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Prevalence and Risk Factors of SARS-CoV-2 Among Patients with Suspected Respiratory Infections at Specialist Hospital, Gombe State, Nigeria

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ABSTRACT

The novel corona virus (SARS-CoV-2) has quickly spread from person to person and claimed millions of lives worldwide. However, there is a lack of epidemiological data on this infectious agent in Gombe State. This study aimed to determine the prevalence of SARS-CoV-2 and its associated risk factors among patients with suspected respiratory infections attending the General Hospital in Gombe State, Nigeria. Approximately 200 nasopharyngeal and/or oropharyngeal samples were collected from participants across Gombe State and screened for COVID-19 using Rapid Diagnostic Kits (RDT). In addition, Semi-structured questionnaires were used to collect additional demographic data. The data were analyzed statistically using SPSS version 22. The results indicated an overall prevalence rate of 26.5%. Chi-square analysis showed that demographic factors such as gender, age, location, and educational background were significantly associated with COVID-19 infection, while tribe and occupation were found to be statistically insignificant. Additionally, binary and multiple logistic regression analyses identified male sex, adult age, urban residence, and lower education levels as significant risk factors for COVID-19 infection. Therefore, this study recommends the implementation of a vaccination program to help contain the spread of SARS-CoV-2 infection.

Keywords: Prevalence, Risk Factor, SARS-COV-2, Respiratory, Infection, Pandemic

INTRODUCTION

Severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) is responsible for the serious respiratory illness known as coronavirus disease (COVID-19). This virus belongs to the family Coronaviridae and is spherical, measuring approximately 125 nm in diameter. It features a linear, single-stranded positive-sense RNA genome, with a total size of around 30 kb (Cui *et al.,* 2019; Cascella *et al.,* 2020). COVID-19 emerged as a pandemic in 2019, resulting in significant morbidity and mortality around the globe (Olapegba *et al.,* 2020). The primary mode of transmission is through respiratory droplets from coughing, sneezing, saliva, and sputum, as well as through direct contact with infected individuals or contaminated surfaces (Guo *et al.,* 2020). Estimates indicate that over 200

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million confirmed cases of SARS-CoV-2 have been reported, with more than 22 million deaths attributed to COVID-19, highlighting the ongoing threat of this pandemic worldwide (Kashte *et al.,* 2021). The African continent has also been severely affected, reporting over 8,711,651 cases and 178,575 deaths (Kashte *et al.,* 2021).

In Nigeria, the first confirmed case was reported on 27th February, 2020 in Lagos from an Italian traveller, however, as of February 27th, 2020 to date, Nigeria has recorded more than two hundred and sixty-six thousand, six hundred and seventy-five 266,675 confirmed cases with over three thousand one hundred and fifty-five 3,155 deaths (NCDC, 2023). Gombe State is one of the North-Eastern states that has been significantly impacted by the coronavirus disease, which surfaced in late 2019. However, there is a notable scarcity of research on the virus within this region. As a result, this study aims to assess the prevalence of SARS-CoV-2 and identify the associated risk factors in Gombe State. The data collected in this study could aid the development of tailored local health interventions, assist clinicians in distinguishing COVID-19 from other respiratory infections, provides hospital administrators with insights into the COVID-19 burden, facilitate the efficient allocation of testing kits, personal protective equipment (PPE), and isolation resources, strengthens disease monitoring and early warning systems in underrepresented regions, supplies evidence for regional health authorities to design policies that reflect the actual risk landscape, and finally contributes to the limited body of research on COVID-19 in northeastern Nigeria, particularly within semi-urban hospital environments.

MATERIALS AND METHODS

Ethical Approval

Ethical approval was obtained from the Ethics Committees of the Gombe State Ministry of Health and the Molecular Diagnostic Laboratory at the Gombe State Specialist Hospital prior to the collection of data and samples from patients.

