Scientific African 15 (2022) e01065

Contents lists available at ScienceDirect

Scientific African

journal homepage: www.elsevier.com/locate/sciaf

Commercial motorcycle operators pose high risk for community transmission of coronavirus disease 2019 (COVID-19) in South-South Nigeria

Godwin Ovie Avwioro[a,*], Andy Egwunyenga[b], Sina Iyiola[c], Ewomazino Odibo[b], Felix M. Onyije[d], Charles A. Oyinbo[e], Temidayo Avwioro[f], Seyi Samson Enitan[g], Osaro Mgbere[h]

[a] Faculty of Science, Delta State University, Abraka, Nigeria
[b] Department of Animal and Environmental Biology, Faculty of Science, Delta State University, Abraka, Nigeria
[c] Department of Histopathology, Obafemi Awolowo University Teaching Hospital, Ile-Ife, Nigeria
[d] Department of Medical Laboratory Science, Niger Delta University, Amasoma, Nigeria
[e] Department of Anatomy, Niger Delta University, Amasoma, Nigeria
[f] Department of Nursing, Obafemi Awolowo University Teaching Hospital, Ile-Ife, Nigeria
[g] Department of Medical Laboratory Science, Babcock University, Ilisan-Remo, Nigeria
[h] Institute of Community Health, University of Houston College of Pharmacy, Texas Medical Center, Houston, TX, United States

ARTICLE INFO

Article history:
Received 28 July 2021
Revised 4 October 2021
Accepted 6 December 2021

Editor DR B Gyampoh

Keywords:
Covid-19
SAR-CoV-2
Knowledge
Awareness
Preventive practice
Commercial motorcycle operators
Nigeria

ABSTRACT

COVID-19 has become a threat to the existence of man as no method of effective treatment has been found. Although the WHO has given guidelines that include physical distancing to prevent the spread of COVID-19, it is not feasible in practice with commercial motorcycle operation, which is a major source of income and means of transportation in Nigeria. We examined the COVID-19 knowledge, awareness, and preventive practices among commercial motorcycle operators (CMOs) and the potentials for community transmission of SARS-CoV-2 in the South-South region of Nigeria. Data used was collected from a cross-sectional survey of 777 CMOs operating in the South-South region of Nigeria. The instrument captured information on their biodata, knowledge, awareness, and preventive practices of COVID-19. The data obtained were subjected to both descriptive and inferential analyses using SAS JMP Statistical Discovery™ software version 14.3 (SAS Institute, Cary, North Carolina, USA). The majority of the CMOs were of age category 26–35 years (36.4%), married (82.1%), under a monogamous union (83.8%), had 3–4 children (43.4%) and resided in rural areas (60.8%). The mean years of experience of the CMOs was 4.9 ± 2.45 years with most depending on daily income of N1,000–2,000 (87.6%). All the CMOs were aware of the existence of COVID-19, but 93.3% of them did not believe it existed in their state. Only 37.8% of them put on facemasks while on duty, although they were aware that they could be infected or infect others in the community. Prevention practices among CMOs were significantly predicted by age category, type of family, number of dependents, and place of residence. We conclude that CMOs have high potentials for transmission of SARS-CoV-2 in the communities because the business does not permit physical distancing. It is

* Corresponding author at: Faculty of Science, Delta State University, Abraka, Nigeria.
E-mail address: avwiorog@gmail.com (G.O. Avwioro).

https://doi.org/10.1016/j.sciaf.2021.e01065

recommended that guidelines requiring mandatory screening of operators and riders be implemented.

Introduction

On January 30, 2020, the World Health Organization (WHO) declared SARS-CoV-2, a virus that causes the coronavirus disease (COVID-19) as the sixth public health emergency of international concern [1]. As of April 25, 2021, data from the WHO showed that more than 145.2 million confirmed cases and 3 million deaths have been reported [1]. According to the Nigeria center for Disease Control (NCDC), Nigeria had a total record of 202,704 confirmed cases of COVID-19 with 2664 deaths as at 22nd of September 2021, with the South-South region accounting for 27,521 of the cases and 545 deaths [2]. In most countries, normal daily life activities including socioeconomic have virtually come to a standstill as a result of the COVID-19 pandemic. Travel by air, sea and land have been severely affected as major airports and land borders were shut especially during the initial stage of the pandemic. People from numerous countries decided to stay at home or were forced to do so by their governments. The economies of many countries, including the giants of the world, the United States have been on a steady decline. The first case of COVID-19 was reported in Nigeria on February 27, 2020. Since then, the NCDC has released advisories and guidelines to help Nigerians respond to the pandemic [3]. In other to curtail the transmission of this disease, the Federal Government of Nigeria set up a Presidential Task Force involving major stakeholders such as the NCDC, Federal Ministry of Health and the State Governments on how to curtail the spread of the disease. However, these measures are obviously not yielding the desired results in view of the steady increase in the number of reported cases within communities in Nigeria [3].

