongst Blacks than Whites up to 52% of COVID-19 deaths [23].

It was reported that SARS-CoV-2 was tested positive in 14.3% of Hispanic, 8.5% of Black, 6.7% of Asian and 3.7% of whites who tested for the disease. The result indicates a noticeable variation depending on ethnicity [29]. Thus, we concluded that there was a variation incidence of 3.8, 2.3, 1.8 higher compared to White (Caucasians).

However, the incidence depends on other factors, such as the type of profession. Another study from the United States found that most ethnic minorities live in poverty level with limited educational achievement and had higher rates of hospital admissions and mortality related due to COVID-19 [33]. In another study conducted in the United States on 5,834,543 individuals, 62,098 tested and 5,630 were found positive.

Among these positive cases, Whites were 40.2%, Blacks were 48.7%, and Hispanics were 11.1%. However, only 5.8% of White tested were positive, while 15.2% of Black tested were positive, and 11.7% of Hispanics tested were positive [35]. Furthermore, racially segregated, impoverished neighbourhoods during a pandemic is one of the main risk factors for coronavirus infection in the entire community [41].

Interpretation of variation of COVID-19 prevalence by ethnicity

Ethnicity, population density, and overweight/obesity (Body mass index (BMI) ≥ 30) were all found to have strong independent associations with Covid-19 mortality [27]. In the U.S., Hispanic and African Americans have the highest obesity rate compared to other populations groups [44]. Paich et al. [45] reported that obesity

significantly affects the treatment results of infected patients with H1N1 influenza.

Thus, being older in age, male in gender, or suffering from respiratory disease, hypertension, diabetes, cardiovascular diseases, and obesity, is leading to worse outcomes of COVID-19 [23]. Differences between ethnic's groups in susceptibility or body response to COVID-19 might be due to genetic predisposition, cultural, socioeconomic, and lifestyle differences [6].

Blacks are affected by many factors include limited health care access, poverty, mass incarceration, infant mortality, and health-related conditions such as heart disease, kidney disease, respiratory disease, stroke, diabetes, and human immunodeficiency virus (HIV). Africa, as a continent, has known for a significant impact of inequity and suffers from 25% of the global disease burden [7]. COVID-19 found to be associated with pulmonary intravascular coagulopathy (PIC), which is a novel pulmonary specific vasculopathy that different from coagulopathy Disseminated intravascular coagulation (DIC).

Thrombotic risk is known to be significantly affected by race; pulmonary vasculopathy may explain differences in mortality and morbidity by race [14]. Venous thromboembolism (VTE) has a significantly higher incidence among African Americans than among Caucasians. Native Americans have an extremely high prevalence of diabetes, and Hispanic/Latin X individuals suffer from similar comorbidities at comparable rates [18].

Even different ethnic individuals living in the same geographical location are showing different susceptibility and outcomes of COVID-19 [14,23,25]. In another study, diabetes found in 39.7% of COVID-19 patients. Also, diabetes was the most common in COVID-19 patients who were 50–64 years age (46.5%; $p = 0.001$) and diabetes was more common in black COVID-19 patients than in nonblack patients (41.7% versus 32.0%; $p = 0.21$). Regarding severe obesity (BMI ≥ 40), median BMI was found higher in Black (31.4) than in nonblack patients (29.6; $p=0.003$). Hypertension more commonly found among black than nonblack patients (69.6% versus 54.0%; $p=0.047$) [20]. Obesity has detrimental effects on lung function [39].

In the U.K., it is well known that BAME ethnic individuals are more than Caucasian Whites are suffering from chronic health problems such as diabetes and cardiovascular disease. Moreover, BAME individuals have significantly earlier onset of disease (e.g., they start to type 2 diabetes in the early 40s). The severity of COVID-19 among BAME patients might be explained by the presence of multiple comorbidities and a longer duration of these chronic pathological conditions [21]. Furthermore, in the United States, also multimorbidity is more common, and occurs at earlier middle age and advanced more rapidly among minority ethnic groups [10].

