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Risk Factor Profile for Morbidity and Mortality in COVID-19 Patients - A Brief Review

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Abstract Coronavirus disease 2019 (COVID-19) is an infectious disease caused by severe acute respiratory syndrome coronavirus (SARS-CoV-2). The first known severe illness was in 2003 when it presented as severe acute respiratory syndrome (SARS) epidemic in China. The current outbreak and spread of the COVID-19 in human population is phenomenal with clinical features, diagnoses, management and prognosis posing daunting public health and clinical challenges. Consequently, the objective of this review is an attempt to identify the possible risk factors of COVID-19. This will possibly make for patient profiling, and ensure better public health and clinical management of disease for reduced morbidity and mortality. It is important to learn about risk factors for severe COVID-19 illness because it can help to take extra precautions to avoid exposure to the virus that causes COVID-19, and to better understand how a medical condition could affect health of patients with the disease. Also it helps to anticipate medical treatment of victims and reduce the risk for severe COVID-19 illness by instituting appropriate and timely management protocols.

Keywords COVID-19, Patient Profile, Risk factors, Morbidity, Mortality

1. Introduction / Historical Perspective of COVID-19 Pandemic

Coronavirus disease 2019 (COVID-19) is an infectious disease caused by severe acute respiratory syndrome coronavirus (SARS-CoV-2). [1], [2] It is an enveloped non-segmented positive-sense RNA virus. [2] SARS-CoV-2 belongs to the broad family of viruses known as coronaviruses. [1] The first known severe illness caused by a corona virus was the 2003 severe acute respiratory syndrome (SARS) epidemic in China. A second outbreak of severe illness began in 2012 in Saudi Arabia with the Middle East respiratory syndrome (MERS). [3], [4] Corona represents crown-like spikes on the outer surface of the virus; thus, the name-coronavirus. [5]

The virus is thought to be natural and has a zoonotic origin. [1], [4] and there are several theories about where the very first case (the so-called patient zero) originated. The first case of someone suffering from Covid-19 can be traced back to November, 2019. [1], [6] At least 266 people, starting from 17 November, contracted the virus and came under medical surveillance, weeks before authorities announced the emergence of the new virus. The Chinese government was widely criticized over attempts to cover up the outbreak in the early weeks, including crackdowns on doctors who tried to warn colleagues about a new SARS-like virus which was emerging in the city of Wuhan in Hubei province. The data said a 55-year-old from Hubei province could have been the first person to contract Covid-19. For about one month after that date there were one to five new cases reported daily, and by 20 December there were 60 confirmed cases. [6]

Based on the genomic sequencing analysis of the virus, some researchers concluded that the virus evolved to its current pathogenic state through natural selection in a non-human host and then jumped to human, a replay of previous coronavirus outbreaks. In this case, bats were fingered as the most likely reservoir for SARS-CoV-2 as it is very similar to a bat coronavirus. There are no documented cases of direct bat-human transmission, however, suggesting that an intermediate host was likely involved between bats and humans. [3] Other researchers, believed that a non-pathogenic version of the virus jumped from an animal host into humans and then evolved to its current pathogenic state within the human population. However, a study co-author cautioned that it is difficult if not impossible to know at this point which of the scenarios is most likely. If the SARS-CoV-2 entered humans in its current pathogenic form from an animal source, it raises the probability of future outbreaks, as the illness-causing strain of the virus could still be circulating in the animal population and might once again jump into humans. The chances are lower of a non-pathogenic coronavirus entering the human population and then evolving virulent properties similar to

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SARS-CoV-2. [3] Therefore, strengthening the monitoring of wild mammals is an urgent measure needed to prevent similar viruses from infecting humans in the future.

