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Predisposing Factors Promoting COVID-19 Infection and Mortality

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Authors' contributions

This work was carried out in collaboration among all authors. Author ACA designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors JON and OTO managed the analyses of the study and managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

The pandemic of COVID-19 infection has had an untold adverse impact on patients living with chronic disease, across various ethnicity/race, age and gender. Underlying hypertension, cardiovascular disease, diabetes and respiratory illness are key risk factors for the development of severe COVID-19 pneumonia and systematic inflammation. Patients who are immunosuppressed by virtue of their chronic disease, age or a therapy have been identified as susceptible groups. The redirection of healthcare services towards the increasing numbers of COVID-19 patients has compromised the healthcare delivery to patients with chronic illness. Movement restriction measures as approach to curb the spread of the infection have also compromised the metabolic

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health of many patients who need enhanced physical activity to improve their health. Media publications on COVID-19 infection and restrictions may have also contributed to the poor mental health of some individuals, especially patients with underlying mental conditions or its risk factors. The inadequate or availability of quality health care system across low income and developing regions especially, those with older age groups, has further accelerated the spread and death rate from COVID-19. Future research should be directed towards protecting vulnerable groups from possible waves of COVID-19 as a measure to reduce the negative impact of the pandemic on these individuals.

Keywords: SARS-COV-2; risk factor; age; sex; ethnicity; background illness.

1. INTRODUCTION

In December, 2019 in Wuhan, China, a novel corona virus was formerly detected [1,2]. The virus outbreak has spread to all countries and on 11th March, WHO (World Health Organization) declared COVID-19 disease a pandemic [1,3,4-7]. It was reported on 14th April, 2020 that total number of confirmed cases were 1,844,863 whereas new confirmed cases were 71,779 with 117,021 death cases [5]. The spread of COVID-19 in different countries varied depending on various factors namely; climate or migration.

The European Region was reported to have the majority of confirmed cases 423,946 (56.45%) which was followed by American region 163,014 (21.70%), others regions made the remaining part [8]. The COVID-19 outbreak resulted in economic disruption globally. It is estimated that over 10million people in Thailand will be facing unemployment. It was reported that 8 million persons had already lost their jobs [9]. Some studies have shown that climate (temperature) was associated with the spread of the disease [10,11,12]. In this paper, we will be focusing on the predisposing factors promoting COVID-19 infection and its mortality.

2. BACKGROUND ILLNESS

A high burden of severity of disease and death from the COVID-19 was observed more in older patients, especially patients with pre-existing medical co-morbities. The global lockdown contributed to why many patients with chronic illness could not access their routine medical care [13]. According to Badawi et al. [14], there was a significant relationship in the 2012 Middle East Respiratory Syndrome (MERS-CoV) outbreak between diabetes, hypertension, heart disease and death in infected patients. In China reports showed that patients with severe complication and death were majorly the elderly. The study by Zhao and co-workers reported that 18.75% of confirmed cases had a history of chronic disease [15].

A research review by Wang et al. [16] supported that diabetes, hypertension, chronic obstructive pulmonary disease, cardiovascular disease were independent risk factors for severe COVID-19 disease. In northern Italy, Onder and colleagues found severe COVID-19 to manifest in greater extent in patients with active cancer and atrial fibrillation. Huang et al. [17] findings revealed that among the 41 subjects with COVID-19 infection, 32% had background medical illnesses; diabetes in 8 subjects, hypertension in 6 subjects, and cardiovascular disease (CVD) in 6 subjects. In the United Kingdom (UK), a cohort study was conducted among 16,749 hospitalized patients with COVID-19; the commonest background illnesses showing comorbidities were chronic pulmonary disease (29%), diabetes (19%), non-asthmatic chronic pulmonary disease (19%), and asthma (14%) [18]. In a research review of eight studies involving 46, 248 patients infected with COVID-19, the commonest comorbidities were hypertension (17±7, 95% - CI 14% - 22%), diabetes (8 ± 6, 95% CI 6 – 11%), cardiovascular disease (5±4, 95% CI 4 – 7%) and then followed by respiratory disease (2 ± 0, 95% CI 1 – 3%).

Compared with confirmed cases with non-severe disease, the pooled odds ratio of hypertension, respiratory disease, and CVD in severe cases was 2.36% (95% CI:1,46 – 3.83), 2.46 (95% CI:1.76 – 3.44), and 3.42 (95%CI:1.88 -6.22) respectively [19]. In a study in New York, hypertension was the most prevalent comorbidity reported in 60% of patients with the disease, next to diabetes, which had 37% of the patients [20]. A multivariate analysis showed that body mass index (BMI), age, and human immunodeficiency virus (HIV) infection or long term kidney disease had a statistically significant relationship with death.

3. AGE

Since its inception, Covid-19 has spread across the nations of the world hence was declared a pandemic whose emergence has produced a large number of cases worldwide [4-7]. As of 29th May, 2020, the statistics of confirmed COVID-19 cases in Italy was 382.3 (per 100, 000 population), 507.2 in Spain, and 13.2 in Japan [4-7]. Of those reported, it has been accounted that older people made a large proportion of fatal cases resulting to a large heterogeneity in the age distribution of mortality.

