DETERMINING THE VULNERABILITY OF STATES IN NIGERIA TO COVID-19

Addie Oluwaseun[1*] Taiwo Olalekan[1] Seun-Addie Kehinde[2]
[1]Department of Geography, Faculty of the Social Sciences, University of Ibadan
[2] National Population Commission of Nigeria, Oyo-State
[*] Email address of the corresponding author: shekinahouse@yahoo.com

Abstract: The impact of the coronavirus disease 2019 (COVID-19) pandemic has been felt globally. However, against the backdrop of the uncertainties surrounding the pandemic, and the pronouncement of the World Health Organization that the virus may never go away, it has become pertinent for nations to identify and protect the most vulnerable of their citizens. This study determined the states with the highest vulnerability to the pandemic in Nigeria. The 2006 population data for each state of the federation was obtained from the National Population Commission (NPC) Nigeria, and was projected to the year 2020. Data on: Nigerians aged 60 years and older, the percentage population in the lowest and second wealth quantiles, percentage population without fixed handwashing and moderate handwashing facilities, and percentage population of male and female without exposure to mass media, were obtained from the 2018 Nigeria Demographic and Health Survey report. Prevalence rates of High Blood Pressure, Diabetes Mellitus, Cardiovascular Disease, and Asthma were extracted from literature. These were used to estimate a vulnerability score for each state of the federation and the Federal Capital Territory. Kebbi had the highest score (39.82), followed by Zamfara (39.27) and Sokoto (39.24), respectively. Osun (11.45), Abia (12.53), and Lagos (15.47), have the least scores, respectively. The most vulnerable geo-political zone was the Northwest, while the least vulnerable was the Southwest. Regression analysis was carried out to model the data. Appropriate steps should be taken to reduce likely mortalities due to high vulnerability to COVID-19 in the identified States.

Keywords: COVID-19, Vulnerability, Cardiovascular disease, Nigeria

INTRODUCTION

The impact of the coronavirus disease 2019 (COVID-19) pandemic has been felt globally. Taking the world by surprise, the global health architecture has not been able to contain the pandemic. The contradictory and inconsistent claims of health authorities across the world, especially, the World Health Organization (WHO), has left so much to be desired. Efforts at stemming the daily incidence of the disease has yielded no satisfactory result, with figures rising unabated.

However, against the backdrop of the uncertainties surrounding the pandemic, and the pronouncement of the World Health Organization that the virus may never go away (BBC, 2020), it has become pertinent for nations to proactively seek means of reducing the impact of the pandemic on their people by identifying and protecting the most vulnerable of their citizens, while awaiting a global remedy.

Vulnerability can either be direct, as a result of infection, or indirect, as a result of altered access to healthcare and other facilities (Banerjee et al., 2020). From the emerging pattern of incidence, those directly vulnerable are the aged, and those who have serious chronic medical conditions such as heart disease, diabetes, elevated blood pressure, and respiratory diseases (Wyper et al., 2020). While those indirectly vulnerable are: the poor, with restricted healthcare access (Link, 2008), those without proper handwashing facilities, the leading approved non-pharmaceutical intervention method (NCDC, 2020), and those with poor mass media exposure, lacking essential information on acceptable prevention protocol.

Very few data and studies are available that describe and estimate the vulnerability of individual African countries to COVID-19. We searched PubMed for articles published on or before 21st June, 2020, using the search terms "Africa", "COVID-19", and "Vulnerability". The only article that met the criteria (Gilbert et al., 2020) considered vulnerability of African countries from the perspective of virus importation from China based on the volume of international travel between the country and the continent. But vulnerability to COVID-19 has gone beyond its importation into the continent, the virus is already on the continent. The immediate goal is to contain its spread in individual countries, and across the continent.

Against this backdrop, we used data from multiple sources to determine local vulnerability to the pandemic within an African

country. We estimated the level of vulnerability of each state of Nigeria to the virus through the use of various population based indicators. We then modelled the suitability of the estimates, thus, determining the real contributory risk factors of COVID-19 vulnerability.

Our model provides a template for estimating vulnerability to the pandemic in other African countries, using data on specific risk factors.