State Area

The study was conducted in the Public Health Molecular Diagnostic Laboratory of Gombe State Specialist Hospital, located in the capital city of Gombe State in northeastern Nigeria, with coordinates: 10015'N 11^{0}10'E. Gombe State shares borders with Yobe to the north, Borno and Adamawa to the east, Bauchi to the west, and Taraba to the south. It is often referred to as the "Jewel in the Savannah" and is primarily inhabited by various indigenous tribes.Gombe State covers a total area of 18,768 km² (7,246 sq mi) and had a population of approximately 2,365,040 people according to the 2006 census (NPC, 2006). The state comprises 11 local government areas, including Akko, Balanga, Billiri, Dukku, Funakaye, Gombe, Kaltungo, Kwami, Nafada, Shongom, and Yemaltu/Deba. The region is home to diverse ethnic groups such as the Fulani, Tangale, Hausa, Tula, Tera, Waja, Bolewa, and Kanuri, each with distinct cultural and linguistic affiliations. Farming is the primary occupation among the inhabitants of Gombe State, while some individuals are engaged in trading and others work as civil servants.

Study Design and subjects

A prospective cross-sectional design was employed in this study, involving a cross-sectional assessment to identify patients exhibiting symptoms related to COVID-19 infection. Participants were selected based on specific inclusion and exclusion criteria. The

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inclusion criteria consisted of individuals who presented symptoms associated with COVID-19 and agreed to participate in the study. Those who did not show any symptoms related to COVID-19 or who were unwilling to participate were excluded. A consent form was distributed to all patients to obtain their voluntary participation in the study. A simple cluster sampling technique was utilized to select the patients. The selected participants were diagnosed to identify the pathogens responsible for the infections.

Sample Size Determination

The sample size of this study was obtained using Cochrane formula below

$$n = \frac{Z2 \times pq}{d2}$$

Where:

n= minimum sample size

Z= standard normal deviate corresponding to 5% significant level

p= Prevalence in previous studies (62%),

q=1-p,

d= precision set at 0.05.

Z=1.96, p=0.62, q=1-0.62. Applying the formula above, the minimum sample size calculated was 362 however, adjusted to two hundred (200) as the baseline sample size of the current study.

Sample Collection and processing

Nasopharyngeal and oropharyngeal samples were collected from patients attending Gombe State specialist Hospital. Furthermore, Semi-structured questionnaires were used to collect additional data on gender, marital status, location, education level, tribe, and occupation. All samples underwent screening for COVID-19 utilizing Rapid Diagnostic Tests (RDTs). The process began with a nasopharyngeal swab collected from the nostril using a swab stick, which was then placed in a virus transport medium (VTM) containing Phosphate Buffered Saline (PBS) to help immobilize and inactivate the virus. Each specimen container was appropriately labelled with the patient's name, epidemiology number, date, and gender. The swab stick was subsequently placed into the RDT kit and allowed to absorb for 10 minutes. The results of the RDT were read and interpreted in accordance with the manufacturer's instructions (Olalekan et al., 2020).

Statistical Analysis

The data obtained were analyzed statistically using SPSS version 25. Prevalence was determined using percentages, and the associations between dependent and independent variables were examined through Chi-square tests, as well as bivariate and multiple logistic regression analyses. The strength of the association was measured using odds ratios (OR) along with 95% confidence intervals. P-values less than 0.05 were considered statistically significant.

RESULTS

Detection and Prevalence of SARS COV-2

During the study period, a total of 200 individuals were tested, with 53 (26.5%) results coming back positive and 147 (73.5%) negative (Table 1). Therefore, the overall prevalence identified in this study was 26.5%.Table 1:

Table 1: Detection of SARS COV-2 using Rapid Diagnostic Test (RDT).

Reaction	Occurrence	Performance (%)
Positive	53	26.5
Negative	147	73.5
Total	200	100

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Prevalence of SARS-COV-2 according to Demographic Characteristics of the Participants

Table 2; provides information about 200 participants, categorized by gender, marital status, location, education level, tribe, and occupation. The study found that males were more susceptible to the virus than females, with a prevalence of (33.0%) in males compared to (19.1%) in females. Statistical analysis revealed a significant association between infection occurrence and gender, with a p-value of <0.05 (χ^2 = 4.921; p = 0.027). Regarding age, the prevalence of coronavirus infection was higher among adults (30.95%) than among younger individuals (16.4%). This association was also statistically significant, with a p-value of <0.05 (χ^2 = 4.603; p = 0.032). In terms of residence, the study found that the prevalence of coronavirus infection in urban areas was 33.6%, which was higher than in rural areas (17.8%). A significant association between residence and coronavirus infection was noted, with a p-value of <0.05 (χ^2 = 6.391; p = 0.011).