In another study that had been conducted on 1200 cases hospitalized due to COVID-19 infection to the King's College Hospital National Health Service (NHS) during the time from March 1, 2020, to May 12, 2020, they found 25.8% of patients were Black which they suffered more than white from hypertension, diabetes mellitus and needed urgent critical care [32]. Controlling good blood pressure relieves the COVID-19 burden.

Hypertension noticed to be more severe and resistant to treatment in African-Caribbean descent than Caucasian whites. Furthermore, another high-risk group for COVID-19 is individuals from south Asians due to their higher incidence of coronary heart disease [25].

Results of the first 200 patients admitted via the Emergency Department at Kings College Hospital, London, that subsequently tested positive for SARS Co-V in any nasopharyngeal swabs. Ethnicity [26]

- Black: 103 (51.5%)
- White: 47 (23.5%)
- Any other (Arab, Indian, Asian): 29 (14.5%)
- Not specified: 21 (10.5%)

Comorbidities [26]

- Malignancy: 15 (7.5%)
- Hypertension: 98 (49%)
- Diabetes: 77 (38.5%)
- Lung disease (COPD and other): 41 (20.5%)
- Renal failure: 28 (14%)
- IHD: 24 (12%)
- Dementia: 24 (12%)

Ethnicity [26]

- White: Male-40 (23.3); Female: 7 (25.0)
- Black: Male: 88 (51.2); Female: 16 (57.1)
- Other: Male: 25 (14.5); Female: 3 (10.7)
- Not specified: Male: 19 (11.0); Female: 2 (7.1)

Ethnicity, population density and overweight/obesity were all found to have strong independent associations with Covid-19 mortality [27].

Compared to white people, people of Asian and Black ethnic origin were found to be at a higher risk of death [28].

Renal disease concerning ethnicity was studied extensively. In the U.S., end-stage renal failure risk is higher by 1.5 to 4 times among ethnic minorities than white. Also, Chronic Kidney Disease (CKD) is known to be a complexity of diabetes mellitus and hypertension; thus, it is crucial to be considered as of implications in the risk of COVID-19. These COVID-19 patients have a chronic kidney disease (proinflammation state) associated with immune system functional defects, which leave them at a higher risk for Pneumonia and URTIs [25]. African populations in the U.K. and the USA are suffering from stroke more commonly, and South Asian groups are suffering from moderately increased risk of coronary heart disease more than White populations [23].

Lung function was investigated in multiple studies and found to be different from different ethnic groups. Lower lung function has an association with minority ethnic descent [25]. Other lung chronic infection, containing asthma, tuberculosis, and COPD might be contributing to the serious morbidity or mortality of COVID-19 in minorities [23].

Vitamin D deficiency, another risk factor for COVID-19, commonly found among minority ethnic populations. For instance, in one study that was found 12.0% of Black African-Caribbean and 42.0% of individuals from South Asia suffering from severe vitamin D deficiency. Correlation of acute respiratory system disorder with a low serum of Vitamin D was observed in some studies. Thus, it was suggested that COVID-19 risk of infection could be reduced by using vitamin D supplementation [25]. Serum concentrations of 25-hydroxy vitamin D were commonly found very low in ethnic minorities who have darker skin in both the U.K. and the USA [23].

Furthermore, in other studies, a statistically significant lower concentration of vitamin D in minorities including Black and Asian (by 16.0 nano mol/L) with probability value (P) of <0.001 than White ethnicity [30]. Vitamin D is essential for healthy immunity; thus, the difference in vitamin D deficiency is partially explaining the differences in immunity against COVID-19 by different ethnicity. Also, the level of immunity, diet, lifestyle and as nutrition elements that are needed to retain level of immunity system, are lower among minorities. In the U.K., vitamin D deficiency cases were found more among the BAME populations. Additionally, a lack of knowledge about the importance of a healthy nutrition and lifestyle is more common among BAME individuals, especially those who live in deprived areas [21]. Disadvantages socially and economically factors such as poor diet, higher alcohol use, cigarette smoking, and exposure to psychosocial stressors are more among minority communities [21,23,36]. It reported also individuals of minority populations such as Blacks, Latinos, and Indian-Americans are working low-benefit occupations with high public contact (more social mixing), lesser capability to work remotely from home and also constitute the majority amongst the dispossessed persons more than Caucasian whites which increased risk of morbidity and mortality of COVID-19 [9].