The expected mortality value is determined by calculating the product of the number of confirmed COVID-19 cases and the mortality rate among cases. As the background mechanism of the heterogeneity of mortality by age, the relationship of two epidemiological factors with mortality can be considered: (i) the age-dependency of infection vulnerability, which accounts for heterogeneity in the number of cases, and (ii) the age-dependency of severity, which accounts for the heterogeneity in the mortality rate; the rate of becoming symptomatic, severe, or fatal case among infected individuals. For the first factor, high infection vulnerability will produce an increased number of infections and consequently an increase in fatal cases. [21,22] The second factor explains that an increase in disease severity will imply a higher mortality rate and resultantly, an increase in the number of fatal cases. This assumption is rational because old age together with the presence of comorbidities has been reported as a risk factor for severe Covid-19 infection [23,24]. Although it is not yet shown in relation to sever acute respiratory syndrome (SARS COV-2), which is the etiology of COVID-19, the relationship of age-dependent severity has been reported in COVID-19 by the determination of innate immune responses in BALB/c mouse model. Besides, suggestions that antibody-dependent enhancement (ADE) can promote the statistics of the observed age-dependency of severity, as suggested in SARS and Middle East Respiratory Syndrome (MERS) cases.

Interestingly, COVID-19 mortality associated with age-dependency is similar among Italy, Japan, and Spain, although the number of deaths vary among them. See table.

4. RACE

Center for Disease Control (CDC), highlighted that ethnicity and race have characteristics features or factors (including socioeconomic status, access to health care, and exposure to the virus related to occupation, e. g., frontline, critical infrastructure workers and essential) that contribute to the way and manner a disease will spread and its severity and management (CDC, 2020). The table below shows the number of cases, hospitalization, and deaths based on races and ethnicity.

5. SEX

Global data indicates higher COVID-19 case infection and fatality rates among men than women [25]. Many countries reported a fatality ratio greater than 1:0 in males and females,

Table 1. Showing the number of death based on age classification in Italy

Age (yrs)	0 - 9	10 -19	20 - 29	30 - 39	40 - 49	50 - 59	60 – 69	>70
Death	3	0	11	58	257	1,051	3,107	25,038

Table 2. Showing the number of death based on age classification in Japan

Age (yrs)	0 - 9	10 - 19	20 - 29	30 – 39	40 - 49	50 - 59	60 -69	>70
Death	0	0	0	2	8	16	44	330

Table 3. Showing the number of death based on age classification in Spain

Age (yrs)	0 - 9	10 - 19	20 -29	30 - 39	40 - 49	50 - 59	60 – 69	>70
Death	2	5	23	61	198	607	1669	16,253

Table 4. Number of cases, hospitalization, and deaths based on races and ethnicity

Rate ratios compared to Whites, non-Hispanic persons	American Indian or Alaska Native, Non-Hispanic person	Asian non-Hispanic persons	Black or African American, non-Hispanic persons	Hispanic or Latino persons
Cases1	1.8x	0.6x	1.4x	1.7x
Hospitalization	4.0x	1.2x	3.7x	4.1x
Deaths	2.6x	1.1x	2.8x	2.8x

Source: cdc.gov.Hospitalization and death by race/ethnicity

getting as high as 3:5 in some cases. However, the mortality rate is higher in females than in males in some countries like India, one of the leading affected countries. In 30th September, 2020, it was reported that India had over 6.4 million recorded coronavirus cases [26]. In India, the mortality rate among men is 2.9% and 3.3% in women. I Vietnam, Nepa and Slovenia also reported higher fatality rates in women than in men. Global statistics shows that biological factors such as strong immune system and behavioral risk factors such as smoking promote the complications and fatality rate of COVID-19 which should place men at higher risk than women but contrarily other reports presents higher fatality rate in women than in men [27,28]. Such differences in findings on the relationship between sex and COVID-19 complication and fatality between countries may be due to limited data across countries, sex-based biases or greater risks for women in some countries because of demographic factors or countries' health profiles.

In India, fatality rate of COVID-19 was reported to be lower than that in the USA. The fact that the Indian population has more of younger people than in the US population could be the rationale why India had low fatality [29]. In addition, due to poor national surveillance testing in India, target groups of symptomatic patients, traced contacts of people who had contact with positive cases were tested. The testing system could result to bias in the enumeration of positive cases in the country. Also, dealing with the large population in India coupled with the poor surveillance system and prioritized testing in institutions were older people are less found could be reasons for the low statistics. These report have been questioned [30]. Previous studies in India have shown a significant difference in gender-based access to health services, with females being less likely to be admitted than males [31]. This could result in bias in the proportion of women population infected with the virus.

Gender-based behavioral differences such like smoking could promote the severity of COVID-19 infection although it has not be clearly proven that smoking is a risk factor for severe disease. Attitudes like hand washing present men to be less likely to wash their hands with soap after using a restroom and in certain cultural practices, women may be more at home unlike men who are always out in the company of friends and job colleagues, hence more at risk of the infection. Unequal access to health care and testing between males and females may cause a shift towards a male bias in infection rates.

6. CONCLUSION

Finally, it is evident that there is a myriad of factors that affect the transmission, virulence and mortality rates of COVID-19 infection. With the current lack of treatment options and prophylactic measures, more interest should be given to elucidating what makes certain groups at higher risk of Covid-19 complications than others.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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