Commercial motorcycle operation is a major source of income for many people in Nigeria [4]. Many persons are reluctant to stop the business of motorcycle operation which has made physical distancing impossible because of the high rate of unemployment in Nigeria. Exposure to airborne pathogens is common to all humans [5,6] and microorganisms from an infectious source may disperse over very great distances by air currents and may be inhaled or ingested by another person who may then become infectious [7,8]. Accordingly, a small percentage of infectious individuals may be responsible for disseminating the majority of infectious particles to healthy individuals [9]. Commercial motorcycle operators can become major sources of rapid spread of SARS-CoV-2 in the community, not only because of lack of physical distancing, but because of the speed of the air current from the commercial motorcycle operators that hits the face of their passengers. This speed is sometimes more than 40 km per hour for inter-city travels. Transmission of SARS-CoV-2 can occur through direct, indirect, or close contact (within 3 feet) with infected people through infected secretions such as saliva and respiratory secretions or their respiratory droplets, which are expelled when an infected person coughs, sneezes, talks or sings [10–13]. In airborne transmission, expelled particles are comparatively smaller in size and thus can remain suspended in air for long periods of time. This means, for an infection to be caused through droplet transmission, a susceptible individual must be close enough to the infected individual and susceptible individuals must have a way of carrying the organisms to the respiratory tract, eyes, mouth, nasal passages, and so forth [14].

There are still many unknowns about SARS-CoV-2, including the clinical spectrum of the disease, its severity and transmissibility [15]. Understanding how, when and in what types of settings SARS-CoV-2 spreads is critical to developing effective public health and infection prevention and control measures to break chains of transmission [16]. In the absence of this knowledge, the WHO is encouraging countries to prepare for multiple scenarios, including large-scale community transmission of COVID-19 [15]. Consequently, Community transmission of SARS-CoV-2 has gradually come to stay and may be with us for a long time until an effective drug is developed for it.

It is believed that findings from our study would lay a strong foundation for the development of more practical and specific guidelines and policies that will benefit both CMOs and their passengers, and thus, help to prevent and control the transmission of COVID-19 in South-South region of Nigeria, where this business constitutes the main source of income for many families and means of transportation in the local communities. Therefore, the objective of this study was to examine the COVID-19 knowledge, awareness, and preventive practices among commercial motorcycle operators (CMO) and the potentials for community transmission of COVID-19 in the South-South region of Nigeria.

Methods

Study design and population

This study was a cross-sectional survey of commercial motorcycle operators (CMO) in the six states that make up the South-South geopolitical region of Nigeria and included motorcyclists that operated in the urban, semi-urban and rural areas of the region. We originally estimated a minimum sample size of 652 which gave a 90% statistical power of detecting effect

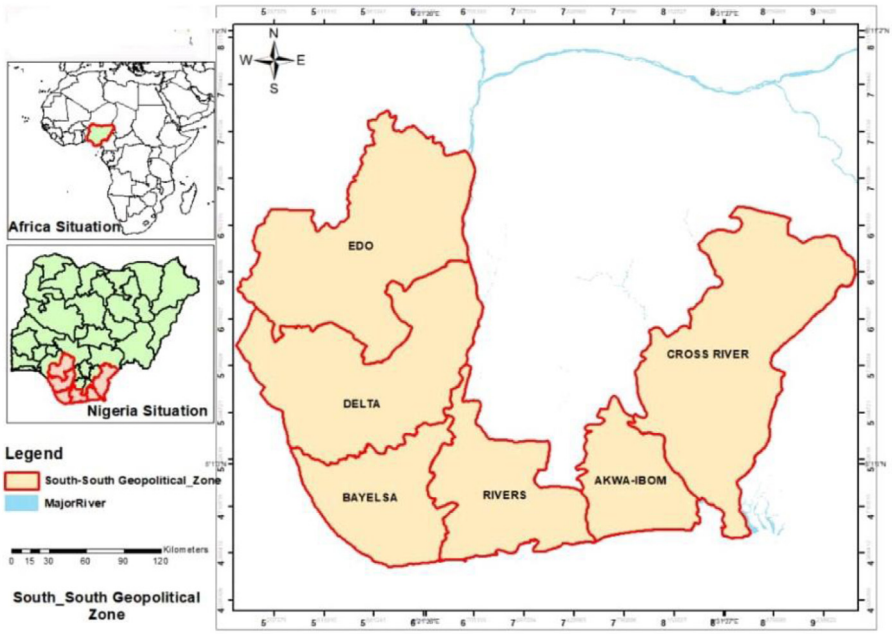

Fig. 1. Map of Nigeria Showing the Six States in South-South Region of Nigeria [18].