METHODOLOGY

Study setting

Nigeria, with a population of over 200 million, is the most populous country in Africa, comprising of six geo-political zones, divided into 36 states and a federal capital territory. As of the 21st of June 2020, she has conducted 115,760 COVID-19 tests, has 20,244 confirmed COVID-19 cases, with 436 deaths, and 6,879 discharged cases. Only Cross-Rivers State has no reported cases (NCDC, 2020).

Table 1. States' COVID-19 composite vulnerability scores

State	LWQ	SWQ	WFHW	HSW	NMM	NMF	% ≥ 60	HBP	DM	CVD	Asthma	Composite	V-Rank
FCT (Abuja)	5.5	13.1	82.2	46.3	44.4	53.7	1	0.29	0.06	0.11	0.18	22.44	27
Bayelsa	1.7	12.1	95.5	84.8	12.5	27.9	2	0.35	0.07	0.13	0.22	21.57	30
Nasarawa	3.9	17.2	53.9	75.7	65.2	54.5	3	0.38	0.08	0.15	0.24	24.93	20
Ebonyi	20.1	26.5	95.7	53.7	30.7	54.6	4	0.45	0.09	0.17	0.28	26.03	17
Taraba	30.3	36.1	98.4	50.7	90.4	78.8	5	0.47	0.09	0.18	0.29	35.52	5
Yobe	63.2	17	41.1	80.5	62.4	72.2	6	0.48	0.10	0.18	0.30	31.22	14
Gombe	40.8	28.2	99.1	52.1	53.4	67.4	7	0.49	0.10	0.19	0.30	31.73	13
Kwara	20.2	11.2	97.1	88.8	62.6	66.5	8	0.49	0.10	0.19	0.30	32.32	12
Ekiti	12	13	81.7	31.6	19.6	42.4	9	0.49	0.10	0.19	0.31	19.13	31
Abia	0.00	1.5	46.4	22.9	22	33.7	10	0.59	0.12	0.22	0.36	12.53	36
Cross River	6.8	21.6	36.4	33.3	27.8	35.9	11	0.60	0.12	0.23	0.37	15.83	33
Adamawa	19.4	34.7	47.1	84.4	89.8	75	12	0.65	0.13	0.25	0.41	33.08	11
Plateau	24.5	30.1	87.6	72.8	79.5	80	13	0.66	0.13	0.25	0.41	35.36	6
Edo	4.2	9.9	89.4	50.7	48.7	25	14	0.67	0.13	0.25	0.41	22.12	29
Kebbi	36.2	36.9	98.2	94.2	65.5	90.6	15	0.67	0.13	0.26	0.42	39.82	1
Enugu	3.2	14.1	90	73.5	27.1	59.5	16	0.67	0.13	0.26	0.42	25.90	18
Zamfara	54.4	17.3	84.2	89.6	88.3	79.7	17	0.67	0.13	0.26	0.42	39.27	2
Kogi	2.8	20.1	95.4	32.5	40.7	65.3	18	0.68	0.14	0.26	0.42	25.12	19
Osun	7.9	13.3	52.4	5.5	15.7	10.6	19	0.70	0.14	0.27	0.44	11.45	37
Ondo	5.1	16.1	97.1	48.5	22.6	42.4	20	0.71	0.14	0.27	0.44	23.03	24
Sokoto	52	26.4	97.3	83.8	74.7	74.8	21	0.76	0.15	0.29	0.47	39.24	3
Ogun	1	7	87.1	65.3	12.8	70.4	22	0.77	0.15	0.29	0.48	24.30	21
Akwa Ibom	3.8	14.9	90.7	23.7	59.7	36.3	23	0.80	0.16	0.31	0.50	23.08	23
Imo	0.3	1.6	82.8	48.1	57.2	40.7	24	0.81	0.16	0.31	0.50	23.32	22
Niger	17.4	30.4	99.1	51	80.3	68.6	25	0.81	0.16	0.31	0.50	33.96	8
Delta	0.8	4.2	87.5	28.1	66.4	37.7	26	0.85	0.17	0.32	0.52	22.96	25
Borno	19.3	18.9	77.4	45.2	64	76.8	27	0.86	0.17	0.33	0.53	30.04	16
Anambra	0.2	6.1	88.6	3.3	11	37.3	28	0.86	0.17	0.33	0.53	16.04	32
Benue	17.5	27.9	98.9	98.6	62.7	52.4	29	0.88	0.17	0.33	0.54	35.36	7
Jigawa	55.3	24.8	56.9	94.9	69.1	64.7	30	0.90	0.18	0.34	0.56	36.15	4
Bauchi	45.2	26.6	40.4	93.4	67	67.8	31	0.96	0.19	0.36	0.59	33.96	9
Rivers	1.8	6.4	80.2	6.5	61.6	54.3	32	1.07	0.21	0.41	0.66	22.29	28
Oyo	4.3	7.5	57.8	27.7	15.8	24.1	33	1.15	0.23	0.44	0.71	15.70	34
Katsina	21.6	39.5	13.5	5.1	50.7	80.5	34	1.19	0.24	0.45	0.74	22.50	26
Kaduna	6.2	30.3	82.5	93.5	66.7	54.9	35	1.26	0.25	0.48	0.78	33.81	10
Lagos	0.00	0.7	64.1	35.9	13.1	16.2	36	1.88	0.37	0.71	1.16	15.47	35
Kano	29.4	24.2	78.5	54.5	52.5	57.1	37	1.93	0.39	0.74	1.20	30.68	15