On January 7, a novel coronavirus, originally abbreviated as 2019-nCoV by WHO, was identified from the throat swab sample of a patient. This pathogen was later renamed as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) by the Coronavirus Study Group and the disease was named coronavirus disease 2019 (COVID-19) by the WHO. [7] The name was chosen to avoid stigmatizing the virus's origins in terms of populations, geography, or animal associations. [8] Human-to-human transmission was confirmed by the WHO and Chinese authorities by 20 January 2020. [1] During the early stages of the outbreak, the number of cases doubled approximately every seven and a half days. In early and mid-January 2020, the virus spread to other Chinese provinces, helped by the Chinese New Year migration and Wuhan being a transport hub and major rail interchange. [1] On 30 January, the WHO declared the coronavirus a public health emergency of international concern. By this time, the outbreak spread by a factor of 100 to 200 times. On March 11, 2020, the WHO declared COVID-19 a global pandemic, its first such designation since declaring H1N1 influenza a pandemic in 2009. [8]

From the foregoing, the spread of the COVID-19 among human population is phenomenal and the presentation, diagnoses, management and prognosis of this disease present daunting clinical and public health challenges. Therefore, the objective of this review is an attempt to identify the possible risk factors of COVID-19. This will possibly make for patient profiling, better public health and clinical management of disease for reduced morbidity and mortality.

2. Risk Factors and Patient Profile in COVID-19

The global death rate for corona virus is about 3.4%, and this fatality is based on several factors, including where a patient is being treated, their age, the severity of the disease, and any pre-existing health conditions they might have. [9] Experts have also predicted that the fatality rate of the disease will decrease as the number of confirmed cases continues to rise. There is another whole cohort that is either asymptomatic or minimally symptomatic," There are some noted differences between the coronavirus and other infectious diseases, like MERS, SARS, and influenza: data suggests COVID-19 does not transmit as efficiently as the flu and that people who are infected but not yet sick with the flu are major transmitters of the disease, which does not appear to be the case for coronavirus. Also COVID-19 appears to cause a "more severe disease" than the seasonal flu, and while people around the world may have built up an immunity to the flu over time, the novelty of the coronavirus means no one yet has immunity, and more people are susceptible to infection. [9]

Coronavirus is a unique virus with unique characteristics and the mortality rate of the disease can differ greatly based on the country of treatment. Furthermore, people with mild cases of the disease will recover in about two weeks, and those with severe cases may take three to six weeks to recover. Despite the higher global death rate, the number of fatalities is based on several factors including where a patient is being treated, their age, the severity of the disease, and any pre-existing health conditions they might have. [9]

A study conducted recently from the Chinese Center for Disease Control and Prevention showed that the virus most seriously affected older people with preexisting health problems. The data suggests a person's chances of dying from the disease increase with age. Notably, the research showed that patients ages 10-19 years had the same chance of dying from COVID-19 as patients in their 20s and 30s, but the disease appeared to be much more fatal in people ages 50 and over. [10]

COVID-19 can affect anyone, and the disease can cause symptoms ranging from mild to very severe. For some other illnesses caused by respiratory viruses (such as influenza), some people may be more likely to have severe illness than others because they have characteristics or medical conditions that increase their risk. These are commonly called “risk factors.” Examples include being 60 years of age or older or having serious underlying medical conditions.

CDC in collaboration with state, local, and territorial health departments; public health, commercial, and clinical laboratories; vital statistics offices; health care providers; emergency departments; and academic and private sector partners, is conducting disease surveillance and field investigations to better understand why some people are more likely to develop severe COVID-19 illness. These efforts will provide vital information to help public health officials make decisions to protect the most vulnerable populations.

It is important to learn about risk factors for severe COVID-19 illness because it can help to take extra precautions to avoid exposure to the virus that causes COVID-19, and better understand how a medical condition could affect health of patients with COVID-19. Also it helps to anticipate medical treatment of victims and reduce the risk for severe COVID-19 illness by instituting appropriate management.

