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Correlation between COVID-19 Patients' Characteristics and Mortality with the Disease in the Gambia

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Abstract:-
Background. A new coronavirus strain known as Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV-2) is responsible for the global pandemic that began in 2019 and continues to plague the planet. The disease's epidemiological features in Africa are different from those in other continents. The aim of this study is to establish the relationship that exists between COVID-19 patients' demographics, symptoms, comorbidities and the risk of COVID-19-related mortality in the Gambia between April 4, 2020 and March 31, 2021.
Design. The researchers studied 3547 confirmed positive COVID-19 anonymized cases derived from the DHIS2 database in a retrospective cohort analysis. The factors analyzed include the demographics of the cases, their signs and symptoms, and their comorbidities. The main outcome of interest was death with COVID-19.
Results. For the time period under consideration, 3547 anonymized positive COVID-19 events were analyzed. The fatality rate was 0.56%, with a median age of 60.5 (50–71) for those who died with COVID-19 and the p-value < 0.001. Males are more likely to develop the disease and die from it (63.1% and 85%, respectively). Except for age and sex (both p < 0.05), all factors studied were considered to be statistically insignificantly correlated with the outcome. Cough (11.1%), fever (9.4%), and shortness of breath (4.3%) were the most common signs and symptoms identified by the cases. 4.62 % and 18.1 % of all confirmed positive COVID-19 cases, respectively, had one of the comorbidities and reported one of the COVID-19 signs and symptoms in TABLE 1. There was no statistically significant association between the signs and symptoms or the comorbidities and the outcome. CVD (2.7%), diabetes (1.5%), and ARDS (0.8%) and CLD (0.4%) were the most often identified comorbidities among the cases. Symptoms and comorbidities were reported more often by survivors than those who died with COVID-19. Age, shortness of breath, and diabetes all increase the risk of death with COVID-19, as per the multivariate logistic regression. In this analysis, however, only age was a significant predictor of mortality with COVID-19.
Interpretation. The findings of our analysis are consistent with those of the Lusaka cohort, which reported that advanced age increased mortality with COVID-19, and that the most common comorbidities were CVD (hypertension) and diabetes, with a higher proportion of male COVID-19 cases. To better understand the characteristics of COVID-19 hospitalized cases in relation to death with COVID-19, length of hospitalization, and treatment, further exploratory data analysis is needed.

Keywords:- *COVID-19; Comorbidities; The Gambia; Ministry of Health; Correlation; Prevalence; Mortality.*

I. RESEARCH BACKGROUND

The year 2020 began with a devastating novel coronavirus disease outbreak aka COVID-19. This infectious disease is brought about by a new coronavirus strain known as Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) [1]. The first case of the virus emerged in December 2019 in Wuhan, China. As a result, the World Health Organization (WHO) declared the coronavirus disease outbreak a Public Health Emergency of International Concern on January 30, 2020 [2]. Moreover, on March 11, 2020, WHO declared the coronavirus as a pandemic [3].

Six days after the characterization of COVID-19 as a pandemic by the WHO, the Gambia registered its first case [4] and cumulatively has recorded 5,459 confirmed cases, 5,070 recoveries, 165 deaths to date [5]. The government sanctioned public health initiatives such as a ban on all types of public gatherings (including places of worship and schools) to establish physical separation, the closure of all land borders, and the prohibition of non-essential travel for 21 days as part of its response efforts to mitigate the effects of the disease outbreak [6, 7, 8]. This has been followed by a stringent measure by declaring a state of public emergency (SoPE) [7].

Like most countries in the world battling with COVID-19, the Gambia's health system has been overwhelmed with the increase in incidence of cases and this continues to cause a great strain on the health care delivery system. Based on the primary health care plan, the government is the primary health care provider, and there are three tiers of health care service delivery (Primary, Secondary, and Tertiary). The primary level has 492 health posts, the secondary level has 38 health centers, and the tertiary level has four tertiary hospitals. 34 private and nongovernment organizations' (NGO) clinics have complemented the government's efforts to provide affordable and high-quality health-care facilities to the public. [9].