For instance, minorities are working in occupations that know of a high risk of COVID 19 infection such as sales and consumer service, transport, and security services. These occupations lead to a harder situation to prevent from keeping social distancing measurements, thus increases their risk of exposure to COVID-19 [16]. Lack of paid sick leave is a factor contributing to increase risk of the disease because workers without paid sick leave continue working even during sick situations. It was reported that low incomes workers are less able to stop working and stay home [29,23].

African Americans have a lower income than other ethnic groups in the U.S. It has recently been demonstrated that low-income areas in New York had seen the most

significant increases in COVID-19 cases. It has been hypothesized that this effect can be explained by differences in socioeconomic status across races since lower-income people have been slower to adopt social distancing, and more often have jobs that do not allow them to do that [12]. The incidence and death from COVID-19 infection increasing drastically in locations with limited irradiance to UV radiation and following lower irradiance days. Primary viral replication occurs in the mucosal epithelium tissues of the nasopharynx. People with dark skin need five times as much exposure to sunlight (UV) to obtain the effects a person with lighter skin receives due to their UV radiation resistivity [12]. People from minorities who live in areas of lower economic level are at increased risk of morbidity and mortality of COVID-19 than white or higher income, respectively [15].

Adults from Black, Asian, and Minority Ethnic populations are associated with the risk of food insecurity at this time of isolation [17]. Differences in immunity levels as well as subordinate hygiene level measurement such as the frequency of handwashing and use of sanitizer are exist between them and Whites [19].

Lower incomes also found to be translated into overcrowded housing, which increases virus transmission. i.e., the probability of infection is increased with the number of people contacted [23,25,29]. In the U.K., the population from BAME minorities are living in households that are more overcrowded than White British households [16]. Educational and linguistic barriers in applying preventative measures lead to poor health outcomes in minority ethnic groups [25]. Even for physicians' inability to self-isolate is linked with a 1.7 times greater risk of COVID-19 infection for BAME ethnic minority hospital physicians [31]. Lack of health insurance commonly found among Black/African American and Hispanic populations, which leads to reduced access to health care and less use of health care. Furthermore, late testing and diagnosis of COVID-19 cases leads to later presentation and significantly affect the treatment outcome [23].

Culture, including worship places and multigenerational households also increased risks of exposure and transmission of COVID-19 and affect the treatment outcomes [23]. It was reported also treatment outcome is significantly affected by Bacillus Calmette-Guérin (BCG) vaccination protocol among different countries. Countries with high dose vaccination protocol of (0.78/million) have lower death rate of COVID-19 in contrast to countries with low dose vaccination protocol of (16.39/million) [25].

Pregnancy is well known as an immune-compromised status characterized by an increased demand on the cardiovascular. It was reported that some pregnant that have confirmed COVID-19, developed cardiomyopathy and respiratory system disorder [34].

In cities of Hubei province in China, Italy and the USA, substantial association between air quality levels (pollution) and COVID-19 morbidity and death rate. Air

pollution leads affect directly the ability of the lungs and respiratory system to eliminate disease-causing agent's such as fungi, viruses, and bacteria and indirectly by increasing the risk of pulmonary and cardiovascular systems diseases. In the U.S., the minorities are at higher risk of exposure to air pollution compared to Whites [38].