3. People at Higher Risk for Severe Illness Include

People 60 years and older

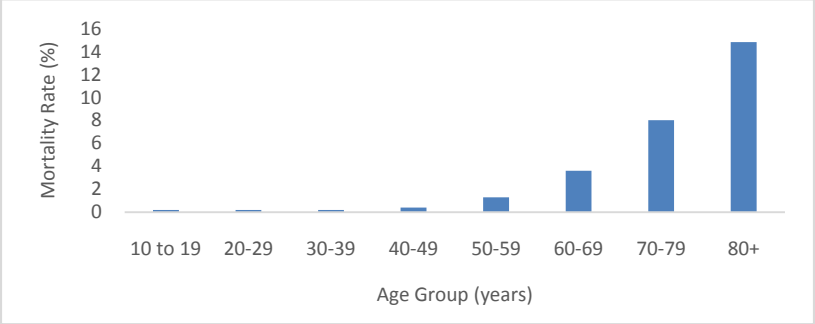

Figure 1. COVID-19 Mortality rate by age (*Source: Chinese Center for Disease Control and Prevention*)

People who live in a nursing home or long-term care facility:

The communal nature of nursing homes and long-term care facilities, and the population served (generally older adults often with underlying medical conditions), put those living in nursing homes at increased risk of infection and severe illness from COVID-19.

People of all ages with underlying medical conditions, particularly if not well controlled, including:

People with chronic lung disease or moderate to severe asthma: Early information about COVID-19 advised that people with chronic lung disease, including asthma, may be at higher risk for COVID-19. [11] The data to date (as of 7/16/20) show no increased risk of COVID-19 infection or severity of COVID-19 disease in people with asthma. The CDC does list moderate-to-severe asthma as a possible risk factor for severe COVID-19 disease, but there are no published data to support that at this time. [11], [12], [13]

People with serious heart conditions: The basis of contracting the infection is the same for all individuals. The virus is transmitted via droplets in the air from an infected person coughing, sneezing or talking; or through touching contaminated surfaces as the virus can survive for several hours or even days on surfaces such as tables and door handles. [14] Once the virus enters the body it causes direct damage to the lungs and triggers an inflammatory response which places stress on the cardiovascular system in two ways. Firstly, by infecting the lungs the blood oxygen levels drop and secondly, the inflammatory effects of the virus itself cause the blood pressure to drop as well. In such cases, the heart must beat faster and harder to supply oxygen to major organs. [15]

Individuals who are immunosuppressed: such as transplant patients, patients with cancer who are receiving chemotherapy or extensive radiotherapy, patients with concomitant leukaemia or lymphoma who have heart disease are theoretically at greatest risk of contracting and succumbing to the effects of the virus. [16] Also included are patients who smoke, had bone marrow or organ transplantation, immune deficiencies, poorly controlled HIV or AIDS, and prolonged use of corticosteroids and other immune weakening medications, stem cells for cancer treatment, genetic immune deficiencies, Use of oral or intravenous corticosteroids or other medicines called immunosuppressants that lower the body's ability to fight. Some infections (e.g., mycophenolate, sirolimus, cyclosporine, tacrolimus, etanercept, rituximab). People with weakened immune systems are at higher risk of getting severely sick from SARS-CoV-2, the virus that causes COVID-19. They may also remain infectious for a longer period of time than others with just COVID-19, minus the risk factors. However, it is difficult to confirm this until more is learnt about this new virus. [17] Other high-risk groups include elderly and frail people as well as pregnant women with concomitant cardiovascular disease. [17] Individuals with heart conditions, such as heart failure, dilated cardiomyopathy, advanced forms of arrhythmogenic right ventricular cardiomyopathy and patients with congenital cyanotic heart disease are at highest risk.

Patients with the obstructive form of hypertrophic cardiomyopathy may also be placed in the same high-risk category. There is no evidence that the virus infects implanted devices such as pacemakers and cardioverter-defibrillators or causes infective endocarditis in those with valvular heart disease. Individuals with heart conditions, such as heart failure, dilated cardiomyopathy, advanced forms of arrhythmogenic right ventricular cardiomyopathy and patients with congenital cyanotic heart disease are at highest risk. [17]

People with severe obesity (body mass index [BMI] of 40 or higher)