LWQ, lowest wealth quantile; SWQ, second wealth quantile; WFHW, without fixed handwashing facility & no handwashing facility; WSW, handwashing facility has no soap and (or) water; NMM, no mass media exposure male; NMF, no mass media exposure female; % ≥ 60, percentage population 60 years and older rank; V-Rank, vulnerability score rank.

Data collection

Population figures from the last official census of the country, in the year 2006, for each state was obtained from the National Population Commission of Nigeria (NPC, 2010). This was then projected to the year 2020. The percentage population of citizens aged 60 years and older, for each of the states, were extracted from the 2018 Nigeria Demographic and Health Survey (NDHS) report (NPC & ICF, 2019), and combined with state population figures to arrive at the figures of citizen age 60 years and older for each state. Also extracted from the report were percentage population of each state in the lowest and second wealth quantiles. The percentage population of each state without fixed handwashing facilities and those without handwashing facilities, and those whose handwashing facilities had no soap and (or) water, were equally extracted from NDHS 2018. Similarly, the percentage population of each state, who have no exposure to mass media were obtained for both gender. The prevalence rates of High Blood Pressure in the country was extracted from *Adeloye et al*. (2015), that of Diabetes Mellitus was taken from *Uloko et al.* (2018), while Asthma prevalence rate was got from *Ozoh et al.* (2019). The country's Cardiovascular Disease prevalence was not readily available; hence the death rate for the disease was used as a surrogate (WHO, 2019). Since the prevalence rates from the various diseases were national figures, they were split based on the population of the states. Making use of prevalence rates for individual state was most ideal, but such figures were not readily available for most of the states.

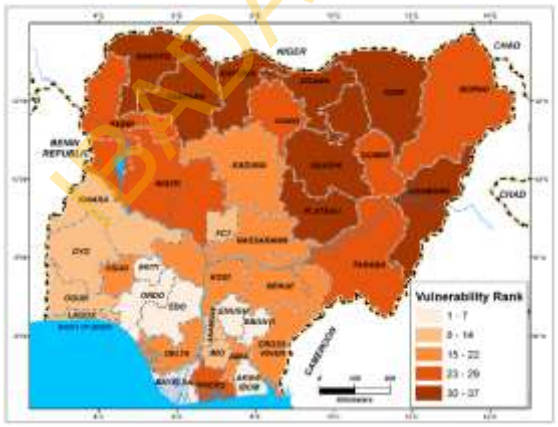

Figure 1. States COVID-19 vulnerability

Statistical analysis

The percentage population of citizens aged 60 years and older were ranked from 1 to 37, for the states and the federal capital territory. The rank score was then summed with the data on wealth quantiles, handwashing, lack of exposure to mass media, and the disease prevalent rates for each state. An average of these variables was then taken to form the composite vulnerability score for each state. Assessing the variables as risk factors, multivariable regression model was used to analyse the composite score of the states and the standardized scores of the variables, determining the risk factors with the strongest contributions. Stepwise regression was then adopted reduce multicollinearity and to eliminate redundant risk factors. The analyses were performed using SPSS16 (IBM, Armonk, NY, USA).