Studies have shown that most of the infected COVID-19 cases will experience mild to moderate symptoms and often times get well with no hospitalization for special treatment. However, people of old age and those with existing noncommunicable diseases like diabetes, hypertension, cancer, cardiovascular disease, and chronic respiratory illness are at higher risk of developing complications from COVID-19 [10, 11, 12].

Despite the Gambia having a median age of 17.8 years and 41.9% of the population having ages within the cohort of 20 and 64 years-of-age [9], the prevalence of hypertension [13], and diabetes [14], which are both known to be significant risk factors for the severity and fatalities of COVID-19, has prevalence rates of 27% and 6%, respectively.

A cohort analysis conducted by the MRCG/GG COVID-19 working group reported that all participants in their study were asymptomatic or mild symptomatic, with zero deaths. The cumulative incidence rate of SARS-CoV-2 infection among the participants was 129 per1,000, which is more than 20 times higher than estimates based on cases reported in the adult Gambian population [9].

The need for hospitalizations will continue to strain both private and public health services, given that the battle against COVID-19 is far from over, with an increase in cases exacerbated by insufficient enforcement and regulation, as well as a lack of commitment to preventive measures. In order to provide prompt and adequate treatment to the infectious population without overloading our fragile health-care system, careful structuring of the health-care delivery system, as well as a detailed understanding of case characteristics, are needed. As a result of these considerations, the analysis and association of such variables that may influence mortality risk with COVID-19 has become crucial in assisting frontline physicians in patient care and ensuring that health care services are provided with the necessary security, quality, and timeliness [15].

While few studies have been conducted in Africa, especially in the Gambia, to correlate patients' clinical records with COVID-19, several such studies have been conducted elsewhere to identify significant variables that could measure mortality risk [16, 17, 18, 19]. From the results of a study on what does and does not correlate with COVID-19 [20], it reported a statistically significant positive association between COVID-19 death rates and the population whose age is above 65 years, and those that are diabetics. Similarly, Fu et al. [21] found that older age, lower oxygenation index, and chronic conditions such as diabetes, obesity, hypertension, hepatic disease, heart disease, and chronic pulmonary disease all raised the likelihood of COVID-19 infection-related mortality [19].

The aim of this research is to investigate the positive cases characteristics that affect mortality with COVID-19 in Gambia. With this viewpoint, we hope to examine the association between patient demographics, symptoms, and comorbidities and the risk of COVID-19 infection-related mortality, a link that is rarely examined in Africa, especially in the Gambia.

II. MATERIALS AND METHODS

In this article, the methodology described below is adopted from [15] and we intend to tailor it to the Gambia context.

A. Data collection

We included 3547 positive COVID-19 cases in the Gambia in this retrospective cohort study, who were diagnosed with COVID-19 between April 4, 2020 and March 31, 2021, as per WHO guidelines. The data for this analysis was extracted from the Ministry of Health's Gambia Health Management Information System (Demographic and Health Information System 2) database. This database's extracted dataset contains anonymized data on positive COVID-19 patients' demographics (e.g., age, sex, area of residence), clinical assessment and diagnosis (e.g., signs and symptoms, diagnosis date, disease start date, date of discharge, severity status, and comorbidities), lab results (e.g., date test required, result, screening test sample CT value, spx type of specimen) and information on the health outcome (e.g., date of dead, date discharge, and health outcome). Patients, their relatives, or COVID-19 case management health care providers reported all of these data. This paper's results were analyzed using an anonymized, processed list of positive COVID-19 patients, which is available in an excel document.