To obtain a real comparison between different countries with majorities of different ethnic groups in a different continent with different healthcare levels with different population density selected and presented in Table 1. Table 1. Showed demographic data of 12 countries from different continents showed a wide variation in incidence and death rate percentage. Older age and obese populations have higher risk factors of COVID -19 compared to the younger population. Figure1 showed that developed countries (European countries and Japan) have the highest half-life expectancy compared to Asian and African countries with a ratio of 1.3 compared to African countries [1,42]. Figure 1 showed that the higher death rate occurred in European countries compared to African countries. Although the outbreak of COVID-19 still ongoing, low incidence and death rates in Asian countries and African countries may remain independent of ethnicity. However, many countries in Africa and Asia have limited COVID-19- testing capabilities; thus, the reported incidence and death might not be accurate compared to their counterpart in developed countries. Besides, Africa has more young inhabitants, and only 3% of the population is above 65 years old, with a median age of 20 years old [46]. Table 1. Shows a summary of COVID 19 risk factors incidence as reported in the literature. Table 2 categorizes risk factors in six main groups, including health problems, demographics, lifestyle, Socio-Economic Status, Work Conditions, and Location and Housing according to the literature from different continents. This list is critical in preventive actions as well as for health care providers to manage patients' conditions and to take the necessary measures earlier for patients with higher risk factors compared to others. The study limitation arises from the rapid spread of the virus worldwide, and although our data is very updated, we still every day new papers published in the COVID-19. However, this also is very useful since many countries still have a limited number of patients or other countries expecting a second wave of the pandemic. Thus, any additional information is required to improve our capability to save lives.

Table 1 shows a summary of risk factors of COVID -19 incidence, death and percentage in May and October 2020. It also shows the difference value which indicate the progress of the disease during these 5 months period. Nigeria, Ethiopia, and South Africa are examples for Blacks. Mexico, Brazil, and Peru are examples for Hispanics. Indonesia, Japan, and Sri Lanka are examples for Asians. United Kingdom, Italy and Greece are examples for Caucasians.

Table 1: Demographic data of 12 countries from different continent showed wide variation in incidence and death rate percentage.

Country	Population (million)	Population density (person/km ²)	% of Obesity	Average half-life	Total infected	Total death	Death rate (%of death/infected)	
					May-20			
					Oct-20			
					Difference value			
Nigeria	206	226	11	55.8	8,915	259	2.9	
					61,992		1,130	1.8
					53,077		871	1.6
Ethiopia	114	115	4	67.8	831	7	0.8	
					93,343		1,426	1.5
					92,512		1,419	1.5
South Africa	59	49	26.8	64.9	27,403	577	2.1	
					715,868		18,968	2.6
					688,465		18,391	2.7
Mexico	128	66	28.1	75.4	78,023	8,597	11	
					891,160		88,924	10
					813,137		80,327	9.9
Brazil	212	25	20	76.6	419,340	25,945	6.2	
					5,394,128		157,134	3
					4,974,788		131,189	2.6
Peru	32	26	21.1	77.4	141,779	4,099	2.9	
					888,715		34,149	3.8
					746,936		30,050	4
Indonesia	273		5.7	72.3	25,216	1,520	6	
					392,934		13,411	3.4
					367,718		11,891	3.2
Japan	126	347	3.3	85	16,683	867	5.2	
					97,498		1,725	1.8
					80,815		858	1.1
Sri Lanka	21		6.5	77.6	1,530	10	0.7	
					8,413		16	0.2
					6,883		6	0.1
United Kingdom	67	281	28.1	81.8	269,127	37,837	14.1	
					873,804		44,896	5.1
					604,677		7,059	1.2
Italy	60	206	21	84	231,732	33,142	14.3	
					525,782		37,338	7.1
					294,050		4,196	1.4
Greece	10	81	22.90%	82.8	2,906	175	6	
					30,782		574	1.9
					27,876		399	1.4

Table 2 categories risk factors in six main groups including health problems, demographics, lifestyle, Socio-Economic Status, Work Conditions and Location and

Housing according to the literature from different continents. This list is very important in preventive actions as well as for health care providers to manage

patients' conditions and to take the necessary measures others.

Table 2: COVID -19 risk factors.