When looking at academic qualifications, the prevalence of coronavirus infection was highest among participants with a primary school education (50%), compared to those in secondary school (24.7%) and tertiary institutions (16.3%). The results indicated a significant association between academic qualification and coronavirus infection, with a p-value of <0.05 (χ^2 = 4.603; p = 0.032). In terms of marital status, married participants exhibited a higher prevalence of coronavirus infection (30.7%) than single participants (23.2%). However, no significant association was found between marital status and the coronavirus infection, as the p-value was >0.05 (χ^2 = 1.411; p = 0.235). Regarding tribes, the Fulani tribe had the highest prevalence of coronavirus infection (29.2%), followed by the Hausa (21.1%) and other tribes (28.2%). However, statistical analysis revealed no significant association between tribe and coronavirus infection, with a p-value of >0.05 (χ^2 = 1.233; p = 0.540). Finally, in terms of occupation, farmers had a higher prevalence of coronavirus infection (34.5%) compared to students (21.1%), civil servants (25.9%), and housewives (32.3%). The statistical analysis indicated no significant association between occupation and coronavirus infection, with a p-value of >0.05 (χ^2 = 1.233; p = 0.540).

Binary Regression Analysis of the Variables Associate Coronavirus Infection

The (Table 3) below presents the results of the binary logistic regression analysis. According to the data, male participants [COR (95% CI) : 2.081 (1.082 - 4.003))], adult participants [COR (95% CI) : 2.284 (1.061 - 4.921))], those who lived in urban areas [COR (95% CI): 2.2344 (1.200 -4.580)], and individuals with primary [COR (95% CI): 5.503 (1.921-15.764)] or secondary academic qualifications [COR (95% CI): 1.803 (0.820-3.964)] were significantly more likely to contract the infection.

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Table 2: Distribution of SARS-COV-2 based on Demographic Characteristics.

Variables	Frequency	No. positive (%)	No. negative (%)	χ^2	P-value
Gender					
Male	106	35 (33.0)	71 (67.0)	4.921	0.027
Female	94	18 (19.1)	76 (80.9)		
Age					
Young	61	10 (16.4)	51 (83.6)	4.603	0.032
Adult	139	43 (30.9)	96 (69.1)		
Marital Status					
Single	112	26 (23.2)	86 (76.8)	1.411	0.235
Married	88	27 (30.7)	61 (69.3)		
Residence					
Urban	90	16 (17.8)	74 (82.2)	6.391	0.011
Rural	110	37 (33.6)	73 (66.4)		
Academic_Qual.					
Primary	30	16 (50.0)	16 (50.0)	11.437	0.003
Secondary	93	21 (24.7)	64 (75.3)		
Tertiary	77	16 (19.3)	67 (80.7)		
Tribe					
Hausa	57	12 (21.1)	45 (78.9)	1.233	0.540
Fulani	72	21 (29.2)	51 (70.8)		
Others	71	20 (28.2)	51 (71.8)		
Occupation					
Student	113	26 (23.0)	87 (77.0)	2.188	0.53
Housewife	31	10 (32.3)	21 (67.7)		
Farmer	29	10 (34.5)	19 (65.5)		
Civil servant	27	7 (25.9)	20 (74.1)		

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Table 3: Binary Regression Analysis of the Variables Associated with Coronavirus infection.

Variables	Frequency	No. Positive (%)	No. negative (%)	COR (95% CI)		p-value
Gender						
Male	106	35 (33.0)	71 (67.0)	2.081	(1.082-4.003)	0.028
Female	94	18 (19.1)	76 (80.9)			1
Age						
Young	61	10 (16.4)	51 (83.6)	1		1
Adult	139	43 (30.9)	96 (69.1)	2.284	(1.061-4.921)	0.035
Marital Status						
Single	112	26 (23.2)	86 (76.8)	0.683	(0.364-1.283)	0.236
Married	88	27 (30.7)	61 (69.3)	1		11
Residence						
Urban	90	16 (17.8)	74 (82.2)	2.344	(1.200-4.580)	0.013
Rural	110	37 (33.6)	73 (66.4)	1		1
Academic_Qua						
Primary	30	16 (50.0)	16 (50.0)	4.187	(1.734-10.114)	0.001
Secondary	93	21 (24.7)	64 (75.3)	1.374	(0.659-2.866)	0.397
Tertiary	77	16 (19.3)	67 (80.7)	1		1
Tribe						
Hausa	57	12 (21.1)	45 (78.9)	0.680	(0.299-1.544)	0.357
Fulani	72	21 (29.2)	51 (70.8)	1.050	(0.509-2.168)	0.895
Others	71	20 (28.2)	51 (71.8)	1		1
Occupation						
Student	113	26 (23.0)	87 (77.0)	0.854	(0.325-2.243)	0748
Housewife	31	10 (32.3)	21 (67.7)	1.361	(0.434-4.270)	0.598
Farmer	29	10 (34.5)	19 (65.5)	1.504	(0.475-4.759)	0.488
Civil servant	27	7 (25.9)	20 (74.1)	1		1