B. Statistical analysis

Continuous non-normal distribution variable (age) was presented using the median and interquartile range (IQR) in statistical analysis, while categorical variables are presented using a frequency count and a percentage. Where the chi-square test assumption is satisfied, a chi-square test is used to estimate p-values between categorical variables; otherwise, Fisher's Exact Test is stated for p-value. To determine the relationship between the outcome variable and age, the Mann-Whitney U Test is used. To account for the influence of the variables on each other, I used the purposeful selection method to choose variables from the univariate analysis with a p-value of less than 0.25 as a criterion for variable inclusion in the multivariate logistic regression. The reason for using a significant level as high as 0.25 for initial variable selection is that the most often used significance level (0.05) often fails to identify significant variables [22]. To determine statistical significance, a P-value of less than 0.05 was used, and the P-values were determined using a two-sided test. The odds ratio (OR), 95 percent confidence interval (CI), and new p-values are reported from the multivariate logistic regression. The Statistical Package for the Social Sciences (SPSS) version 20 of the International Business Machine (IBM) was used to perform the above-mentioned analysis.

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III. RESULTS

At the time of data extraction, there were 4650 confirmed positive cases in the DHIS2 database for the time period under consideration. However, 3547 confirmed positive cases were included in the dataset as valid cases for analysis after filtering out patients with missing or invalid records. The table below (TABLE 1) shows a descriptive summary of the variables for analysis with respect to the outcome variable- decisive outcome of the confirmed positive cases.

From TABLE 1, the percentage of deaths among the confirmed positive cases compared to those who survived is (0.56% vs 99.44%). The median age of the confirmed positive death cases was greater than those who survived (60.5 (50-71) years vs 35.0 (27-49) years; $p < 0.001$) in our study. Moreover, after artificially dichotomizing the continuous age variable into less than or equal to 60 years and above 60 years, we found 88.9% are ≤ 60 years whereas 11.1% are >60 years. Moreover, 99.7% of all positive cases ≤ 60 years survived while only 0.3% died. As for cases > 60 years, 97.5% of them survived while 2.5% died. More males (85.0%) died from COVID-19 compared to females (15.0%). Moreover, more males were confirmed positive for COVID-19 than females (2238 (63.1%) vs 1309 (36.9%)) and sex is found to be statistically significant associated with mortality from COVID 19 ($p = 0.042$). In this study, 93.2 percent of confirmed positive COVID-19 cases reside in the urban area, while only 6.8% reside in the rural area. Residents of urban Gambia accounted for 95% of the deaths, while residents of rural Gambia accounted for 5%. However, the place of residence of the cases was not found to be statistically significant associated with COVID-19 mortality ($p = 1.00$).

As for the signs and symptoms, in TABLE 1, none was found statistically significant associated with mortality with COVID-19 ($p > 0.05$) in this study. Among all the confirmed positive cases, 641 (18.1%) had at least one of the signs and symptoms (i.e., either fever or cough or sore throat, or diarrhea or vomiting or shortness of breath) whereas 2906 (81.9%) cases were asymptomatic. The most common signs and symptoms reported among the confirmed positive cases were cough 395 (11.1%), fever 332 (9.4%), and shortness of breath 154 (4.3%). As for the less common signs and symptoms among the positive cases, 26 (0.7%), 33 (0.9%), 52 (1.5%) had manifested vomiting, diarrhea and sore throat, respectively. Moreover, among the positive death cases, only 2 (10%) manifested one of the signs and symptoms of COVID-19.

Equally, in TABLE 1, none of the comorbidities reported were found to be statistically significant associated with mortality with COVID-19 (for all, $p > 0.05$). At least one of the comorbidities was present in 164 (4.62%) of the positive cases in this sample (i.e., ARDS, CVD, CLD, diabetes, immunodeficiency, neurological problems, liver disease, kidney disease). Among them, 96 (2.7%), 52 (1.5%), 27 (0.8%), and 15 (0.4%) had CVD, diabetes, ARDS, and CLD, respectively; these were the most common comorbidities. As for the positive death cases, just 2 (10%) of the positive death cases had at least one of the comorbidities listed. The fatality rates for those with CVD, Diabetes, and ARDS were 2.1%, 1.9%, and 3.7%, respectively, when all confirmed positive cases were considered.