No.		Risk Factor	Reference
1.	Health Problems	Chronic obstructive pulmonary disease (COPD)	23
2.		Chronic lung or respiratory system disease	18
3.		Chronic kidney disease	7,25
4.		Cerebrovascular disease	,23
5.		Cardiovascular disease /coronary heart disease	18,23,25
6.		Stroke	7,23
7.		Hypertension	18,23,25
8.		Diabetes	18,23,25
9.		Obesity	18,23,27
10.		Vitamin D deficiency	21,23,25,30
11.		Pregnancy	34
12.		Compensated respiratory alkalosis with metabolic acidosis	34
13.		Human immunodeficiency virus (HIV)	7
14.		Low immunity levels	21
15.		Low lung function	25
16.		Asthma	23
17.		Tuberculosis	23
18.		Lack of BCG vaccination	25
19.		Infant mortality	7
20.	Demographics	Minor Ethnicity (Black, Hispanic, Asian, Others)	14,15,16,18,23,25,27
21.		People with dark skin	12
22.		Older age	23
23.		Sex (man)	23
24.	Life style	Diet imbalance	21
25.		History of smoking / higher cigarette smoking	23
26.		Alcohol use	23
27.		Rely on public transport for their travel	25
28.		Exposure to infected cases	9
29.		Lower levels of hygiene the frequency and timing of hand washing as well as use of sanitizer.	36
30.	Socio-Economic Status	Inability of self-isolate	25
31.		Poverty,	7
32.		Homeless	9
33.		Detained	9
34.		Limited health care access,	7,19,23

		Less likely to have health insurance, with consequent reduced health-care access and use.	
35.		Low incomes	12
36.		Low socioeconomic status / socioeconomically disadvantaged	12,25
37.		Poor living conditions, and	
38.		Food insecurity	17
39.		Limited resources	19
40.		Exposure to psychosocial stressors.	23
41.		Lower baseline health	19
42.		Increased perceived discrimination, and	19
43.		Culture, including places of worship, multigenerational households	23
44.		Educational and linguistic obstacles in adopting preventative measures.	25
45.	Work Conditions	Workers in low-benefit occupations	9
46.		Lack of paid sick leave.	29
47.		Work in health services/or another service-sector	25
48.		Work in place of high exposure risk /high public contact	9
49.		Work as essential workers/zero hours contracts and non-salaried jobs	16,29
50.	Location and Housing	Air pollution in place of work or residency	38
51.		Living in racial segregation places	41
52.		Locations with lower irradiance	12
53.		Live in low-income households	15
54.		Population density	27
55.		Mass incarceration,	7
56.		Crowded housing	16,23,25

CONCLUSIONS

From previous studies, ethnicity has an impact on the incidence and treatment outcome of many clinical conditions, including COVID-19. African American, Hispanic societies are likely to have greater incidence rates of chronic diseases including diabetes mellitus, hypertension and respiratory system disorders than their white counterparts. The current literature showed that even if people live in the same geographical region and with the same economic level, they have a different response to the COVID-19. The highest incidence may be attributed to differences in socioeconomic status across races since lower-income people have been slower to adopt social distancing, and more often have jobs that do not allow them to do that. As a result, the current data showed that Hispanics, Africans, and Asians have an incidence factor of 3.8, 2.3, 1.8 higher compared to White (Caucasians), respectively. Although the incidence depends on other factors such as type of profession, this also indicates variation in incidence according to ethnic

group. In-country levels, the death rate seems to be independent of ethnicity with Asian and African Countries have the least death rate. A risk factors list developed to provide effective patient management and to improve the outcome of the prevention, diagnosis, and therapeutic intervention and help in selecting appropriate policies by health care providers. In addition to that, in promising drug or vaccination testing, the various responsibilities of different ethnic groups must be considered.

REFERENCES

1. <https://covid19.who.int/>
2. Zhao Y, Zhao Z, Wang Y, et al. Single-cell RNA expression profiling of ACE2, the receptor of SARS-CoV-2. Am J Respir Critical Care Med 2020; 202:756-759.
3. Sawalha AH, Zhao M, Coit P, et al. Epigenetic dysregulation of ACE2 and interferon-regulated

