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Case Report

Differences in vulnerability between health workers and the general population: Is volunteer selection required for COVID-19 control in Nigeria?

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Abstract

As of November 8th 2020, the prevalence of the COVID-19 infection in Nigeria is 9.3% while the cumulative fatality rate was 1.8%. Health care workers play important roles in controlling pandemics. However, their health status determines to a great extent the stability or vulnerability of a health system. The stress accruing from high patient flow amidst scarcity of healthcare resources may impact on their health negatively. Stress and lack of a good diet plan may facilitate the development of some diseases such as hypertension (HTN), diabetes mellitus (DM), chronic kidney disease (CKD) and cardiovascular diseases (CVD). These diseases are confirmed correlates of COVID-19 morbidity and fatality. Despite the high awareness of preventive healthcare services among health workers (65%), the prevalence of these diseases are high due to low treatment and control. Although the pooled prevalence of HTN and DM were lower among health workers than the in general population (22.0% vs 37.8% and 6.5% vs 8.1%, respectively), the prevalence of pre-HTN and pre-DM were higher in health workers than in the general population (35.1% vs 22.3% and 19.4% vs 5.9%, respectively). Some of these diseases go undiagnosed until their late stages. Thus, increasing their vulnerability to COVID-19. To prevent controllable fatalities, health workers should be screened before they are engaged in the treatment of COVID-19 patients, irrespective of their previous medical history. Simultaneous testing for comorbidities and COVID-19 should also be carried out in the general population, especially for high-risk groups to prevent future vulnerabilities to communicable diseases.

Keywords: COVID-19; health workers; Nigeria; vulnerability

INTRODUCTION

In late 2019, some people in Wuhan, China suffered a certain type of progressive pneumonia. Major signs and symptoms associated with the disease include fever, fatigue, dry cough, anorexia, dyspnea, and shortness of breath. The high mortality rate associated with the disease drew the attention of international research communities. Following extensive studies, the infectious disease was linked to a Novel Coronavirus. "On 11 February 2020, the World Health Organization (WHO) announced the name of the Novel Coronavirus as COVID-19" and the infection was declared a pandemic on the 11 March 2020 by WHO (1). Ever since, the disease has led to economic crisis, a scale-up of healthcare resources, and increasing military presence employed to enforce isolation so as to slow down the spread of the disease. Globally, as of 23 March 2020, the total number of cases is about 378,000 with over 16,000 deaths (1). The meta-analysis carried out by Yang et al and Sun et al. reveal a fatality rate of 4 to 5% (2,3). Although male status and older age remain key players in the development of COVID-19 associated pneumonia, the tendency to develop severe symptoms depends on whether the affected individual has other underlining chronic diseases or comorbidities (2). Such comorbidities include hypertension, diabetes, cardiovascular diseases, chronic obstructive pulmonary disease, and chronic renal diseases, in decreasing order of frequency (Table 1). The meta-analysis carried out by Yang et al. shows a similar trend of association (2). The comorbidities are more prevalent in severe cases of infection than in non-severe cases (4,5). However, mounting evidence suggested that the prevalence of COVID-19 associated comorbidities are not uniform across all regions (6). The variation may largely be adduced to the type and frequency of comorbidities in the region. A high prevalence of associated comorbidities may translate into a higher number of severe cases of COVID-19 disease and fatality.

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Table 1. Comparison of comorbidities of COVID-19 in severe and non-severe cases in China

Comorbidity	All cases	Percentage (%) difference between NS/NICU and S/ICU		Ratio between NS/NICU and S/ICU	
	N= 1237	Mainland	Wuhan	Mainland	Wuhan
		Guan et al. (4)	Wang et al. (5)	N=926/173	n=102/36
Hypertensions	208 (16.8)	10.3	36.7	1:1.8	1:2.7
Diabetes	95 (7.7)	10.5	16.3	1:2.8	1:3.8
Cardiovascular disease	49 (4.0)	5.1	15.7	1:2.7	1:16.7
Cancer	20 (1.6)	0.9	5.2	1:2.1	1:1.9
COPD	16 (1.3)	2.9	7.3	1:5.8	1:8.3
Chronic renal disease	12 (1.0)	1.2	3.6	1:3.4	1:2.8

S/ICU; Severe/ICU, NS/NICU; Non-severe/Non-ICU, COPD; Chronic obstructive pulmonary disease

The table shows that hypertension is the most prevalence comorbidity in China. The difference in the prevalence hypertension between severe and non-severe cases ranges from 10.3 to 36.7%. The table also shows that the ratio of the comorbidities between severe and non-severe cases is always higher than 1:1.9. In Mainland and Wuhan, the prevalent comorbidities in severe COVID-19 disease were COPD and cardiovascular diseases, respectively

This review paper identified vulnerabilities in the Nigerian health system and the general population. It proffers solutions to help control the spread of the virus among the Nigerian people, especially among health workers.