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Multiple Logistic Regression Analysis of the Variables Associate with Coronavirus infection

In the Table 4 below Adjusted Odd Ratio (AOR) was calculated using multi-variable logistic regression analysis. The results showed that male gender had a significant association with the infection [AOR (95% CI): 2.024 (1.002-4.088)]. In addition, being an adult [AOR (95% CI): 3.590 (1.488-8.660)] and having a primary academic qualification [AOR (95% CI): 5.503 (1.921-15.764)] were also significantly associated with the infection.

Table 4: Multiple Logistic Regression of the Variables Associated with Coronavirus infection.

Variables	Frequency	No. positive (%)	No. negative (%)	AOR (95% CI)	p-value
Gender					
Male	106	35 (33.0)	71 (67.0)	2.024 (1.002-4.088)	0.049
Female	94	18 (19.1)	76 (80.9)	1	1
Age					
Young	61	10 (16.4)	51 (83.6)	1	1
Adult	139	43 (30.9)	96 (69.1)	3.590 (1.488-8.660)	0.004
Residence					
Urban	90	16 (17.8)	74 (82.2)	1.937 (0.935-4.013)	0.075
Rural	110	37 (33.6)	73 (66.4)	1	
Academic_Qua					
Primary	30	16 (50.0)	16 (50.0)	5.503 (1.921-15.764)	0.001
Secondary	93	21 (24.7)	64 (75.3)	1.803 (0.820-3.964)	0.142
Tertiary	77	16 (19.3)	67 (80.7)	1	1

DISCUSSION

The prevalence of coronavirus infections varies considerably across different studies and populations. In our study, we determined that the overall prevalence of coronavirus in the study area was 26.5%. This finding aligns with some previous research. For example, a study conducted in Jakarta reported a general prevalence of 15.7% among 64,364 specimens, with a peak prevalence of 26.3% observed in March 2020 (Setiadi *et al.,* 2022). Another study focusing on healthcare professionals indicated a prevalence of 21.5%, with 26.6% testing positive via rapid tests (Zayer, 2023). Additionally, a separate investigation revealed a SARS-CoV-2 infection prevalence rate of 26.92% among 130 individuals (Ghobah *et al.,* 2023).

In contrast, a study at Brahmanbaria Medical College recorded a significantly high positivity rate of 56.54% among suspected cases, suggesting considerable transmission

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within that population (Akter *et al.,* 2021). Okoroiwu et al. (2021) also examined COVID-19 in Nigeria, reporting a prevalence of just 1.25% in Gombe State. The variability in prevalence rates indicates that factors such as testing methodologies, population demographics, and the timing of data collection can markedly influence the reported figures. For instance, the elevated prevalence observed in the Brahmanbaria study may reflect localized outbreaks or differing testing strategies compared to those employed in Jakarta (Akter *et al.,* 2021; Setiadi *et al.,* 2022). Overall, while these studies reveal diverse prevalence rates, they underscore the importance of continuous monitoring and targeted public health interventions to effectively manage COVID-19. The differences in reported rates also highlight the necessity for context-specific strategies in addressing the pandemic.

The relationship between demographic factors such as gender, age, location, and educational level and COVID-19 infection has been extensively studied, revealing significant correlations. Various studies have used statistical analyses to explore these relationships, highlighting their importance in understanding the spread and impact of the virus. Our study found that demographic factors such as gender, age, location, and education level are strongly associated with coronavirus infection, as determined by chi-square analysis. Similar findings have been reported in other studies. Notably, males are more likely to test positive for COVID-19 and to experience severe outcomes compared to females. This is often attributed to biological differences, such as variations in immune responses and the expression of certain enzymes like ACE2, which play a role in the virus's entry into cells (Francia *et al.,* 2022; Vahidy *et al.,* 2021). In the UK Biobank study, the positivity rate was higher for males at 31.6%, compared to 27.3% for females, indicating that gender-related factors significantly impact infection risk (Azizi *et al.,* 2022). Age is another critical factor, with older individuals exhibiting higher susceptibility and mortality rates. A global study found a positive correlation between median age and the incidence, case fatality, and mortality rates of COVID-19 (Hu *et al.,* 2021).