- genes might suggest increased COVID-19 susceptibility and severity in lupus patients. *Clin Immunol* 2020; 215:108410.
4. Cai H. Sex difference and smoking predisposition in patients with COVID-19. *Lancet Respir Med* 2020; 8:e20.
 5. Pareek M, Bangash MN, Pareek N, et al. Ethnicity and COVID-19: An urgent public health research priority. *Lancet* 2020; 395:1421-1422.
 6. Khunti K, Singh AK, Pareek M, et al. Is ethnicity linked to incidence or outcomes of covid-19? *BMJ* 2020; 369:m1548.
 7. Laurencin CT, McClinton A. The COVID-19 Pandemic: A call to action to identify and address racial and ethnic disparities. *J Racial Ethn Health Disparities* 2020; 7:398-402.
 8. Rimmer A. Covid-19: Disproportionate impact on ethnic minority healthcare workers will be explored by government. *BMJ* 2020; 369:m1562.
 9. Bavel JJV, Baicker K, Boggio PS, et al. Using social and behavioural science to support COVID-19 pandemic response. *Nat Hum Behav* 2020; 4:460-471.
 10. Quiñones AR, Botosaneanu A, Markwardt S, et al. Racial/ethnic differences in multimorbidity development and chronic disease accumulation for middle-aged adults. *PLoS One* 2019; 14:e0218462.
 11. Yancy CW. COVID-19 and African Americans. *JAMA* 2020; 323:1891-1892.
 12. Bäcker A. Why COVID-19 may be disproportionately killing African Americans: Black overrepresentation among COVID-19 mortality increases with lower irradiance, where ethnicity is more predictive of COVID-19 infection and mortality than median income. *SSRN* 2020.
 13. Alifano M, Alifano P, Forgez P, et al. Renin-angiotensin system at the heart of COVID-19 pandemic. *Biochimie* 2020; 174:30-33.
 14. Fogarty H, Townsend L, Ni Cheallaigh C, et al. COVID19 coagulopathy in Caucasian patients. *Br J Haematol* 2020; 189:1044-1049.
 15. Raifman MA, Raifman JR. Disparities in the population at risk of severe illness from COVID-19 by race/ethnicity and income. *Am J Prev Med* 2020; 59:137-139.
 16. Aldridge RW, Lewer D, Katikireddi SV, et al. Black, asian and minority ethnic groups in England are at increased risk of death from COVID-19: Indirect standardisation of NHS mortality data. *Wellcome Open Res* 2020; 5:88.
 17. https://foodfoundation.org.uk/wp-content/uploads/2020/04/Report_COVID19FoodInsecurity-final.pdf
 18. Haynes N, Cooper LA, Albert MA. Association of black cardiologists. at the heart of the matter: unmasking and addressing the toll of COVID-19 on diverse populations. *Circulation* 2020; 142:105-107.
 19. Myers EM. Compounding health risks and increased vulnerability to SARS-CoV-2 for racial and ethnic minorities and low socioeconomic status individuals in the United States. 2020.
 20. Gold JAW, Wong KK, Szablewski CM, et al. Characteristics and clinical outcomes of adult patients hospitalized with COVID-19 - Georgia, March 2020. *Morb Mortal Wkly Rep* 2020; 69:545-550.
 21. Gumber A, Gumber L. Differential effects of COVID-19 by gender and ethnicity. *BMJ* 2020; 369:m1548.
 22. Li G, Hu R, Zhang X. Antihypertensive treatment with ACEI/ARB of patients with COVID-19 complicated by hypertension. *Hypertens Res* 2020; 43:588-590.
 23. Bhalra N, Curry G, Martineau AR, et al. Sharpening the global focus on ethnicity and race in the time of COVID-19. *Lancet* 2020; 395:1673-1676.
 24. Johnson MRD, Bhopal RS, Ingleby JD, et al. A glossary for the first world congress on migration, ethnicity, race and health. *Public Health* 2019; 172:85-88.
 25. Abuelgasim E, Saw LJ, Shirke M, et al. COVID-19: Unique public health issues facing Black, Asian and minority ethnic communities. *Curr Probl Cardiol* 2020; 45:100621.
 26. Sneep R, Cattle F, Brookes A, et al, Early epidemiological and clinical analysis of the first 200 patients with COVID-19 admitted via the emergency department in kings college hospital, London: A retrospective cohort study. *SSRN* 2020.
 27. Bray I, Gibson A, White J. Coronavirus disease 2019 mortality: A multivariate ecological analysis in relation to ethnicity, population density, obesity, deprivation and pollution. *Public Health* 2020; 185:261-263.
 28. Williamson E, Walker AJ, Bhaskaran KJ, et al. Open safely: Factors associated with COVID-19-related hospital death in the linked electronic health records of 17 million adult NHS patients. *medRxiv* 2020; 20092999.
 29. Ahmed SM, Shah RU, Bale M, et al. Comprehensive testing highlights racial, ethnic, and age disparities in the COVID-19 outbreak. *medRxiv* 2020; 200920311.
 30. Darling AL, Ahmadi KR, Ward KA, et al. Vitamin D status, body mass index, ethnicity and COVID-19: Initial analysis of the first-reported U.K. Biobank COVID-19 positive cases (n 580) compared with negative controls (n 723). *medRxiv* 2020; 20084277.
 31. Daga S, Chakravorty I, Bamrah J, et al. Self-reported occupational risk for COVID-19 in