size of 0.3 at error probability of 0.05 [17]. However, at the end of the survey which was conducted during the government lockdown between May 4th, 2020 and June 15th, 2020, a total of 777 CMOs completed the survey.

Study area

The study area covered the 125 Local Government Areas that make up the six states in the South-South geopolitical zone of Nigeria with a land mass of approximately 85,303 km^2s (Fig. 1). The states are Delta (25), Akwa Ibom (31), River (23), Cross Rivers (18), Bayelsa (9) and Edo (19). The total population of the area as projected by the National Population Census in 2016 was 28,829,288, made up of Rivers (7303,924), Delta (5663,362), Akwa Ibom (5482,177), Edo (4235,595), Cross River (3866,269) and Bayelsa (2277,961) [18].

Study instrument and data collection

The study used a structured questionnaire to elicit responses from the CMOs. The instrument sought information about the responders' biodata, social economy, how well they understand prevention and transmission of SARS-CoV-2 to their passengers while carrying them to their destination, perception of their family members to transmission of COVID-19 and their disposition to the measures put in place by the government to prevent the spread of the disease. We initially conducted a pilot test to validate the instrument using 10 CMOs from each of the six states in the South-South region of Nigeria ($n = 60$). Data obtained were analyzed to assess the construct validity, and internal consistency and reliability. Experts' opinions were sought from public health professionals and health informaticians to streamline the questionnaire and ensure simplicity and ease of understanding of items relative to the sample population, accuracy of the knowledge measured, and interpretability. The final validated questionnaire was randomly administered in-person to the CMOs who consented to participate in the survey in the six states that make up the South-South geopolitical zone of Nigeria and covered CMOs the urban, semi-urban and rural areas. However, because of the variations in the timing of lockdown by the different states within the region, it was not possible to administer the questionnaire simultaneously, but was staggered over the period of 6 weeks. The research assistants who administered the questionnaire took all the necessary precautions and followed the recommended COVID-19 guidelines including wearing of facemasks and use of alcohol-based hand sanitizers during the field work. Facemasks and hand sanitizers were given free of charge to participants on successful completion of the survey for their time. However, they were not informed in advance about the materials gift to avoid coercion and conflict of interest.

Data management and measures

The CMOs' responses to questions related to COVID-19 knowledge, awareness and preventive practices to avoid contracting the disease or infecting others were scored as '1′ (yes) or '0′ (no). We computed the knowledge, awareness, and preventive practice scores by summing up the items within each group. The COVID-19 Knowledge score was made up of 20 items with a mean score of 12.07 (SD: 1.93, Range: 9–16) and Cronbach α of 0.67, while COVID-19 awareness score

was made up of 8 items with a mean score of 4.50 (SD: 0.55, Range: 4–6) and Cronbach α of 0.56. The COVID-19 preventive practice score among the CMOs was computed using 10 items with a mean score of 4.46 (SD: 0.87, Range: 3–6) and Cronbach α of 0.56. Subsequently, using the mean values, we created dichotomized measures for KAP defined as "good" (> mean) and "poor" (< mean), respectively.

The independent factors considered in our study include: age category (15–25, 26–35, 35–45 & 46^{+} years); marital status (single vs. married); type of family (monogamous vs. polygamous); number of children (0, 1–2, 3–4, & 5^{+}); occupation (government worker vs. self-employed); years of experience (< 5, 5–7 & 8^{+}); daily income (N1,000–2000 vs. N3,000–4000); number of dependents (0, 1–3, 4–6 & 7^{+}); place of residence (urban, semi-urban & rural) and state of origin (Akwa-Ibom, Bayelsa, Cross River, Edo, Delta & Rivers).