Additionally, urban areas have reported higher infection rates than rural settings, likely due to factors like population density and mobility patterns (Salehi *et al.,* 2022). In urban areas, the incidence of COVID-19 infections had a positive test rate of 48.5%, compared to 41.3% in suburban settings (Sohrabi *et al.,* 2022). The odds of testing positive were significantly higher for individuals living in urban environments, with an adjusted odds ratio (aOR) of 4.58 (De Lusignan *et al.,* 2020). Furthermore, lower educational attainment, particularly among those who have only completed primary school, is associated with increased vulnerability to COVID-19, possibly due to limited access to health information and resources (Berhanu *et al.,* 2021). While these studies emphasize the strong associations of gender, age, and location with COVID-19 infection, it is essential to consider the dynamic nature of the pandemic and the impact of additional factors, such as public health interventions and vaccination campaigns. These elements can influence infection patterns and should be integrated into ongoing research and policy-making efforts.

Several studies employing binary and multiple logistic regression analysis have identified male sex adult, age, urban residence, and lower education levels as significant risk factors for COVID-19 infection. These demographic patterns have been consistently observed across various populations and geographic regions. Our study similarly found

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that male, adult participants living in urban areas and those with only primary or secondary education were significantly more likely to contract COVID-19. These findings align with a study conducted at the University of Washington Medicine, which involved 67,652 participants. This study revealed that males were 14% more likely to test positive for SARS-CoV-2 and had an 80% higher risk of developing severe COVID-19 compared to females (Stalter *et al.,* 2022). Additionally, a case-control study in western Iran also identified male gender as a significant risk factor for COVID-19 (Shahbazi *et al.,* 2020). The English primary care surveillance study indicated that working-age individuals (40-64 years old) had significantly higher odds of testing positive for COVID-19 compared to those aged 0-17 years (De Lusignan et al., 2020). Moreover, this study found that individuals living in urban areas had significantly higher odds of testing positive for COVID-19 compared to those in rural areas (de Lusignan *et al.,* 2020). Similarly, the Iranian case-control study identified urban residence as a *significant* risk factor (Shahbazi *et al.,* 2020). A study conducted in Beijing found that individuals with only a high school education were at an increased risk of COVID-19 exposure (Lu *et al.,* 2022). Furthermore, research examining disparities in COVID-19 exposure indicated that education level was one of the main factors influencing residents' risk of contracting the virus (Srivastava *et al.,* 2022).

Conversely, a longitudinal study involving 5,164 participants in the Czech Republic found that younger individuals had a higher risk of contracting COVID-19 (Flegr *et al.,* 2021). Additionally, a case-control study conducted in Nigeria revealed that individuals living in rural areas and those with no formal education faced greater odds of contracting COVID-19 compared to their urban and more educated counterparts. Interestingly, the study indicated that most of the infected individuals had tertiary education, suggesting that higher educational attainment may be associated with increased exposure due to occupational or social mobility (Utulu *et al.,* 2022). Furthermore, research conducted in Southeast Asia reported that female participants, particularly those in caregiving roles, were more exposed to COVID-19 because of their household and healthcare responsibilities (Tri Sakti *et al.,* 2022).

CONCLUSION

The current study identified a moderately higher prevalence of coronavirus infection in Gombe State. It was noted that some individuals are still carrying the virus in their respiratory tracts. The research found that factors such as gender, age, location, and educational qualifications were significantly associated with coronavirus infection, while tribe and occupation did not show significant associations. Furthermore, our findings indicate that males generally face a higher risk of severe COVID-19 outcomes compared to females, and older adults are more likely to test positive for the virus. Living in urban areas has also been linked to a higher rate of COVID-19 infections. Additionally, a lower level of education is associated with an increased risk of contracting the virus. Our results suggest that special attention should be given to male patients with lower educational backgrounds, particularly older individuals residing in urban areas, to enhance clinical management. It is also recommended to encourage vaccination programs for those in high-risk groups to help contain the spread of coronavirus.

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