- hospital doctors from black Asian & minority ethnic communities in UK. *Phy* 2020; 6.
32. Teo JT, Bean D, Bendeyan R, et al. Impact of ethnicity on outcome of severe COVID-19 infection. Data from an ethnically diverse U.K. tertiary centre. *medRxiv* 2020; 20078642.
 33. Wadhwa RK, Wadhwa P, Gaba P, et al. Variation in COVID-19 hospitalizations and deaths across New York city boroughs. *JAMA* 2020; 323:2192-2195.
 34. Juusela A, Nazir M, Gimovsky M. Two cases of coronavirus 2019-related cardiomyopathy in pregnancy. *Am J Obstet Gynecol* 2020; 2:100113.
 35. Rentsch CT, Kidwai-Khan F, Tate JP, et al. Covid-19 by race and ethnicity: A national cohort study of 6 million United States veterans. *med Rxiv* 2020; 18:2020.05.12.20099135.
 36. Walter LA, McGregor AJ. Sex- and gender-specific observations and implications for COVID-19. *West J Emerg Med* 2020; 21:507-509.
 37. Patel AP, Paranjpe MD, Kathiresan NP, et al. Race, socioeconomic deprivation, and hospitalization for COVID-19 in English participants of a national biobank. *medRxiv* 2020; 2:2020.
 38. Brandt EB, Beck AF, Mersha TB. Air pollution, racial disparities, and COVID-19 mortality. *J Allergy Clin Immunol* 2020; 146:61-63.
 39. Sattar N, McInnes IB, McMurray JJV. Obesity Is a risk factor for severe COVID-19 Infection: Multiple potential mechanisms. *Circulation* 2020; 142:4-6.
 40. McCoy J, Wambier CG, Vano-Galvan S, et al. Racial variations in COVID-19 deaths may be due to androgen receptor genetic variants associated with prostate cancer and androgenetic alopecia. Are anti-androgens a potential treatment for COVID-19? *J Cosmet Dermatol* 2020; 19:1542-1543.
 41. Yu Q, Salvador CE, Melani I, et al. The lethal spiral: Racial segregation and economic disparity jointly exacerbate the COVID-19 fatality in large american cities. *PsyArXiv* 2020; 0621.
 42. <https://www.worldometers.info/demographics/life-expectancy/>
 43. <https://renewbariatrics.com/obesity-rank-by-countries/>
 44. El Chaar M, King K, Galvez Lima A. Are black and Hispanic persons disproportionately affected by COVID-19 because of higher obesity rates? *Surg Obes Relat Dis* 2020; 16:1096-1099.
 45. Paich HA, Sheridan PA, Handy J, et al. Overweight and obese adult humans have a defective cellular immune response to pandemic H1N1 influenza A virus. *Obesity* 2013; 21:2377-86.
 46. Quaresima V, Naldini MM, Cirillo DM. The prospects for the SARS-CoV-2 pandemic in Africa. *EMBO Mol Med* 2020; 12:e12488.