Statistical analysis

We applied descriptive statistics such as frequency, percentage and mean to evaluate the distribution of the socio-demographic characteristics of the study population. To determine the internal consistency and reliability of the items used to compute the knowledge, awareness, and preventive practice scores (KAP), we applied the Cronbach's alpha coefficient. The three scores showed fairly acceptable-to-good internal consistency. Furthermore, we conducted series of bivariate analyses between the three dependent measures (KAP scores) and the socio-demographic characteristics using *t*-test or one-way analysis of variance as applicable to determine if differences existed across the independent factors. In order to assess the overall response of the CMOs, we used the Chi-Square test to determine the independent associations between dichotomized measure for KAP ("good" vs. "poor") and the socio-demographic characteristics. Based on the outcomes of these analyses, variables that met the models' statistical threshold of $P<.10$ were selected a priori and simultaneously entered in the multivariable logistic regression models for KAP using appropriate referent for each socio-demographic characteristic. Therefore, the number of predictor variables that met the entry criteria varied slightly within the dependent measures (KAP). The KAP levels "good" represented as "1″ was used as the target (event) and "poor" represented as "0″ was used as referent. However, during the preliminary run, some covariates that were found to be biased, zeroed or unstable were removed from the model. Only covariates that made the final model for each measure (KAP) are presented in Table 4. The analyses produced estimates of adjusted odds ratios (aOR), 95 percent confidence intervals (95% CI) and corresponding p-values for each characteristic within the KAP measures. All statistical tests conducted were 2-tailed, and probability of < 0.05 was used as the threshold for declaring statistical significance. Data management and statistical analyses were conducted using SAS JMP Statistical Discovery™ Software version 14.3 (SAS Institute, Cary, North Carolina, USA).

Human subject protection

This study protocol and materials were reviewed and approved by the Ethical Committee of the Delta State University, Abraka, Delta State, Nigeria. Informed consents were obtained from all study participants.

Results

Characteristics of the study population

The socio-demographic characteristics of the sample population is presented in Table 1. The majority of the CMOs were of age category 26–35 years (36.4%), married (82.1%), under a monogamous union (83.8%), had 3–4 children (43.4%) and reside in the rural areas of the South-South region (60.8%). The mean years of experience of the CMOs was 4.9 ± 2.45 years with most of them having daily income range of N1,000–2000 (87.6%) and 4–6 persons (41.2%) depending on this income. The CMOs were most common in Delta State (35.0%) and the least common Bayelsa (9.4%) and Rivers (9.9%) states, where motorcycle is the least means of transportation.

COVID-19 knowledge, awareness and preventive practice scores among CMO

Table 2 shows the comparisons of the CMOs' COVID-19 knowledge, awareness and preventive practice scores by sociodemographic characteristics. We noted highly significant variations across these measures by sociodemographic characteristics among the CMOs in South-South region. For instance, knowledge among the CMOs improved significantly ($p<.0001$) with age, and individuals who were in a polygamous union and had more children were more knowledgeable about COVID-19. CMOs who had 7 or more dependents were significantly ($p<.0001$) more knowledgeable about the disease than individuals with a smaller number of dependents. COVID-19 knowledge tended to increase significantly ($p<.0001$) with increase years of experience in the commercial motorcycle operation business with those having 5 years plus experience being more knowledgeable about the disease. CMOs who operated in the rural areas tended to be more knowledgeable ($p<.001$) about COVID-19 than those operating in the urban and semi-urban areas of the South-South region. We noted no significant differences ($p>.05$) in COVID-19 knowledge by main occupation, daily income category and state of origin of the CMOs.

Awareness about COVID-19 increased significantly ($p<.0001$) with age category peaking at 35–45 years. CMOs who were married and had more than 3 children ($p<.0001$) were more aware of the presence of the COVID-19 in the community compared to those who were single or had less number of children (Table 2). Operators' increased years of experience

Table 1
Socio-demographic characteristics of sample population.

Characteristic	N	%
Age Category (Years)		
15 −25	214	27.5
26–35	283	36.4
35–45	211	27.2
46+	69	8.9
Marital Status		
Single	139	17.9
Married	638	82.1
Type of Family		
Monogamy	651	83.8
Polygamy	126	16.2
Number of Children		
0 (None)	139	17.9
1–2	128	16.5
3–4	337	43.4
5+	173	22.3
Mean ± SD	777	3.4 ± 2.31
Occupation		
Government worker	77	9.9
Self-Employed	700	90.1
Years of Experience as CMO		
< 5	359	46.2
5–7	311	40.0
8+	107	13.8
Mean ± SD	777	4.9 ± 2.45
Average Daily Income		
₦1000-₦2000	681	87.6
₦3000–4000	96	12.4
Number of Dependent(s)		
0	126	16.2
1–3	119	15.3
4–6	320	41.2
7+	212	27.3
Mean ± SD	777	4.6 ± 2.74
Place of Residence		
Urban	86	11.1
Semi-Urban	219	28.2
Rural	472	60.8
State of Origin		
Akwa-Ibom	133	17.1
Bayelsa	73	9.4
Cross River	109	14.0
Delta	272	35.0
Edo	113	14.5
Rivers	77	9.9

