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RESEARCH ARTICLE

Determinants of COVID-19 disease outcomes among patients admitted at an infectious disease centre in sub-Saharan Africa

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Abstract

***Background*:** Although the COVID-19 epidemic seems to have ceased, with only few new sporadic cases seen, reports of new strains of the virus could lead to a resurgence and death. Hence, this study identified the determinants of COVID-19 disease outcomes among patients admitted in Ibadan, Nigeria.
***Objective*:** This study aims to identify the determinants of COVID-19 disease outcomes among patients admitted at the Infectious Disease Centre, Olodo, Ibadan, Nigeria.
***Method*:** A facility-based retrospective study with a review of the records of all cases (932) of laboratory confirmed COVID-19 disease patients who received treatment between April 2020 and January 2022 at the centre was conducted. Data was analysed at the level of significance of 5%.
***Results*:** The mean age (S.D.) of the patients was 36.97 (14.6) years, while the mean number of days on admission was 14.87 (11.33) days. Most were males (66.7%). Many (51.5%) were symptomatic at admission and 4% had co-morbidities. Poor outcome was associated with employment status, tachycardia, diastolic hypertension, hypoxaemia (SPO2 <95%), and obesity (BMI > 30 kg/m^2). Employment status was the most significant predictor of poor COVID-19 admission outcome (OR: 3.17, 95% CI 1.53–6.57). The case fatality rate was 3.3%.
***Conclusion*:** Patients' employment status should help healthcare practitioners in the risk assessment of COVID-19 disease patients' and subsequent treatment. Clinicians need to have a high index of suspicion and prioritize the care of healthcare workers. Community members should be educated that being asymptomatic does not necessarily mean no infection.

Keywords: *COVID-19, Determinants, Nigeria, Admission outcomes*

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Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) is the virus strain of Coronavirus Disease 2019 (COVID-19) and is a novel virus that was detected in Wuhan city, Hubei Province, China. The COVID-19 outbreak was first reported to the World Health Organization (WHO) on December 31, 2019. It was declared a world-wide health emergency and a global pandemic on January 30 and March 11, 2020 respectively [1]. The global spread included Nigeria, the most populous country in Africa, with an estimated population of about 200 million people [2]. The first case of the novel coronavirus was discovered in Nigeria on February 27, 2020 [3]. Nigeria ranked 12th amongst one of the African countries with a high burden of the disease [4].

The burden of COVID-19 cuts across the different geopolitical zones of Nigeria. The highest COVID-19 burden was in the Southwest region. Oyo state ranked second to Lagos and both states contributed over 40% of the total national disease burden. Ibadan the administrative headquarter and economic hub of Oyo State, is in close proximity to Lagos State, the COVID-19 epicentre of the country [3]. Despite the decreasing disease burden, there is a dearth of information on the factors influencing COVID-19 disease outcomes in Nigeria.

COVID-19 is a novel disease with a seemingly variable clinical presentation and progression. In several parts of the world, commonly reported symptoms include fever, dry cough, fatigue, myalgia, headache, sore throat, abdominal pain, and diarrhoea [5]. In a study that reported the

predictors of poor outcome among COVID-19 patients in Lagos, patients ages ranged from 4 days to 98 years with a mean of 43.0 (16.0) years. Of the patients who presented with symptoms, cough (19.3%) was the most common presenting symptom. This was followed by fever (13.7%) and difficulty in breathing, (10.9%). The most significant clinical predictor of death was the severity of symptoms and signs at presentation. The case fatality rate was 4.3% [6].

Although the epidemic has ceased, the development of new strains of the virus could lead to a resurgence and ultimately death [7]. Understanding the patients' characteristics, clinical profile, and assessing the prognostic factors for COVID-19 disease outcomes would guide risk assessment of patients and help improve case management of COVID-19 patients in Nigeria. The purpose of this study was to identify factors influencing COVID-19 disease outcomes among 932 patients admitted at an infectious disease centre (IDC) in Ibadan with the hope that these findings will fill some gaps in research on COVID-19 in Nigeria.

Methods

Study setting

The IDC, Olodo, was the first IDC and the largest isolation/treatment centre in Oyo state. It was commissioned in April, 2020 at the commencement of the pandemic [8]. It served as the major referral and treatment centre for COVID-19 patients in the state. The 100-bed facility had 60 clinical staffs (doctors, nurses, laboratory scientists, and ancillary staffs) trained in COVID-19 case management who provided 24-h care for COVID-19 patients. The IDC admitted between 5 and 10 new patients daily at the peak of the outbreak in 2021.