CASE REPORT

In Nigeria, the first case of COVID-19 was reported on 27 February 2020. Since then, 697,543 samples have been tested and 64,728 cases have been confirmed (7). All efforts to prevent the spread of the disease by the Nigeria Centre for Disease Control (NCDC) have proved futile. Although some persons without any a travel history or close contact with confirmed COVID-19 cases have tested positive, most of the affected individuals had travel history to Italy, Canada, France, Netherlands, Spain, the United Kingdom, and America. It is yet unknown whether these returnees observed the 14 days prescribed self-isolation and social distancing. If they did not, the number of new cases could triple in the next few weeks. South Western States and the FCT (Northern region) appear to be having a high number of new cases due to their proximities to major airports, Nnamdi Azikiwe and Murtala Muhammed International Airports, and late closure (23 March 2020) of the airports. Other factors such as the frequency of comorbidities may be driving the infection rate. Though the South-Eastern States seem to be less affected due to the fact that its Akanu Ibiam International Airport Enugu was earlier closed (21 March 2020), infected asymptomatic interstate travelers from affected states may facilitate the spread of the disease to the region. After the index case was identified, Nigeria recorded her first COVID-19 related death on the 23 March 2020. According to the NCDC, the diseased (male; 67 years old) had other underlying illnesses. This further underscores the fact that age, malefactor, and other underlining diseases play critical roles in the severity of the disease. Since Nigeria lacks the infrastructure to produce vaccines or drugs to cure the infected, identifying individuals with comorbidities is an important step to reducing COVID-19 fatality in the country.

A study carried out in line with the Infectious Disease Vulnerability Index revealed that Nigeria has a high risk of importation of COVID-19 infection (51%) and high vulnerability (27%) due to its direct link and volume of travel to China (8). This is buttressed by the fact that as of April 15th there are only 13 laboratories in the Nigeria equipped for COVID-19 testing (7). The IDVI related study also shows that Nigeria has moderate management and control of the disease due to its low score in the laboratory capacity (8). This is buttressed by the fact that there are only 13 laboratories in the Nigeria equipped for COVID-19 testing. The number of laboratories is inadequate considering the fact that 13 laboratories are serving 36 States and a population of about 180 million people. Thus, with sub-optimal testing (of 7,153 samples out of 180 million people) a high rate of infection is expected in the next few weeks. Again, global experience has shown that there are never enough health workers when it comes to testing and treating infected persons, especially in low healthcare resource countries in the likes of Nigeria. As of April 15th 2020 the NCDC reported that the prevalence of the viral infection was 9.0% while the cumulative fatality rate (CFR) was 3.0%. As at that time, the most affected age group is 31-40 years (21%) while the rate of infection was higher in males (71%) than in females (29%) ratio 2.4:1. Interestingly, as of November 8th 2020, the prevalence of the viral infection rose to 9.3% while the cumulative fatality rate (CFR) decreased to 1.8%. The prevalence of infection was still higher in males (2.3%) than among females (1.3%) while the male to female ratio