Within characteristic, percentages may not add up to exactly 100 due to rounding up.

in the business was significantly associated with increased awareness of the disease ($p<.01$). Similarly, CMOs with more dependents had increased awareness of the presence of COVID-19 in the community ($p<.0001$) than those with less number of dependents. CMOs who reside in urban and semi urban areas had more awareness ($p<.0001$) about COVID-19 compared to those who reside in the rural areas of the South-South region.

COVID-19 preventive practices varied significantly ($p<.0001$) by age category (Table 2). CMOs who were 46 years and above adopted more preventive strategies than those in age category 35–45 years or less. Similarly, CMOs who were single ($p<.0001$) and those from a polygamous family setting ($p<.001$) adopted more COVID-19 preventive practices than the CMOs who were married and from monogamous family setting. CMOs who resided in the urban and rural areas significantly ($p<.001$) adopted more preventive strategies than those who were operating in the semi urban areas of the South-South region. The average daily income, years of experience and state of origin did not significantly ($p>.05$) influence the level of preventive strategies adopted by the CMOs in the South-South region.

Knowledge of COVID-19 symptoms and preventive practices

All the participants (100%) identified cough as one of the main symptoms of COVID-19, but only about half of them (47.9%) were aware of the other symptoms that include fever, shortness of breath and frequent sneezing (Results not pre-

Table 2
Comparisons of COVID-19 knowledge, awareness and preventative practice scores by socio-demographic characteristics among CMOs in the South-South Region of Nigeria.

Characteristic	N	Knowledge Score			Awareness Score			Preventive Practice Score		
		Mean ± SEM	Prob>|t|/F	P-value	Mean ± SEM	Prob>|t|/F	P-value	Mean ± SEM	Prob>|t|/F	P-value
Age Category (year)										
15 −25	214	11.8 ± 0.13[a]	17.51	<0.0001****	4.3 ± 0.04 [a]	19.05	<0.0001****	4.4 ± 0.06[ab]	7.09	<0.0001****
26–35	283	12.0 ± 0.11[b]			4.5 ± 0.03 [b]			4.6 ± 0.05[bc]		
35–45	211	11.9 ± 0.13[b]			4.7 ± 0.04 [c]			4.3 ± 0.06[a]		
46+	69	13.6 ± 0.23[b]			4.4 ± 0.06[ab]			4.7 ± 0.10[c]		
Marital Status										
Single	139	11.7 ± 0.12[a]	−2.90	0.0040**	4.3 ± 0.49[a]	−4.11	<0.0001****	4.9 ± 0.05[a]	8.70	<0.0001****
Married	638	12.1 ± 0.08[b]			4.5 ± 0.02[b]			4.4 ± 0.04[b]		
Type of Family										
Monogamy	651	12.0 ± 0.08 [a]	2.49	0.0132**	4.5 ± 0.02	−1.65	0.101ns	4.4 ± 0.03	3.79	0.0002***
Polygamy	126	12.3 ± 0.11 [b]			4.4 ± 0.04			4.7 ± 0.07		
Number of Children										
None	139	11.7 ± 0.16[a]	5.91	0.0005***	4.3 ± 0.04[a]	24.99	<0.0001****	4.9 ± 0.07[a]	18.99	<0.0001****
1–2	128	11.7 ± 0.17[a]			4.2 ± 0.05[a]			4.2 ± 0.07[b]		
3–4	337	12.2 ± 0.10[ab]			4.6 ± 0.03[b]			4.3 ± 0.05[bc]		
5+	173	12.5 ± 0.15[b]			4.5 ± 0.04[b]			4.5 ± 0.06[c]		
Occupation										
Government worker	77	12.0 ± 0.32	0.23	0.8185ns	4.4 ± 0.06[a]	2.64	0.0097**	4.7 ± 0.08[a]	−2.66	0.0090**
Self-Employed	700	12.1 ± 0.07			4.5 ± 0.02[b]			4.4 ± 0.03[b]		
Years of Experience as CMO										
< 5	359	11.6 ± 0.09[a]	18.69	<0.0001****	4.4 ± 0.03[a]	5.67	0.0036**	4.5 ± 0.05	0.06	0.9371ns
5 – 7	311	12.5 ± 0.11[b]			4.6 ± 0.03[b]			4.5 ± 0.05		
8+	107	12.4 ± 0.18[b]			4.5 ± 0.05[ab]			4.5 ± 0.08		
Average Daily Income										
N1,000-N2,000	681	12.1 ± 0.07	−0.40	0.6892ns	4.5 ± 0.02	2.94	0.0039**	4.4 ± 0.03	1.57	0.1190ns
N3,000-N4,000	96	12.0 ± 0.24			4.6 ± 0.05			4.6 ± 0.10		
Dependent(s)										
0	126	11.7 ± 0.17[a]	7.85	<0.0001****	4.4 ± 0.05[a]	23.80	<0.0001****	4.9 ± 0.08[a]	13.19	<0.0001****
1–3	119	11.7 ± 0.17[a]			4.2 ± 0.05[b]			4.3 ± 0.08[b]		
4–6	320	12.0 ± 0.11[a]			4.6 ± 0.03[c]			4.4 ± 0.05[b]		
7+	212	12.6 ± 0.13[b]			4.6 ± 0.04[c]			4.3 ± 0.06[b]		
Place of Residence										
Urban	86	11.4 ± 0.21[a]		0.0003***	4.8 ± 0.06[a]	24.71	<0.0001****	4.7 ± 0.09[a]	6.89	0.0011***
Semi-Urban	219	11.9 ± 0.13[ab]	8.07		4.6 ± 0.04[a]			4.3 ± 0.06[b]		
Rural	472	12.3 ± 0.09[b]			4.4 ± 0.02[b]			4.5 ± 0.04[a]		
State of Residence										
Akwa-Ibom	133	12.1 ± 0.17	0.88	0.4922ns	4.5 ± 0.05	0.70	0.6250ns	4.5 ± 0.08	0.56	0.7303ns
Bayelsa	73	11.9 ± 0.23			4.5 ± 0.06			4.5 ± 0.10		
Cross River	109	12.3 ± 0.19			4.6 ± 0.05			4.5 ± 0.08		
Delta	272	12.1 ± 0.12			4.5 ± 0.03			4.5 ± 0.05		
Edo	113	11.8 ± 0.18			4.5 ± 0.05			4.4 ± 0.07		
Rivers	77	12.0 ± 0.22			4.5 ± 0.06			4.4 ± 0.10		