Again, in TABLE 1, predictors that determine severity of COVID-19 (i.e., ICU admission, MV required, EMO required) were found not to be statistically significant associated with mortality with COVID-19 (all, $p > 0.05$). Among all the positive cases, 26 (0.7%) needed EMO, 20 (0.6%) required ICU admission, and 9 (0.3%) required MV. In addition, only 2 (10%) among the positive death cases experienced one of these severity predictors.

TABLE 1: SUMMARY OF THE VARIABLES FOR ANALYSIS WITH RESPECT TO THE DEFINITIVE OUTCOME, CONFIRMED COVID -19 POSITIVE CASES

Total Confirmed Positive Cases (n = 3547)			
Variables	***Survived (n = 3527)***	***Died (n = 20)***	***p-value***
Age	35.0 (IQR = 22)	60.5 (IQR= 21)	**<0.001**
Sex			**0.042**
Male	2221 (63.0%)	17 (85.0%)	
Female	1306 (37.0%)	3 (15.0%)	
Residence			1.00
Urban	3286 (93.2%)	19 (95.0%)	
Rural	241 (6.8%)	1 (5.0%)	
Signs and symptoms			
Fever	331 (9.4%)	1 (5.0%)	1.00
Cough	395 (11.2%)	0 (0.0%)	0.157
Sore throat	52 (1.5%)	0 (0.0%)	1.00
Shortness of breath	152 (4.3%)	2 (10%)	0.215
Diarrhea	33 (0.9%)	0 (0.0%)	1.00
Vomiting	26 (0.7%)	0 (0.0%)	1.00
Comorbidities			
Renal disease	6 (0.2%)	0 (0.0%)	1.00
Cardiovascular disease (CVD)	94 (2.7%)	2 (10%)	0.097
Acute Respiratory Distress Syndrome (ARDS)	26 (0.7%)	1 (5%)	0.142

Immunodeficiency	2 (0.1%)	0 (0.0%)	1.00
Diabetes	51 (1.5%)	1 (5.0%)	0.261
Chronic Lung Disease (CLD)	15 (0.4%)	0 (0.0%)	1.00
Neurological problem	7 (0.2%)	0 (0.0%)	1.00
Liver disease	3 (0.1%)	0 (0.0%)	1.00
Severity			
Intensive Care Unit (ICU) Admission Required?	19 (0.5%)	1 (5.0%)	0.107
Mechanical Ventilation (MV) Requires?	9 (0.3%)	0 (0.0%)	1.00
Extracorporeal Membrane Oxygenation (EMO) Required?	25 (0.7%)	1 (5.0%)	0.137

From TABLE 1, variables that met the purposeful selection criteria of p-value < 0.25 from the univariate analysis were included in a multivariate logistic regression to determine the association between positive COVID-19 patients' characteristics and mortality with the disease. The results are presented in Although the multivariate logistic analysis found no statistically significant correlation between nearly all patient characteristics variables and mortality with COVID-19, however, older age (OR = 1.064; 95 % CI: 1.037 - 1.092), shortness of breath (OR = 2.077; 95 % Ci: 0.285 - 15.118), and diabetes (OR = 1.179; 95% CI: 0.099 - 14.083) all increase the odds of death among the positive COVID-19 cases in this study (TABLE 2).

TABLE 2 below. From the result, all the variables that determined positive COVID-19 patients' characteristics were found not to be statistically significant associated with mortality with COVID-19, with the exception of age (OR = 1.064; 95% CI: 1.037 - 1.092; p < 0.001), which was found to be statistically significant associated with mortality with COVID-19, implying older age is associated with increased risk of mortality with COVID-19. Although the multivariate logistic analysis found no statistically significant correlation between nearly all patient characteristics variables and mortality with COVID-19, however, older age (OR = 1.064; 95 % CI: 1.037 - 1.092), shortness of breath (OR = 2.077; 95 % Ci: 0.285 - 15.118), and diabetes (OR = 1.179; 95% CI: 0.099 - 14.083) all increase the odds of death among the positive COVID-19 cases in this study (TABLE 2).