RESULTS AND DISCUSSION

Results

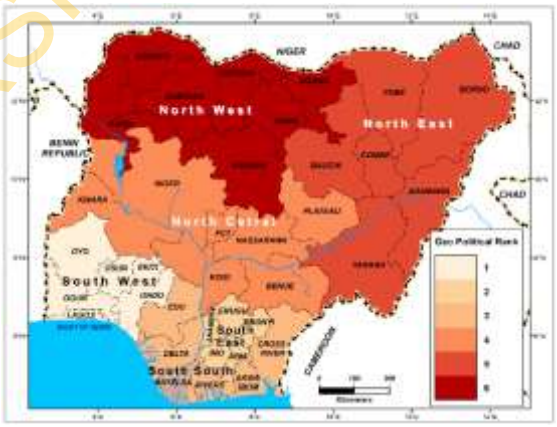

Figure 2. Geo-political zone COVID-19 vulnerability

The state with the highest vulnerability score was Kebbi, with 39.27 points (Table 1). Zamfara had the next highest score of 39.27 points. Sokoto came in the third place with 39.24 points. On the other end of the spectrum, Osun, with 11.45 points, had the least score. Abia was next with 12.53 points, followed by Lagos with 15.47 points. Several of the most vulnerable state were located in the northern part of the country (Figure1). Pooling the vulnerability rank of the states on geo-political basis revealed that the most vulnerable geo-political zone was the Northwest, followed by the Northeast and the Northcentral geo-political zones, respectively (Figure 2). The least vulnerable was the Southwest, followed by the

Southsouth and the Southeast geo-political zones, respectively.

In the multivariable regression model analysis, lowest wealth quantiles, handwashing, and lack of exposure to mass media, were predictors of vulnerability to the pandemic. However, percentage population of citizens aged 60 years and older, and disease prevalent rates did not contribute significantly to the model (Table 2).

Table 2. COVID-19 vulnerability model

Model	B	*p*
Constant	26.683	.000
Z_LWQ	2.118	.000
Z_SWQ	0.804	.070
Z_WFHW	-1.804	.000
Z_HSW	-1.857	.000
Z_NMM	2.220	.000
Z_NMF	2.094	.000
Z_Above_60	0.585	.372
Z_HBP	15.825	.432
Z_DM	-8.102	.373
Z_CVD	-15.152	.341
Z_Asthma	7.807	.745

The evident multicollinearity of the variables was resolved by a stepwise multivariable regression analysis. Reducing the variables from eleven to seven, the prevalent rates of High Blood Pressure, Diabetes Mellitus, Cardiovascular Disease, and Asthma were eliminated from the model (Table 3).

The summary of the stepwise regression model revealed that, though included in the model, not having fixed handwashing facilities, percentage population of citizens aged 60 years and older, and the percentage population in the second wealth quantile made negligible contributions to the model (Table 4). None exposure of women to mass media, handwashing facilities without soap and (or) water, none exposure of men to mass media, and the percentage population in the lowest wealth quantile, were the strong predictors of vulnerability to the COVID-19.

Table 3. COVID-19 vulnerability stepwise model

Model	B	*p*
Constant	26.683	.000
Z_NMF	2.010	.000
Z_HSW	-2.016	.000
Z_NMM	2.109	.000
Z_LWQ	2.140	.000
Z_WFHW	-1.774	.000
Z_Above_60	0.992	.002
Z_SWQ	0.829	.050

Discussion

As of 21st June, 2020, Lagos and Abuja account for a little more than half of the COVID-19 cases in Nigeria. Like in other developing countries, this gives a false sense of safety in rural areas, which governments to beware of (Fortaleza et al., 2020). Given the country's limited capacity to care for victims, and test for the virus, governments and health authorities need to be proactive in order to avert the impending danger.