Study design

This was a single-centre, facility-based retrospective cohort study using secondary data extracted from the case records of COVID-19 cases managed from April 2020 to January 2022 at the IDC, Ibadan Oyo State, Nigeria.

Study population

Patients who were hospitalized with a diagnosis of COVID-19 infection using the positive antigen based rapid diagnostic test or reverse transcriptase polymerase chain reaction (RT-PCR) in accordance with the protocol established by the World Health Organization (1) comprised the study population. Patients were discharged after a negative PCR-based SARS-CoV-2 virus test. All patients were treated with a cocktail that included chloroquine or hydroxychloroquine, zinc, vitamins C and D, and or antibiotic(s) as indicated. Physiotherapy and nutritional support for these patients were also considered as priority.

Sampling technique

Total sampling of all available case records of patients' admitted during the study period was done. All the 932 met the inclusion criteria and were analysed.

Study instruments

The study instrument consisted of a 35-item proforma that was used to extract information from the patients' medical records. Data was collected using the proforma adapted from Naseef et al. [9]. The instrument was revised following a review of literature on COVID-19 disease correlates and admission outcomes [10, 11].

The proforma was serialized to avoid multiple administration and data was anonymised to protect the privacy of the patients.

Data collection

Data was extracted by the researcher and two research assistants, between January and February 2023.

Study variables

The primary outcome of the study was discharged alive, died in hospital, or transferred to tertiary healthcare facility. The independent variables were socio-demographic characteristic (age, sex, religion, marital status, and occupation); medical history (date of admission, date of discharge, duration of admission, history of co-morbid condition(s), history of being symptomatic at admission); clinical findings [temperature (^{o}C), pulse rate, blood pressure, respiratory rate, oxygen saturation (SPO2% on air) at admission, need for oxygen therapy (yes/no), height (metres), and weight (kilogram)]; laboratory findings at admission [packed cell volume/haemoglobin level (PCV/Hb), white blood cell count (WCC) and differentials (Neutrophils (N), Lymphocytes (L), Eosinophils (E)), and Platelet count]. Clinical parameters were considered normal using reference ranges for Nigerians as defined by Miri-Dashe et al. [12] and Ayemoba [13] Laboratory values were classified into low (less than normal), normal, and high (greater than normal).

Data management and analysis

Extracted data was entered into a password protected computer. Data was analyzed using SPSS version 22. Categorical variables were presented in frequencies and percentages, normally distributed continuous variables were presented as means and standard deviations (SD). Co-morbidities and presenting symptoms were analyzed using multiple responses. The Chi-square test was used to test the association between the dependent and independent variables. The level of significance was set at 5% ($P < 0.05$). Significant variables in the bi-variate analysis were included in the multi-variate analysis. Multiple logistic regression analysis was used to identify the determinants of treatment outcomes.

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Ethical considerations

Ethical approval was obtained from the Research and Ethics Committee for Planning and Statistics, Oyo State Ministry of Health (Ref No. AD13/479/279). Permission to conduct research was obtained from the hospital administration of IDC. Data was de-identified to ensure the privacy of the patients' information and was stored in a password protected computer.

Results

Nine hundred and thirty-two (932) patient case files were reviewed, comprising 622 (66.7%) males and 310 (33.3%) females, with a male to female ratio of 2:1. There were no exclusions due to unavailable records.

Patient characteristics

The mean age (SD) of the patients was 36.97 ± 14.63 years and mean duration of admission was 14.87 ± 11.33 days. As shown in Table 1, 69% (643) of the patients were older adults (27–59 years), while the young adults (18–26 years) were 19.5% (182), 2.8% (26) were children, and 8.7% (81) were elderly. A total of 58.8% (548) of the patients were married and most, 73.0% (680), were employed non-health workers (NHW). A total of 51.5% (480) were symptomatic on admission; presenting symptoms included fever, headache, chest pain, and cough. Four per cent (37) had a co-morbid condition; diabetes, hypertension, and asthma were most common.