BMI has gained international acceptance as a standard for recognition and classification of overweight and obesity. [18] By this parameter, obesity has been found as the number one risk factor for developing a severe case of COVID-19 in people under the age of 55. Having a BMI of 30 or higher increases a person's risk of developing a severe case of COVID-19 by 27%, and a BMI of 40 or higher doubles a person's risk. Countries with high obesity rates from western Europe to the US are struggling to keep people alive in intensive care units. Britain, long described as "the fat man of Europe" also has the highest number of Covid-19 deaths in Europe. Almost 30% of adults in the UK are classed as obese. The figure is nearly 40% in the US, where COVID deaths have topped 100,000. It is striking, that wealthy countries appear to have higher mortality rates than impoverished ones. Africa so far has not experienced the explosion of deaths that Europe has. There will be many

factors, and absence of good data collection will be one. But low rates of obesity, type 2 diabetes and the chronic disease of the heart and other organs are likely to play a part. [19]

People with diabetes: The vast majority (around 98%) of people infected to date have survived. Older people and people with pre-existing medical conditions (such as diabetes, heart disease and asthma) appear to be more vulnerable to becoming severely ill with the COVID-19 virus. When people with diabetes develop a viral infection, it can be harder to treat due to fluctuations in blood glucose levels and, possibly, the presence of diabetes complications. There appear to be two reasons for this. Firstly, the immune system is compromised, making it harder to fight the virus and likely leading to a longer recovery period. Secondly, the virus may thrive in an environment of elevated blood glucose. [20], [21]

People with chronic kidney disease undergoing dialysis: The morbidity and fatality of COVID-19 are much higher in members of the senior population who manifest multiple co-morbidities. Patients with chronic kidney disease (CKD) usually have several co-morbidities, such as hypertension, diabetes, and cardiovascular disease. [22] In addition, patients on hemo-dialysis need to visit the dialysis center regularly three times every week. Therefore, the dialysis center becomes a potential vector responsible for spreading this pandemic. In previous epidemics or catastrophic situations, the fatality rate was much higher in patients on dialysis than that in the general population. [23]

People with liver disease: Liver damage in COVID-19 patients may be caused by the virus directly infecting liver cells. Previous studies have shown that some viruses that primarily target the upper respiratory tract also affect the liver, such as SARS-CoV, which causes SARS, and MERS-CoV, which causes Middle East respiratory syndrome. [24] In addition, cytokine storm caused by excessive immune response induced by the virus may also be one of the pathways of liver damage [25], [26]. In most patients with severe COVID-19, there is an abnormal increase in serum proinflammatory cytokines. The influence of underlying liver diseases and the liver injury status in different COVID-19 patients should be carefully evaluated. Patients with chronic hepatitis B who have been treated with long-term nucleoside analogues are in the immune tolerance stage and have virus inhibition. When they are infected with SARS-CoV-2, they will have sustained liver damage. In patients with COVID-19 complicated with autoimmune hepatitis, special attention should be paid to the effect of glucocorticoids on prognosis of the disease. Due to the high level of ACE2 receptor expression in bile duct cells, COVID-19 patients complicated with cholangitis may have aggravated cholestasis, resulting in increased levels of alkaline phosphatase and gamma glutamyl transpeptidase. Patients with liver cancer or cirrhosis of the liver are more likely to be infected with the virus as their immune function is relatively lower. [24] Patients with severe illness were more likely to be infected with HBV than those without severe illness (2.4% vs 0.6%). In addition, patients with cirrhosis and liver cancer with systemic immunodeficiency may be more vulnerable to SARS-CoV-2 infection. [27] Michaels et al [40] recently described the possible risks associated with transplantation in SARS-CoV-2 positive recipients, as liver transplantation may involve donor-to-recipient transmission of the virus.