TABLE 2: PATIENTS' CHARACTERISTICS AS RISK FACTOR ASSOCIATED WITH MORTALITY OF POSITIVE COVID-19 PATIENTS.

Variables	***OR (95% CI)***	***p-value***
Age	1.064 (1.037 – 1.092)	< 0.001
Sex	0.307 (0.089 – 1.063)	0.062
Symptoms		
Shortness of breath	2.077 (0.285 – 15.118)	0.470
Comorbidities		
Acute Respiratory Distress Syndrome (ADRS)	0.799 (0.003 – 195.603)	0.936
Cardiovascular Disease (CVD)	0.648 (0.111 – 3.768)	0.629
Diabetes	1.179 (0.099 – 14.083)	0.896
Severity		
Intensive Care Unit (ICU) Admission required	0.288 (0.001 – 78.889)	0.664
Extracorporeal Membrane Oxygenation (EMO) required	0.994 (0.048 – 18.742)	0.970

IV. DISCUSSION

In this retrospective cohort study of confirmed positive COVID-19 cases in the Gambia, 99.4% of the cases survived and the fatality rate was 0.56% from the disease. The fatality rate in our study is far lower compared to what was reported elsewhere in another study [11, 12, 15, 18, 19, 21]. The low case fatality rate in our study could be attributable to a number of factors such as low prevalence of cases (11.1%) among older ages (> 60 years) in this study; age is considered a major risk factor associated with mortality from COVID-19 [12, 17], and is statistically significant associated with mortality with COVID-19 in this study. In addition, other factors such as weak systematic surveillance on morality, inadequate resources for mass testing, systematic registration and prompt confirmation of all deaths as most of the deaths reported were confirmed positive at postmortem [9, 23], and low turnup for testing due to fear of stigmatization could all explain the low fatality rate in our study.

Examining demographic characteristics of the cases showed only 2.5% of all deaths in this study were above 60 years, the median age was greater among death cases at 60.5 (50 – 71) years, more males contracted the disease (63.1%) as well as died (85%) from the disease, and a greater percentage of all the confirm positive cases (93.2%) and all death cases (95%) were urban dwellers. Sex was statistically significant associated with the outcome in this study but it does not increase the risk of mortality with COVID-19. A similar finding was reported in a study conducted in Lusaka, Zambia and they reported 76% of all deaths from COVID-19 were under 60 years, more males (69%) died from the disease, and a high prevalence of cases was observed among males compared to females (21.7% vs 15.4%) [23]. Rice et al. (2021) conducted a study across Sub-Saharan Africa (SSA) and found that there is substantial subnational heterogeneity in the distribution of high-risk age groups, with a higher burden expected in SSA's metropolitan areas, where density and thus transmission are likely higher [24]. Similarly, individuals over the age of 60 are underrepresented in the MRCG cohort, whereas urban residents are overrepresented [9]. This study has some dissimilarities in finding with the Lusaka study. Notably, the Lusaka study reported a surprisingly high prevalence of mortality related to COVID-19 and a lower median age of 48 (36 – 72) years among those who died with COVID-19. In addition, the Lusaka study reported that only a minority were tested for COVID-19 prior to their death as most of the deaths occurred in the communities in the absence of medical care. This finding depicts the reality of most African countries, especially the Gambia. Hence, the statistics presented might be an underestimation of the realities.

Recent studies reported a high prevalence of signs and symptoms of COVID-19 among the positive cases; found symptoms as important factors in explaining the outcome, and increased the odds of mortality from COVID-19 [19, 15, 23]. On the contrary, the present study found a very high prevalence of asymptomatic COVID-19 cases (81.9%), and signs and symptoms, reported in table 1, are not statistically significant associated with the outcome, nor did they increase the odds of mortality with COVID-19 except for shortness of breath (OR = 2.077; 95% CI: 0.285 – 15.118) which was equally reported in [19, 15]. In the present study, only 18.1% of all the cases presented at least one of the signs and symptoms tabulated in TABLE 1. The most common signs and symptoms reported by the positive cases were cough (11.1%), fever (9.4%), and shortness of breath (4.3%), and only 2 (10%) of the death cases manifested one of the signs and symptoms of COVID-19. Although studies elsewhere have reported similar findings [15, 21], however the prevalence of symptoms is much lower in the present study. Important justification for the lower prevalence of signs and symptoms in this study could attributable to a poor data recording system. Moreover, a good number of positive cases under five years of age and those above 75 years have been reported in the dataset and thus may be unable to report signs and symptoms, thus causing underreporting. Also, large youthful positive cases in the study could explain the lower prevalence of symptoms, which is typical of the age structure of most African countries, as morbidity with COVID-19 decreases with youthful age [24].