of infection rose to 3.1:1. Although, as of November 8th 2020, greater percentage of the infected population were from Southern Nigeria (67.2%) as compared to Northern Nigeria (32.8%)(7), individuals living in Northern Nigeria had higher prevalence of HTN and DM (37.5% and 6.3%, respectively) than those living in Southern Nigeria (38.8% and 11.0%, respectively; Table 2). This might be the reason for the higher CFR in Northern Nigeria (2.1%) than in Southern Nigeria (1.6%). As of November 8th 2020, the prevalence of COVID-19 infection was higher in the age group of >70 years (17.7%) than in the age groups of 61-70 years (11.2%), 51-60 years (3.9%), 41-50 years (1.5%), 31-40 years (0.6%), 21-30 years (0.4%), 11-20 years (0.3%) and ≤10 years (0.4%)(7). The higher prevalence of HTN and DM among those who were older than 40 years (Table 3) might explain why there is a higher prevalence of COVID-19 infection in those who are in the age groups of 41-70 years and > 70 years. The reason for the change in the most affected group, from 31-40 years to > 70 years (between April 15th 2020 and November 8th 2020), is still unknown. It could be due to improving level of adherence to the COVID-19 infection prevention protocols on the part of those within the age group of 31-40 years. On the other hand, it could be due to higher prevalence of hypertension (44.4% to 60.3%) in age group of > 70 years (Table 3). Among the six geopolitical zones of Nigeria, South-West had the highest rate of infection (47.1%) while North-East had the highest CFR (3.7%) than other geopolitical zones (Figure 1). The health system could be overwhelmed by the rate of infection when the available healthcare workers are also vulnerable to the disease. According to the NCDC, the prevalence of the viral infection is 9% with a cumulative fatality rate (CFR) of 3%. The most affected age group is 31-40 years (21%) while the prevalence is higher in males (71%) than in females (29%) (7). The rate of infection and CFR may be influenced by the presence of comorbidities such as cardiovascular diseases (CVD) and chronic kidney diseases (CKD) (3-5).

Table 2. Prevalence of comorbidities in relation to region and sex

References	Zone	GPT	Area	HTN	PHTN	DM	PDM	CKD	HTN		DM	
									F	M	F	M
Oluyombo et al. (16)	South	West	Semi-Urban	47.2	-	6.8	6.0	-	47.3	48.9	6.0	8.6
Olamoyegun et al. (17)	South	West	Semi-Urban	55.5	29.1	-	-	-	-	-	-	-
Akpan et al. (18)	South	West	Urban	30.1	-	5.8	-	24.2	28.5	33.2	6.2	4.7
Akinbodewa et al. (19)	South	West	Urban	43.4	32.3	6.2	-		41.1	44.7		
Okwuonu et al. (20)	South	West	Semi-urban	36.9	-	7.9	-	7.8	42.3	29.4	8.5	7.2
Dokunmu et al. (21)	South	West	Semi-Urban	31.0	36.8	8.9	6.7		8.2	7.3	-	-
Okoye et al. (22)	South	South	Rural	34.2	-	2.1	-	27.2	-	-	-	-
Isara and Okundia, (23)	South	South	Rural	37.6	-	4.6	-	-	35.1	43.7	5.8	1.9
Okafor &Unuigbe (24)	South	South	Rural	39.4	-	6.1	-	-	-	-	-	-
Oguoma et al. (25)	South	South	Rural/Urban	35.7	-	5.4	4.9	-	-	-	2.6	10.9
Ulasi and Ijoma (26)	South	East	Semi-Urban	17.2	-		-	14.6	-	-	-	-
Odili and Okafor (27)	South	East	Rural	54.1	-	8.2	-	-	-	-	-	-
Obinna et al. (28)	South	East	Rural	24.6	-	18.8	-		33.7	30.8	25.2	19.7
Chukwuonye et al. (29)	South	East	Semi-urban	38.0	-	7.8	-	7.5	-	-	-	-
Mukadas & Misbau (30)	North	West	Rural/Urban	39.1	-		-	-	-	-	-	-
Nalado et al. (31)	North	West	Urban	29.8	3.5	3.6	-	-	4.9	24.9	0.4	3.1
Makusidi et al. (32)	North	West	Urban	30.2	8.5	6.0	-	-	-	-	-	-
Bello-Ovosi et al. (33)	North	West	Urban	55.9	23.8	23.3	-	-	51.9	3.4	19.2	5.2
Mean±				**37.8**	**22.3**	**8.1**	**5.9**	**16.3**	**32.6**	**29.6**	**9.2**	**7.7**
Standard deviation				10.5	13.4	5.6	0.9	9.1	16.4	15.9	8.5	5.7

HTN= Hypertension, PHTN= Prehypertension, DM= diabetes mellitus, PDM= Pre-diabetes mellitus, CKD= Chronic Kidney disease, F= Female, M= Male

The prevalence of HTN is higher in rural communities than in urban communities (38.0% vs 37.9%) while the prevalence of diabetes is higher in Urban than in rural communities (9.0% vs 8.0%). The prevalence of HTN is higher in South-Western Nigeria (40.6%) than in North Western Nigeria (38.8%), South-Southern Nigeria (36.7%) and South-Eastern Nigeria (33.5%) while the prevalence of diabetes is higher in South-Eastern Nigeria (11.6%) than in North Western Nigeria (10.7%), South-Western Nigeria (7.1%) and South-Southern Nigeria (4.6%).