Diagnostic findings of the COVID-19 patients at admission

Most patients had normal clinical vital signs on admission [Temperature – (51.2%), Pulse rate – (88.4%), Respiratory rate – (64.3%), Systolic blood pressure – (76.6%), Diastolic blood pressure – (76.8%), Oxygen saturation – (91.7%)]. Only 2.3% of patients had a fever and almost half, 45.8%, had hypothermia while about a quarter (29.7, 23, and 22%) had tachypnea, high systolic and diastolic blood pressures respectively. Packed cell volume, white cell count, and platelets count were within the normal range in most of the patients; 93.3, 85.4, and 82.5% respectively. More than half of the patients (63.3%) had lymphocytosis, and 15.2% patients had neutrophilia.

Treatment outcomes of COVID-19 patients on admission

The majority (95.3%) of the patients recovered and were discharged, while 31 (3.3%) died and 13 (1.4%) were referred to University Teaching Hospital, Ibadan for specialist care.

Association between demographic characteristics and outcomes of the COVID-19 admissions

There was no significant difference in outcome between older-age and poor outcomes (referral to tertiary centre

Table 1. Profile of the COVID-19 patients (N = 932)

Profile of patients	Frequency (*n*)	Percentage (%)
Age (years) mean-SD	36.97 ± 14.63	
< 18	26	2.8
18–26	182	19.5
27–59	643	69.0
≥ 60	81	8.7
Sex		
Male	622	66.7
Female	310	33.3
Religion		
Islam	286	30.7
Christianity	646	69.3
Marital status		
Single	379	40.7
Married	548	58.8
Widowed	05	0.5
Occupation		
Student	48	5.2
Employed (HW)	68	7.3
Employed (NHW)	680	73.0
Unemployed	72	7.7
NA	64	6.9
Duration of admission (days)		
Mean (SD)	14.87 (± 11.33)	
1–14	653	70.1
15–28	216	23.2
29–42	38	4.1
> 42	25	2.7
Symptomatic on admission		
Yes	480	51.5
No	452	48.5
Co-morbidity* (*n* = 37)		
Diabetes	13	1.4
Hypertension	11	1.2
Asthma	16	1.7
Others**	30	3.2
Presenting symptoms (*n* = 480)		
Fever	216	23.1
Headache	199	21.4
Cough	169	18.1
Chest pain	164	17.5
Fatigue	58	6.2
Muscle pain	41	4.4
Anorexia	36	3.9
Anxiety	20	2.1
Loss of taste	14	1.5
Anosmia	13	1.4
Joint pain	10	1.1
Back pain	04	0.4

NA: Not available. *Multiple response. **Others (Sickle Cell Disease, Cancer, Chronic Obstructive Pulmonary Disease).

Table 2. Association between diagnostic findings and treatment outcomes of the COVID-19 patients

Clinical findings	Treatment outcomes				Total *N* = 932		χ^2	*P*
	Discharged *n* = 888		Died/Referred *n* = 44					
	n	%	*n*	%	*n*	%		
Pulse rate							20.34	0.00**
Low	23	88.5	03	11.5	26	100		
Normal	793	96.4	30	3.6	824	100		
High	66	85.7	11	14.3	77	100		
Diastolic blood pressure							9.92	0.01**
Normal	689	96.4	26	3.6	715	100		
High	187	91.2	18	8.8	205	100		
Oxygen saturation							187.36	0.00**
96–100	710	98.3	12	1.7	722	100		
90–95	44	69.8	19	30.2	63	100		
< 90	11	50.0	11	50.0	22	100		
Body mass index							26.10	0.00**
< 18	37	100	00	0.0	37	100		
18–24.99	192	98.5	03	1.5	195	100		
25–29.99	88	94.6	05	5.4	93	100		
> 30	49	83.1	10	16.9	59	100		

*Fisher's exact test, **P-value at 5% level of significance.

or death) and there were no differences by sex, marital status, or religion. A total of 10% of students or the unemployed (12/120) were referred to tertiary centre or died, and this prevalence was 7.4% (5/68) in healthcare workers (HCWs), but lower in non-health care workers at 3.4% ((23/680); χ^2 11.43, $P = 0.03$). In logistic regression analysis, occupation was the only significant factor that affected disease treatment outcomes. Odds Ratio (OR) for referral to tertiary centre or death was 1 for patients in school or unemployed, 2.27 (CI 0.83–6.17) for non-HCW, and 3.17 (1.53–6.57), $P = 0.00$ for HCWs.