Several studies elsewhere have reported a high prevalence of existing comorbidities among those who died with COVID-19 infection and the most common comorbidities reported in these studies were kidney disease [15], CVD and diabetes [19, 11, 21, 12], chronic pulmonary disease and liver disease [21]. All these studies except [21] reported comorbidities are significantly associated with mortality and, equally, increase the odds of mortality with COVID19. However, in the present study, the same cannot be said as only 164 (4.62%) of all the confirmed positive COVID-19 cases reported at least one of the comorbidities in TABLE 1, and only 2 (10%) of the death cases confirmed positive with COVID-19 had reported at least one of the comorbidities. The most common comorbidities reported in this study were CVD 96 (2.7%), diabetes 52 (1.5%), ARDS 27 (0.8%) and CLD 15 (0.4%), and a greater percentage of those who reported comorbidities were among those who survived. Similarly, the existence of all the comorbidities was found to be statistically insignificantly associated with the outcome TABLE 1 and, all except diabetes (OR =1.179; 95% CI: 0.099 – 14.083), decreases the risk of mortality with COVID-19 TABLE 2. Similar findings have been reported in [21, 9, 23]. The reason for the comparatively lower prevalence of comorbidities among the cases in this study compared to studies elsewhere could be explained by the youthfulness of the COVID-19 cases in this study since advanced ages, which are less prevalent in this study, are prone to weak immunity and sedentary lifestyles which predisposes them to comorbidities [19].

Finally, the present study has some important limitations. Firstly, most of the arguments given in explaining the variations that exist in this study are based on supposition and the researcher’s experience with the prevailing situation in the country. Secondly, analysis was specific to the data reported in the DHIS2 database, thus there might be a possibility of incompleteness in recording of all cases within the timeframe examined. Thirdly, we noted that the findings presented in the present study do not imply causality but rather give insight as to who are more susceptible to mortality with COVID-19. Lastly, this study uses a retrospective design and analysis was based on only confirmed positive COVID-19 cases with complete data in the DHIS2 database.

By contrast, one of the strengths of this study is that the DHIS2 database contains an official dataset of the Ministry of Health, the Gambia, and it reliably contains representative data of the COVID-19 cases in the Gambia. Although some cases were omitted from the study due to missing parameters, the data in the database was obtained from the cases themselves or their families and registered by physicians, surveillance officers, and laboratory personnel. A validated anonymized dataset extracted from the DIS2 database is available as a supplementary document for reproducibility shake.

V. CONCLUSION

The incidence of COVID-19 cases in the Gambia seems far from seizing and thus understanding mortality with COVID-19 relative to patients’ characteristics is paramount. Reassuringly, this study found no statistically significant associated between the characteristics analyzed and mortality with COVID-19 except for age and sex ($p < 0.05$). Equally, all the characteristics analyzed in the multivariate logistic regression were found to decrease the risk of mortality with COVID- 19 except for age, shortness of breath, and diabetes TABLE 2, which increase the risk of mortality with COVID-19. Only age was found to be a significant predictor of mortality with COVID-19. For future work, since the pandemic is far from over, analyzing hospitalized patients’ characteristics relative to length of hospitalization, type of treatment, and mortality with COVID-19 will go a long way in understanding clinical case management and reducing the burden on the treatment centers. Hence, I would recommend data on hospitalized patients to become readily available for exploratory analysis to better understand the hospitalized cases.

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