Interestingly, the strongest risk factor revealed by the model was female non-exposure to mass media (newspaper, television or radio). This further buttresses the strategic position of women in the African community. Over 90% of women in Kebbi State do not access any form of mass information, compared to 10.6% of their counterparts in Osun. This poses a great danger because women are the domestic managers. If unaware of the disease and the attendant symptoms, they are not equipped to seek prompt medical attention. Preventive measures such as the isolation of sick family members is impossible. Thus, the better informed women are, through various mass medium, the less vulnerable the community will be to the pandemic. It is more cost effective for states to step-up efforts at getting more women informed about the virus, and its health implications, especially the more vulnerable states.

Table 4. COVID-19 vulnerability model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.821 [a]	.674	.664	4.57158
2	.916 [b]	.839	.830	3.25827
3	.945 [c]	.893	.883	2.69414
4	.956 [d]	.914	.903	2.45488
5	.971 [e]	.943	.934	2.02662
6	.979 [f]	.958	.950	1.76731
7	.982 [g]	.963	.955	1.68007

Models: a. Constant, Z_NMF, b. Constant, Z_NMF, Z_HSW, c. Constant, Z_NMF, Z_HSW, Z_NMM, d. Constant, Z_NMF, Z_HSW, Z_NMM, Z_LWQ, e. Constant, Z_NMF, Z_HSW, Z_NMM, Z_LWQ, Z_WFHW, f. Constant, Z_NMF, Z_HSW, Z_NMM, Z_LWQ, Z_WFHW, Z_Above_60, g. Constant, Z_NMF, Z_HSW, Z_NMM, Z_LWQ, Z_WFHW, Z_Above_60, Z_SWQ

The globally approved non-pharmaceutical interventions against COVID-19 infection are regular hand washing and physical distancing. From the analysis, the second predictor of vulnerability was handwashing facilities without soap and (or) water. Again, availability of portable water for the general population came to the fore. More than half of the population of 20 out of the 36 states in the country do not have soap and (or) water for handwashing. And, worrisome is the fact that all these states, except Bayelsa, Enugu, Ogun, Eboyi, and Edo, were located in the northern part of Nigeria. How effective, then, can the non-pharmaceutical intervention be in the country? Hence, in the bid to stem the spread of COVID-19 in the country, states have to increase the supply of portable water to the populace.

That there is a strong association between poverty and diseases, especially, infectious diseases, is established in the literature (Links, 2008). It was therefore not surprising that the percentage population of citizens in the lowest wealth quantile was a predictor of vulnerability. Half of the states in the country, mostly in the northern part, have double digit lower wealth quantile percentages, the highest been Yobe (63.2%). Whereas, states like Lagos and Abia have no citizens in the lowest wealth quantile. Thus, there is the need for more concerted effort to pull more Nigerians out of the lowest wealth quantile, since COVID-19 might be around for a long time.

Even though prevalence rates of chronic diseases were eliminated from the model, the need for accessible, up-to-date data on diseases, especially, chronic ones, cannot be over emphasized. Apart from the fact that some of the prevalence figures used were dated, the unavailability of prevalence rate of cardiovascular disease for the country led to the death rate from the disease being used as surrogate. Relevant authorities need to make such national figures more accessible and current. Also, such figures need to be disaggregated to state and local government levels.

CONCLUSION

Available evidences suggest that the aged, and those with underlining critical health conditions are the most vulnerable to COVID-19. However, old age and chronic diseases may not be the right focus for African countries. Although age was included in the model, it made a weak contribution. In the same vein, chronic diseases were non-predictors, thus eliminated. While not overlooking the negative contributions of old age and chronic illnesses to disease infection, African countries might need to look more at improving the level of: information of their people (especially the women), their basic hygiene, and poverty, in order to effectively contain the spread of the virus, and mitigate its impact. This will go a long way in reducing likely mortalities due to high vulnerability to COVID-19 in the identified states of Nigeria, and the continent at large.