Abbreviations: SEM: Standard Error of Mean; Prob>|t|/F: Probability of t and F values.
Within characteristic and associated measures (Knowledge, Awareness and Preventive Practice Scores) means with different superscripts (a, b, c, d, e) are significantly different at $p<.05$.).
Significance Level: **=$p<.01$; ***=$p<.001$; ****=$p<.0001$; ns=Not significant ($p>.05$).

sented). A summary of response to COVID-19 preventive practice related questions among CMOs in the South-South region of Nigeria is presented in **Table SM1**. Only 37.8% ($p<.0001$) of CMOs reported using face mask regularly while operating as motorcyclists. All the CMOs knew they could be infected or could infect others, but they were not willing to stop the business and would not be happy if government stopped them from working because of non-compliance with the directive on the use of facemask or face covering. More than half of their family members (52.3%) encouraged the CMOs to always wear face masks to protect themselves and their passengers. All the study participants were aware they could prevent the spread of the virus if they stayed away from people, stop shaking people's hands and wear facemasks. All participants also, asserted that the distance between them and their passengers was less than 3 feet or the recommended 6 feet. About 55.9% ($p<.0001$) of the respondents were happy about both state and federal government lockdown orders whereas, 44.1% ($p<.0001$) expressed dissatisfaction with the orders. None of the participants had ever seen a COVID-19 patient, but they had heard of COVID-19 (Results not presented). All CMOs' family members asserted that they have heard of COVID-19 and knew that they could be infected if they do not wear face masks. Despite this, only 43% of family members were in the habit of reminding the CMOs about the existence of COVID-19. None of the responders ever heard of community transmission of SARS-CoV-2. However, 93.3% ($p<.0001$) of the CMOs in the South-South Nigeria did not believe in the presence of COVID-19 in the region (Results not presented).