There was no significant difference in outcome by length of stay, 4.6% (30/653) of those staying for 2 weeks or less were transferred to a tertiary hospital or died, 4.2% (9/216) of those staying for 2–4 weeks, and 7.9% (5/63) of those staying for over 28 days. Six percent (29/480) symptomatic patients were transferred or died compared to 3.3% (15/452) asymptomatic patients on admission (χ^2 – 3.84; P 0.06).

Association between diagnostic findings and treatment outcomes of COVID-19 patients

Table 2 shows that abnormal pulse rate, diastolic hypertension, high BMI, and SpO2 < 96% were associated with poorer outcome. Temperature, respiratory rate, systolic blood pressure, polycythemia, neutrophilia, lymphopenia, and thrombocythemia did not show statistically significant differences in outcome.

Discussion

This cross-sectional retrospective study assessed the determinants of COVID-19 treatment outcomes among patients in Ibadan, Nigeria. In 2020, globally, hospitals were almost overwhelmed with COVID-related admissions with in-hospital mortality rates as high 30% [7] and numerous studies identified variables associated with poor outcome. The experience in sub-Saharan Africa was fortunately less serious than in Europe and the Americas. In the present study that encompassed the three major waves of the pandemic the outcome for patients admitted to a hospital was favourable with 95% being discharged alive and highest frequency was amongst non-HCWs. Most of the patients admitted were males, the married, and those in employment. Most patients had normal clinical vital signs, packed cell volume, white cell count, and platelet count because about half were admitted as asymptomatic.

The demographic characteristics of patients were similar to the findings of Abayomi et al. in Lagos and Ibrahim et al. in Katsina [6, 11]. The age group mostly affected by COVID-19 in Lagos, Ekiti, and Katsina states of Nigeria was similar to our findings [6, 11, 14]. Also, most studies reported a male preponderance [10, 15–17] although a few studies reported a female preponderance [18, 19]. Similar to our findings, Akinyemi et al. reported a higher proportion of married participants having COVID-19 infection [20]. Likewise, Usman et al. in their field epidemiological study in Southwest Nigeria also found that traders and artisans were more likely to have COVID-19 infection

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[21]. Demographic profile similarity with other studies is a reflection of the general demographic characteristics in Nigeria. The age group mostly affected comprises the working population and thus more susceptible to COVID-19 infection due to their day-to-day interaction. The prevalence of chronic disease was very low (37/932) compared to studies elsewhere. The spectrum of co-morbidities was similar to that reported by others, but the prevalence of asthma was greater than hypertension and diabetes in the present study [11, 18, 22].

Although, globally, temperature check had been a screening and monitoring tool, most patients studied had a low to normal body temperature. This is consistent with the findings of Jibrin et al. [23] and it may be due to many patients being asymptomatic at admission or self-medicating prior to admission [24]. Most admissions during the first wave were based on being positive for SARS-CoV2 with or without clinical signs and symptoms. Most patients (623/932) were discharged from the hospital within 14 day of admission which is comparable to previous Nigerian studies. In the study of the first 32 diagnosed COVID-19 patients in Nigeria, Bowale et al. reported also that patients required a median duration of 2 weeks hospital stay to recover in contrast to Ibrahim et al.'s findings [11, 25].

Overall outcome was favourable with a mortality rate of 3.3% and comparable to that in other studies in Africa. Similar to our findings, most of the patients in the cohorts of COVID-19 patients studied by Ibitoye et al., in South-West Nigeria recovered [14]. Likewise, Kaso et al. in their study of hospitalized COVID-19 patients in Ethiopia reported that more than four-fifth of the patients had favourable treatment outcomes [18] However, Ibrahim et al. reported a higher mortality rate of 16% in northern Nigeria [11]. The difference in outcomes may reflect different demographic characteristics of the patients and variation in healthcare resources [8].

Similar to this study, most studies show greater mortality rate in the elderly. Most of the fatalities/transfers to tertiary care (34/44) occurred among the older adults (28–59 years) but there was a trend to poorer outcome for the elderly similar to the findings in most studies [14, 15] There was a non-significant higher rate of poor outcome for females in the present study which contrasts with higher mortality amongst males reported by others [16]. Elimian also found that older age, being symptomatic, and being hospitalized were factors independently associated with increased risk of COVID-19 mortality in Nigeria, while Ibitoye et al. reported a higher mortality or delayed clinical recovery amongst older patients, and those hospitalized [14, 17].