REFERENCES

Adeloye, D., Basquill, C., Aderemi, A.V., Thompson J.Y., & Obi F.A. (2015). An estimate of the prevalence of hypertension in Nigeria: a systematic review and meta-analysis. *J Hypertens*. 2015; 33(2):230-242. doi:10.1097/HJH.0000000000000413

Banerjee, A., Pasea, L., Harris, S., Gonzalez-Izquierdo, A., et al. (2020) Estimating excess 1-year mortality associated with the COVID-19 pandemic according to underlying conditions and age: a population-based cohort study. *Lancet* 2020; 395: 1715–25

British Broadcasting Coporation. (2020). Coronavirus may never go away, World Health Organisation warns. https://www-bbc-com.cdn.ampproject.org/v/s/www.bbc.com/news/amp/world-52643682?amp_js_v=a2&amp_gsa=1&usqp=mq331AQFKAGwASA%3D#aoh=1594

5603340856&referrer=https%3A%2F%2Fwww.google.com&amp_tf=From%20%251%24s&ampshare=https%3A%2F%2Fwww.bbc.com%2Fnews%2Fworld-52643682. (Accessed 12th July 2020).

Fortaleza CMCB, Guimarães RB, de Almeida GB, Pronunciate M, Ferreira CP. (2020). Taking the inner route: spatial and demographic factors affecting vulnerability to COVID-19 among 604 cities from inner São Paulo State, Brazil. *Epidemiology and Infection* 148, e118, 1–5. https://doi.org/10.1017/S095026882000134X

Gilbert, M., Pullano, G., Pinotti, F., Valdano, E., Poletto, Pierre-Yves Boëlle, C., D'Ortenzio, E., Yazdanpanah, Y., Eholie, S.P., Altmann, M., Gutierrez, B., Kraemer, M.U.G., Colizza, V. (2020). Preparedness and vulnerability of African countries against importations of COVID-19: a modelling study. *Lancet* 2020; 395: 871–77. https://doi.org/10.1016/S0140-6736(20)30411-6

Link, B.G. (2008). Epidemiological sociology and the social shaping of population health. *Journal of health and social behavior*. 2008;49(4):367-384.

National Population Commission (NPC). (2010). *Population and housing census of the Federal Republic of Nigeria 2006*. Abuja, Nigeria

National Population Commission. (NPC) [Nigeria] and ICF. (2019) *Nigeria Demographic and Health Survey 2018*. Abuja, Nigeria, and Rockville, Maryland, USA: NPC and ICF.

NCDC. (2020). Public health advisory to Nigerians on Coronavirus disease. https://COVID19.ncdc.gov.ng/advisory/ (Accessed 12th July 2020).

Nigeria Center for Disease Control (NCDC). (2020). COVID-19 situation report. Situation report 114. https://ncdc.gov.ng/diseases/sitreps/?cat=14&name=An%20update%20of%20COVID-19%20outbreak%20in%20Nigeria. (Accessed 20th June 2020).

Ozoh, O.B., Aderibigbe, S.A., Ayuk, A.C., Desalu, O.O., et al. (2019). The prevalence of asthma and allergic rhinitis in Nigeria: A nationwide survey among children, adolescents and adults. *PLoS One*. 2019; 14(9): e0222281. Published online 2019 Sep 13. doi: 10.1371/journal.pone.0222281

Uloko, A.E., Musa, B.A., Ramalan, M.A., Gezawa, I.D., et al. (2018). Prevalence and Risk Factors for Diabetes Mellitus in Nigeria: A Systematic Review and Meta-Analysis. *Diabetes Ther*. 2018 Jun; 9(3): 1307–1316. Published online 2018 May 14. doi: 10.1007/s13300-018-0441-1

WHO (2019) WHO and Nigerian Government move to curb cardiovascular diseases. https://www.afro.who.int/news/who-and-nigerian-government-move-curb-cardiovascular-diseases. (Accessed 20th June 2020).

Wyper G.M.A, Assunção R., Cuschieri, S., Devleeschauwer, B., et al. (2020) Population vulnerability to COVID-19 in Europe: a burden of disease analysis. *Archives of Public Health* (2020) 78:47 https://doi.org/10.1186/s13690-020-00433-y