Table 3. Prevalence of HTN and DM across all age groups

Oluyombo et al. (16)			Isara & Okundia, (23)			Iloh et al. (37)	Owolabi et al. (10)	Olamoyegun et al. (17)		Bello-Ovosi et al. (33)	
Age	HTN	DM	Age	HTN	DM	HTN	HTN	Age	HTN	HTN	DM
< 30	21.3	4.9	18-29	10.2	0.0	1.3	0.0	< 20	0.2	-	-
31-40	19.6	10.7	30-49	27.2	7.1	15.6	13.0	20-40	2.0	-	-
-	-	-	-	-	-	-	-	≤ 40	-	9.6	2.9
41-50	46.0	11.0	40-49	-	-	29.4	26.0	41-60	27.4	-	-
51-60	50.0	6.2	50-69	44.1	5.4	31.6	33.0	> 40	-	45.5	21.8
61-70	58.8	8.6	60-69	-	-	15.6	36.0	> 60	65.1	-	-
> 70	60.3	9.8	70-90	44.4	1.8	-	-	-	-	-	-
-	-	-	≥ 70	-	-	6.5	-	-	-	-	-

HTN= Hypertension, DM= diabetes mellitus

The table shows that the upper limit of prevalence among those with HTN and DM who are 40 years and younger is 27.2% and 10.7%, respectively while the upper limit of prevalence among those with HTN and DM who are older than 40 years is 65.1% and 21.8%, respectively. This suggests that individuals who are above the age of 40 years are at risk of contracting COVID-19 than those who are younger (≤ 40 years).

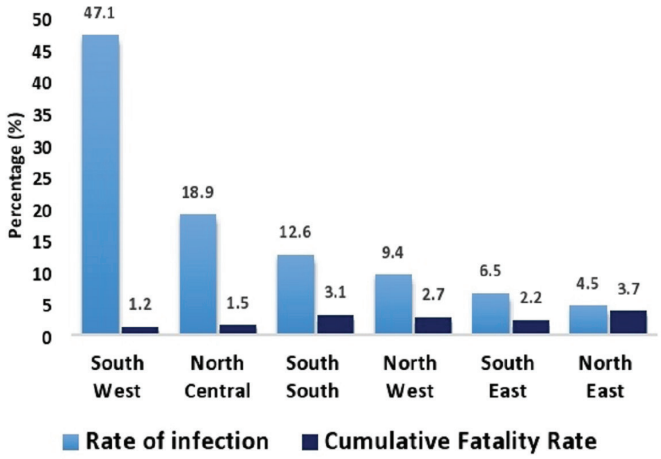

Figure 1. Rate of infection and CFR in the six geopolitical zones of Nigeria (7)

DISCUSSION

The awareness of hypertensive status is high among health workers (65%), yet the prevalence of HTN (20.1-23.8%) and pre-HTN (35.1%) are equally high (9,10). Although there is a paucity of data on the prevalence of HTN among health workers in Northern Nigeria, evidence shows that the prevalence of undiagnosed hypertension is higher among workers in Southern Nigeria than in Northern Nigeria (65.3% vs 26.2%) (9,11). Currently, no explanation has been put forward but the difference could be diet-related. Furthermore, the prevalence of HTN among Doctors, Nurses, Pharmacists, Laboratory personnel and other health workers is 11.0%, 9.9%, 27.3%, 21.4%, and 24.6%, respectively with higher prevalence in men than in women (28.0% vs 13.8%) (10). The differences could be attributed to work burnout due to patient flow and the number of personnel working in each unit. An earlier study lends support to this assertion by showing that the prevalence of high strain jobs among Doctors, Nurses, Pharmacists, Laboratory personnel and other health workers is 11.1%, 19.8%, 45.5%, 25.0% and 26.9%, respectively (12). This suggests that the higher prevalence of HTN observed in Pharmacists could be due to stress at work. Apart from HTN, the prevalence of undiagnosed diabetes, pre-diabetes, and diabetes among health workers is 28.6%, 19.4%, and 6.5%, respectively (13). Studies have shown that the prevalence of HTN and diabetes are lower in health workers than in the general population, however, the prevalence of pre-HTN and pre-diabetes are higher in health workers than in the general population (Table 2). The difference suggests that health workers control their pre-hypertensive and pre-diabetic conditions better than the general population. However, they are equally at risk (2-3 fold) of developing CVD and CKD (14,15). Thus, it important that the COVID-19 volunteers be screened for HTN, pre-HTN, diabetes, and pre-diabetes before they are engaged so as to prevent fatalities in the already stressed workforce, especially those who are above the age of 40 years (Table 3). Health workers with comorbidities may be allowed to work in units that do not handle infectious diseases.