The prevalence of comorbidity in our patients was very low compared with other studies which have shown an association between comorbidity and both hospitalisation and mortality from COVID-19. As reported by others we found obesity to be associated with poor outcome. The loss of significance of this observation on multivariate analysis may have been due to collinearity between variables. Osibogun et al. and Ibitoye et al. reported a more significantly higher proportion of deaths or delayed clinical recoveries among patients with co-morbidities [10, 14]. The co-morbidities associated with death were diabetes and sickle cell disease. Osibogun et al. also reported that comorbidities that predicted death were hypertension, diabetes, renal disease, cancer, and HIV [10].

Employment status had a significant impact on outcome. A poor outcome was more likely in the unemployed patients [19]. However a higher proportion of HCW patients had an unfavourable outcome compared with the non-HCW patients. This is in contrast to the report of Alshamrani et al. of a lower case fatality in HCW patients (12.3/100,000) compared to non-HCW patients (28.1/100,000) [26].

We found that simple clinical observations on admission were indicative of outcome. The significant association between treatment outcomes and pulse rate, diastolic blood pressure, and oxygen saturation we found were similar to the findings of Ibrahim et al. in Katsina state, Nigeria [11]. However, no clinical signs retained significance on multivariate analysis. This is probably due to the relatively small number of patients and collinearity between variables.

The probability of death increasing with increase in white cell count is corroborated by the findings of Ibrahim et al. in northern Nigeria and Zhu et al. regression analysis results that showed a significant association between leucocyte count and death [11, 22]. This is in contrast to an earlier study from Wuhan, China, where there were more leukopenia and lymphopenia cases [27]. The observation of leucocytosis and neutrophilia among non-recovered groups may indicate a secondary bacterial infection complicating the COVID-19 infection thus resulting in a poor treatment outcome [24].

Patients' employment status was the only significant positive predictor of treatment outcomes. Elimian et al. reported the odds of COVID-19 death was higher among farming occupation while Drefahl et al. reported a significant association between occupation and COVID-19 treatment outcomes in their cohort study in Sweden [17, 28]. We found a lower odds of death among the public and private civil servants, including the HCWs which could be related to their literacy level and possibly having a higher socioeconomic status, influencing their understanding of the disease and good health seeking behaviour.

This was a retrospective study, information was obtained from patients' case files. However, information bias due to recall might have occurred. Also, retrieval of records resulting in the missing of some variables limited full data collection. Despite this, the study adds to the body of knowledge on treatment outcomes of COVID-19

infection and emphasizes the importance of patients' employment status in the management of the infection. Our results are hospital-based and cannot be generalized to the overall population of COVID-19 patients. Despite this, it provides useful information to guide clinicians in treatment of CIVID-19 patients.

Limitation

Although we could retrieve the case records of all the patients managed during the period of study, a few had incomplete data. In any case, these are hospital-based data that represented COVID-19 patients who were admitted at the facility and may not be an exact reflection of COVID-19 treatment outcomes in the state.

Implication for policy makers

This study provides useful information for policy makers at public and health institutions to plan interventions to improve recovery from future sporadic cases of COVID-19 infection. It also helps in early detection of a resurgence from reports of an increase infection in the employed population and especially the health care workers. Patients' occupation should be a key factor considered in the classification of disease severity and subsequently in its treatment.

Implication for clinical practice

Knowledge of the factors influencing COVID-19 recovery will guide clinicians' case management and thus reduce the impact of the disease and its complications, as well as improve the clinical outcomes. However, risk assessment of the workplace, workforce, and individual can help reduce potential workplace susceptibility.

Conflict of interest

The authors declare that there is no conflict of interest in writing this manuscript.

Author contributions

Adekunle W.A. – Conceptualization, study design, data collection, analysis and manuscript writing.

Salawu M.M. – Study design, supervision and manuscript writing.

Obembe T.A. – Study design, supervision and manuscript writing.

Ismail W.O. – Analysis and manuscript writing.

Fasasi I.A. – Data collection.

Bello M.D. – Data collection.

Fawole OI – Conceptualization, study design, supervision and manuscript writing.

Authorship details

A.W.A. and F.O.I. conceptualized the study; A.W.A., F.O.I., S.M.M., and O.T.O. designed the study; A.W.A., F.I.A., and B.M.D. were involved in data retrieval, collection, and collation; A.W.A. and I.W.O. analyzed the data; A.W.A., S.M.M., O.T.O., I.W.O., and F.O.I. were involved in manuscript development/writing; F.O.I. reviewed the manuscript. All the authors have agreed to the final manuscript.

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