People with Dementia: A new study suggests that the risk of severe COVID-19 may be increased if a person has a genotype that is associated with dementia, as well as other cardiovascular issues. The study indicates that having the genetic component of dementia might increase the risk of developing a more severe case of COVID-19. [28] In addition, a person with dementia is more likely to be living in a care home, and these facilities have been key sites for the spread of the disease. Also, because of dementia's effects on cognitive function, a person with dementia may be less likely to follow safety protocols and so have more risk of exposure to the virus. Adding to these known risk factors, the present research suggests that the genetic conditions that can contribute to dementia may increase a person's chances of developing a severe case of COVID-19. [28]

People with Disabilities: Disability alone may not be related to higher risk for getting COVID-19 or having severe illness. Most people with disabilities are not inherently at higher risk for becoming infected with or having severe illness from COVID-19. However, some people with disabilities might be at a higher risk of infection or severe illness because of their underlying medical conditions. All people seem to be at higher risk of severe illness from COVID-19 if they have serious underlying chronic medical conditions like chronic lung disease, a serious heart condition, or a weakened immune system. Adults with disabilities are three times more likely than adults without disabilities to have heart disease, stroke, diabetes, or cancer than adults without disabilities. [17] Also at risk are: people who have limited mobility or who cannot avoid coming into close contact with others who may be infected, such as direct support providers and family members, people who have trouble understanding information or practicing preventive measures, such as hand washing and social distancing and people who may not be able to communicate symptoms of illness. [17]

Racial and Ethnic Minority Groups: The impacts of the COVID-19 crisis are not uniform across ethnic groups, and aggregating all minorities together misses important differences. Understanding why these differences exist is crucial for thinking about the role policy can play in addressing inequalities. Per-capita COVID-19 hospital deaths are highest among the black Caribbean population and three times those of the white British majority. After accounting for the age, gender and geographic profiles of ethnic groups, inequalities in mortality relative to the white British majority are therefore starker for most minority groups than they first appear. After stripping out the role of age and geography, Bangladeshi hospital fatalities are twice those of the white British group, Pakistani deaths are 2.9 times as high and black African deaths 3.7 times as

high. Occupational exposure may partially explain disproportionate deaths for some groups. Key workers are at higher risk of infection through the jobs they do. More than two in ten black African women of working age are employed in health and social care roles. Many ethnic minorities are also more economically vulnerable to the current crisis than are white ethnic groups. The fact that larger shares of many minority groups are of working age means that these populations are more exposed to labour market conditions as a whole, but even amongst working-age populations there are clear inequalities in vulnerability to the current crisis. The potential for buffering incomes within the household depends on partners' employment rates, which are much lower for Pakistani and Bangladeshi women. As a result, 29% of Bangladeshi working-age men both work in a shut-down sector and have a partner who is not in paid work, compared with only 1% of white British men. Bangladeshis, black Caribbeans and black Africans also have the most limited savings to provide a financial buffer if laid off. Only around 30% live in households with enough to cover one month of income. In contrast, nearly 60% of the rest of the population have enough savings to cover one month's income. [29]

Newly Resettled Refugee Populations: Refugees to the United States, especially those who are recently resettled, may be in living or working conditions that put them at risk of getting COVID-19. Some refugees also have limited access to health care, as well as certain underlying medical conditions that put them at higher risk of more severe illness from COVID-19, compared to the rest of the U.S. population. [30] A refugee is someone who has been forced to flee their country because of a well-founded fear of persecution for reasons of race, religion, nationality, or political opinion. Nearly 750,000 refugees resettled in the United States from 2008 to 2019, and thousands more have resettled since then. While as of 11 May 2020, no concentrated outbreak had been reported in refugee and internally displaced camps and settlements, the risk of transmission of COVID-19 could be heightened in situations of fragility, high population density and refugees living in camps. The consequences of the pandemic may be aggravated by pre-existing structural weaknesses. Forcibly displaced people in fragile contexts may be disproportionately affected by the crisis, having lost their means of livelihoods and at times lacking access to adequate living standards including housing, food, water and sanitation, education and access to health services. Barriers to accessing national health services include exclusion from public health care, high costs, lack of documentation and administrative hurdles. [30], [31]

Gender differences: In the first preliminary study investigating the role of gender in morbidity and mortality in patients with Novel Coronavirus Disease (COVID-19), it was found that men are more at risk for worse outcomes and death, independent of age, with COVID-19. While males and females have the same prevalence of COVID-19, male patients have a higher mortality. [32]