In Nigeria, the prevalence of CVD is 37% (Table 2) and it accounts for 20.1% of all hospital admissions and 17% of all hospital-related mortality. Risk factors include older age (≥35 years), male status, diabetes, HTN, and heart failure (16,21). Studies have shown that HTN and heart failure account for 54.3% and 36.6% of all CVD admissions, respectively (25,34,35). Some of the affected patients present at the last stages of CVD due to a lack of awareness and treatment of predisposing factors. The study carried out by Dokunmu et al. reveal that about 31% and 5% of Nigerians have undiagnosed HTN and diabetes

(21). Literature shows that the former and the later are prevalent in South-Western Nigeria and South-Eastern (Table 2). Patients with co-existing HTN and diabetes (2.2 to 6.7%) have a higher risk of CVD than those with one of the predisposing factors (28,31). More so, individuals with both pre-HTN and pre-diabetes (prevalence= 10.4%) (36) or HTN and pre-diabetes (prevalence= 33.1%) (37) are equally at risk of developing CVD than individuals with either pre-HTN (prevalence= 22.3%) or pre-diabetes (prevalence= 5.9%) and those without the risk factors (Table 2) (38). Pre-diabetes is defined as fasting plasma glucose of 100-125 mg/dL or 2 hours post-prandial plasma glucose level of 140-199 mg/dL (36) while pre-HTN is systolic blood pressure of 120-139 mmHg, and/or diastolic blood pressure of 80-89 mmHg (15). Most individuals with pre-diabetes and pre-HTN develop HTN and diabetes later in life due to a lack of diet control. Sadly, even after being informed, only 45.5% and 15.4% of individuals diagnosed with HTN and diabetes receive treatment largely due to the cost of treatment and religious belief (16). Studies have also shown that HTN and diabetes account for 32.1-36.9% and 4.9-7.9 % of all CKD, respectively (20,39). The prevalence of CKD observed in this review (23.2%, Table 2) is higher than the value reported by Wokoma et al. (11.7%) following a systematic review (39). This suggests that CKD may be increasing in Nigeria. Chronic kidney disease accounts for 23.2% of all medical outpatient attendance and 22.0% of medical deaths. The disease is preponderant in males than in females (ratio= 1.9-2.3:1) (9,17,26) and also higher in rural communities than in urban communities (16.4% vs 7.0%). The reasons for the differences are yet unknown, however, it could be due to a lack of awareness of preventive health care and the non-utilization of preventive healthcare services. The prevalence of DM is 0.8%, 7.5%, and 3.5% in the age range of 12-35 years, 36-60 years, and ≥60 years, respectively while the prevalence of hypertension is 0.5%, 13.7%, and 3.1% in the same age ranges, respectively (26). Hypertension and diabetes are associated with 36.8% and 5.3% of all chronic obstructive pulmonary disease (COPD). The chronic obstructive pulmonary disease accounts for 2.2%, 13.7%, and 21.3% of all respiratory distress, hospitalization and hospital-related mortality, respectively (40).

CONCLUSION

This review revealed that health workers could be vulnerable to COVID-19 due to the high prevalence of pre-HTN and pre-diabetes while the general population could be vulnerable to the virus due to the high prevalence of HTN and diabetes as well. It also revealed that health workers in Southern Nigeria are more vulnerable to the disease than their Northern counterparts due higher prevalence of undiagnosed HTN. Considering the general population, the review suggests that the higher CFR observed in Northern Nigerian populace could be due to higher pooled prevalence of diagnosed HTN and DM in the region. To prevent controllable fatalities, health workers should be screened before they handle COVDI-19 patients, irrespective of their previous medical history. Simultaneous testing for comorbidities and COVID-19 should also be carried out in the general population, especially for high-risk groups to prevent future vulnerabilities..

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