Associations between COVID-19 knowledge, awareness and preventive practices, and sociodemographic characteristics

The associations between COVID-19 knowledge, awareness and preventive practice, and socio-demographic characteristics among CMOs in the South-South region of Nigeria are shown in Table 3. We noted statistically significant ($p<.05$) variations across the dichotomized dependent measures of knowledge, awareness and preventive practice and socio-demographic characteristics. Overall, 73.9% ($p<.0001$) of the CMOs reported having good knowledge of COVID-19. CMOs who were from monogamous family setting (60.2%, $p<.01$), had 3–4 children (31.3%, $p<.001$), 4–6 dependents (28.4%, $p<.0001$), self-employed (68.2%, $p<.001$), and had 5–7 years' experience (31.9%, $p<.001$) had good knowledge of COVID-19. Awareness among the CMOs in the South-South region was significantly ($p<.05$) associated with age category, marital status, number of children, occupation, years of experience, daily income, number of dependents and place of residence (Table 3). Among participants who implemented good COVID-19 preventive practices, 35.8% ($p<.0001$) were married, 40.0% ($p<.0001$) were of monogamous family setting, 18.5% ($p<.0001$) had 3–4 children, 43.9% ($p<.05$) earned daily income of N1,000-N2,000, had 4–6 dependents (21.2%, $p<.0001$) and lived in the rural areas (30.6%, $p<.001$) of the South-South region.

Multivariable logistic regression model

Table 4 presents the multivariable logistic regression model of COVID-19 pandemic knowledge, awareness and preventive practices among CMOs in the South-South region of Nigeria. In general, good knowledge of COVID-19 among CMOs was significantly ($p<.05$) predicted by the type of family, number of children, occupation, and their years of experience in the commercial motorcycle operation business. CMO from polygamous family setting were about 2 times (adjusted Odds Ratio (aOR): 1.77; 95% Confidence Interval (CI): 1.02–3.07; $p<.05$) more likely to have good knowledge of COVID-19 than those from monogamous family setting. Similarly, participants who were self-employed as CMOs were approximately 2 times (aOR: 1.93; 95%CI: 1.13–3.30; $p<.01$) more likely to have good knowledge of COVID-19 than those who worked in the government and also operate as motorcyclist. CMOs who had 5–7 and 8^{+} years of experience in the business were 65% (aOR: 1.65; 95%CI:1.12–2.45; $p<.01$) and 81% (aOR: 1.81; 95%CI: 1.03–3.20; $p<.05$) more likely to have good knowledge than CMOs who had less than 5 years' experience, respectively. In contrast, awareness about COVID-19 in the South-South region was significantly ($p<.05$) determined by CMOs' age category, occupation, years of experience, average daily income and place of residence. Awareness about COVID-19 was more pronounced with increasing age with individuals in age category 26–35 and 36–45 years being 2.41 (aOR:2.41; 95%CI: 1.59–3.64; $p<.0001$) and 2.86 (aOR:2.86; 95%CI: 1.74–4.68; $p<.0001$) more likely to have good awareness of COVID-19 than those who were 15–25 years old. CMOs who had 5–7 years' experience were 89% (aOR: 1.89; 95%CI: 1.31–2.73; $p<.001$) more aware of the COVID-19 pandemic than those with <5 years' experience. Prevention practices among CMOs were significantly predicted by age category, type of family, number of dependents, and place of residence. The odds of adopting the approved COVID-19 preventive practices increased significantly with increased age category of the CMOs. CMOs who were from polygamous family settings were 2.55 times (aOR: 2.55; 95%CI: 1.53–4.24; $p<.001$) more likely to have good COVID-19 preventive practices than those from monogamous family settings.

Overall relationships between COVID-19 knowledge, awareness and preventive practices

The assessment of the overall relationships between COVID-19 knowledge and awareness on the CMO implementation of the preventive practices are presented in **Table SM2**. Although we observed no direct significant relationship ($p>.05$) between COVID-19 knowledge and preventive practices, COVID-19 awareness in the region was however, significantly ($p<.0001$) associated with good implementation of the recommended preventive practices among the CMOs. CMOs who had good awareness about the COVID-19 outbreak in the communities were 2.40 times (OR: 2.40; 95%CI:1.80–3.21; $p<.0001$) more likely to also adopt good preventive practices against the disease.

Table 3
Associations between COVID-19 knowledge, awareness and preventive practices, and socio-demographic characteristics among CMOs in the South-South Region of Nigeria.