Geographical location temperature differences: To date, COVID-19 has established significant community spread in cities and regions along a narrow east west distribution roughly along the 30-50° N' corridor at consistently similar weather patterns consisting of average temperatures of 5-11℃, combined with low specific (3-6 g/kg) and absolute humidity (4-7 g/m^3). There has been a lack of significant community establishment in expected locations that are based only on population proximity and extensive population interaction through travel. The distribution of significant community outbreaks along restricted latitude, temperature, and humidity are consistent with the behavior of a seasonal respiratory virus. Additionally, we have proposed a simplified model that shows a zone at increased risk for COVID-19 spread. Using weather modeling, it may be possible to predict the regions most likely to be at higher risk of significant community spread of COVID-19 in the upcoming weeks, allowing for concentration of public health efforts on surveillance and containment. [33] According to some models [34], temperate warm and cold climates are more favorable to spread of the virus, whereas arid and tropical climates are less favorable. However, model uncertainties are still high across much of sub- Saharan Africa, Latin America and South East Asia. While models of epidemic spread utilize human demography and mobility as predictors, climate can also help constrain the virus. This is because the environment can mediate human-to-human transmission of SARS-CoV-2, and unsuitable climates can cause the virus to destabilize quickly, hence reducing its capacity to become epidemic. [34]

BCG Vaccine: During BCG's long existence, an array of evidence has emerged to suggest that the BCG vaccine may also offer beneficial off-target effects, providing some protection against not just some forms of TB but other diseases as well. This is because it appears to help boost the immune system. Given that health organizations across the world are urgently looking for ways to treat and prevent the spread of COVID-19, until a vaccine is developed, some attention has now turned to the BCG vaccine. In theory, it would be a very attractive option as its safety has long been established. This means, if it was shown to have some form of prophylactic effect on COVID-19, it could potentially be given to large numbers of people who have not yet contracted the disease, to reduce its spread and the number of people who go on to develop severe symptoms. However, there is still not enough evidence to draw any conclusions. [35] What is known is that, the way in which BCG vaccination reacts with the human immune system suggests it can have general immune-boosting effects. When scientists have compared the immune systems of people who had the BCG vaccine with those who have not, they discovered that the immune cells that first respond to disease in BCG vaccinated people are more alert and ready to act on a potential threat. An alert immune system means the body is better prepared to fight disease. This idea has been supported by studies carried out in babies born in Guinea-Bissau. These

suggested that the vaccine may help reduce child mortality beyond what you would expect by preventing TB alone. Reports from controlled medical trials also suggest it could reduce the likelihood of people getting other respiratory infections, some of which are caused by viruses with a very similar form to COVID-19. Even if it can't stop people contracting the disease, certain data suggests that there is a chance it may prove helpful in reducing the severity of symptoms responsible for the pandemic's death toll. [36]

A number of research teams are taking a closer look at whether receiving a dose of the BCG vaccine may prevent or help people fight off a COVID-19 infection and reduce the number of COVID-19-related deaths. A study looking at the global linkage between the BCG and COVID-19 found that there was a significant inverse correlation between the 'BCG index' or how well the BCG vaccine was deployed in a country and deaths from COVID-19. The researchers only looked at mortality because while there are many conflicting counts of cases and deaths for many countries, the death count is more likely to be accurate. They found that every 10% increase in the BCG index was associated with a 10.4% reduction in COVID-19 mortality. They saw high mortality rates in France and the UK than Germany or Scandinavia and suggest that where the BCG vaccination was given to older children (as in the UK), it may have missed a "critical window" early in life where BCG vaccination could have resulted in lifelong enhanced immunity. [37]

A team of Nigerian researchers undertook a similar multi-country level comparison of BCG vaccination policy and COVID-19 cases and deaths. They found a striking link between countries that had very high mortality and no BCG vaccination policy – most notably, Italy and the USA. [37] Both groups of researchers acknowledge the major variables involved in pandemic response that could affect the number of deaths, such as the quality of the health care system by country, surveillance systems, and testing capacity. This means that it will only be known for certain if the BCG vaccine works against COVID19 once the results of a number of clinical trials have been fully scrutinized. Because of the urgency, scientists from four different countries have already assembled and kicked-off a number of studies to see if the vaccine can help protect those on the pandemic frontline.

A team in the Netherlands have made headway in recruiting 1,000 healthcare workers in eight Dutch hospitals to see if it has an effect on the amount of sick leave taken. Nurses, doctors and other key hospital staff will either get the vaccine or a dummy drug (placebo). Comparing the number of sick days between groups is a good way of judging if the BCG vaccine could reduce the severity of COVID-19 side effects and provide some protection against the disease. [38] Researchers in Australia have also launched a very similar trial and are hoping to study more than 4,000 healthcare workers, tracking their progress with email surveys and text messages. [39] A new experimental type of BCG vaccine called VPM1002 is another interesting candidate. A study in Germany is testing whether it can protect healthcare workers and older patients from COVID-19, following research on mice, which showed it can protect against other viral lung infections. Mice infected with influenza were also found to have lower levels of influenza viruses in their blood if they were given the BCG vaccine beforehand, hinting the vaccine may be helping the immune system mop up the virus. [40]

Malaria belt and antimalaria use (eg Chloroquine) Chloroquine (CQ) and Hydroxychloroquine (HCQ) have immunomodulatory and anti-inflammatory effects. The weak bases in its structure enter the cytoplasmic vesicles by entering through the cytoplasmicmembrane, thus increasing the pH from 4.0 to 6.0, and acid-dependent subcellular functions are inhibited. [41] Consequently, antigen processing in macrophages is impaired due to the increase in pH. CQ and HCQ inhibit the pro-inflammatory cytokines like TNF-α, IL-1, and IFN-γ, intracellular Toll-like receptor (TLR) 7/9 and down regulate TLR-mediated signal transduction. [42] Another aspect of antimalarials is the reduction of autoimmunity by the up-regulation of apoptosis and the elimination of autoreactive lymphocytes. [43] HCQ and CQ have been shown to show antiviral activity by inhibiting receptor binding and membrane fusion, which play a role in the entry of coronaviruses into the cell. [43] Moreover, the replication of the virus is blocked due to the change in pH required for lysosome and enzyme activities. Due to the mechanisms of action of these drugs, over activation of the immune system triggered by SARS-CoV-2 may be suppressed and the progression to severe disease may be slowed. [42] In addition, it is suggested that CQ and HCQ could potentially be beneficial, also with low cost, wide use worldwide including rheumatic disease and lower side effect profile. [43] Inhibition of the virus in cells treated with CQ before or after infection suggested that CQ is both prophylactic and therapeutically advantageous. However, there is no evidence of prophylactic use in guidelines. CQ has also been used worldwide for malaria treatment and prophylaxis over the years, and CQ has been shown to inhibit coronavirus replication. [44] Malarial drug use trends changed from CQ or SP to ACTs in African countries in the following years. Today, CQ is not recommended for P. falciparum treatment in Africa. However, CQ use has persisted for many years especially in private sectors since CQ and SP are cheaper than ACT and available in the marketplace widely. [45] Consequently, although the number of tests and health data carried out in Africa and especially in the malaria-intensive regions is not clear, this situation will become clearer with further analysis in the post-pandemic period. Perhaps it will be thought that the use of HCQ can provide protection for COVID-19. [46]

4. Conclusions

This brief review is an attempt to stereotype the profile of a COVID-19 victim with a view to developing and adopting appropriate, effective and efficient public health precautions and clinical measures that might reduce morbidity and mortality among people at risk, and to control the global

spread of COVID-19 pandemic. This brief review is of practical significance in the sense that it offers an explanation for the hitherto amazingly low morbidity and mortality of this disease in tropical regions of Africa and Nigeria in particular.

Need for further research: The pattern and clinical features of COVID-19 are still unfolding. There is therefore need for continued further research that will make for better understanding of the holistic epidemiology and control of this new scourge in the global community.

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