Characteristic	N (%)	Knowledge				Awareness				Preventive Practice			
		Poor	Good	Test Statistic		Poor	Good	Test Statistic		Poor	Good	Test Statistic	
		n (%)	n (%)	X^2	P-value	n (%)	n (%)	X^2	P-value	n (%)	n (%)	X^2	P-value
Overall	777 (100)	203 (26.1)	574 (73.9)	177.14	<0.0001****	412 (53.0)	365 (47.0)	2.84	0.0918 ns	376 (48.4)	401 (51.6)	0.80	0.3698 ns
Age Category (Years)													
15 –25	214 (27.5)	43 (5.5)	171 (22.0)	63.87	<0.0001****	148 (19.1)	66 (8.5)	40.03	<0.0001****	100 (12.9)	114 (14.7)	9.32	0.0253*
26–35	283 (36.4)	116 (14.9)	167 (21.5)			139 (17.9)	144 (18.5)			131 (16.9)	152 (19.6)		
35–45	211 (27.2)	44 (5.7)	167 (21.5)			84 (10.8)	127 (16.3)			119 (15.3)	92 (11.8)		
46+	69 (8.9)	0 (0.0)	69 (8.9)			41 (5.3)	28 (3.6)			26 (3.4)	43 (5.5)		
Marital Status													
Single	139 (17.9)	28 (3.6)	111 (14.3)	3.14	0.0764ns	93 (12.0)	46 (5.9)	13.10	0.0003***	16 (2.1)	123 (15.8)	92.20	<0.0001****
Married	638 (82.1)	175 (22.5)	463 (59.6)			319 (41.1)	319 (41.1)			360 (46.3)	278 (35.8)		
Type of Family													
Monogamy	651 (83.8)	183 (23.6)	468 (60.2)	8.19	0.0042**	340 (43.8)	311 (40.0)	1.02	0.3116 ns	340 (43.8)	311 (40.0)	23.66	<0.0001****
Polygamy	126 (16.2)	20 (2.6)	106 (13.6)			72 (9.3)	54 (7.0)			36 (4.6)	90 (11.6)		
Number of Children													
0 (None)	139 (17.9)	28 (3.6)	111 (14.3)	16.16	0.0011***	93 (12.0)	46 (5.9)	64.25	<0.0001****	16 (2.1)	123 (15.8)	103.04	<0.0001****
1–2	128 (16.5)	48 (6.2)	80 (10.3)			99 (12.7)	29 (3.7)			85 (10.9)	43 (5.5)		
3–4	337 (43.4)	94 (12.1)	243 (31.3)			136 (17.5)	201 (25.9)			193 (24.8)	144 (18.5)		
5+	173 22.3)	33 (4.3)	140 (18.0)			84 (10.8)	89 (11.5)			82 (10.6)	91 (11.7)		
Occupation													
Government worker	77 (9.9)	33 (4.3)	44 (5.7)	12.40	0.0004***	51 (6.6)	26 (3.4)	5.99	0.0144**	37 (4.8)	40 (5.2)	0.004	0.9500 ns
Self-Employed	700 (90.1)	170 (21.9)	530 (68.2)			361 (46.5)	339 (43.6)			339 (43.6)	361 (46.5)		
Years of Experience as CMO													
< 5	359 (46.2)	119 (15.3)	240 (30.9)	17.06	0.0002***	214 (27.5)	145 (18.7)	11.89	0.0026**	179 (23.0)	180 (23.2)	0.59	0.7433 ns
5 – 7	311 (40.0)	63 (8.1)	248 (31.9)			145 (18.7)	166 (21.4)			146 (18.8)	165 (21.2)		
8^+	107 (13.8)	21 (2.7)	86 (11.1)			53 (6.8)	54 (7.0)			51 (6.6)	56 (7.2)		
Daily Income													
N1,000-N2,000	681 (87.6)	173 (22.3)	508 (65.4)	1.49	0.2222ns	337 (48.5)	304 (39.1)	12.07	0.0005***	340 (43.8)	341 (43.9)	5.20	0.0226*
N3,000-N4,000	96 (12.4)	30 (3.9)	66 (8.5)			35 (4.5)	61 (7.9)			36 (4.6)	60 (7.7)		
Number of Dependent(s)													
0	126 (16.2)	28 (3.6)	98 (12.6)	21.20	<0.0001****	80 (10.3)	46 (5.9)	64.80	<0.0001****	16 (2.1)	110 (14.2)	89.74	<0.0001****
1–3	119 (15.3)	42 (5.4)	77 (9.9)			98 (12.6)	21 (2.7)			69 (8.9)	50 (6.4)		
4–6	320 (41.2)	99 (12.7)	221 (28.4)			136 (17.5)	184 (23.7)			155 (20.0)	165 (21.2)		
7+	212 (27.3)	34 (4.4)	178 (22.9)			98 (12.6)	114 (14.7)			136 (17.5)	76 (9.8)		
Place of Residence													
Urban	86 (11.1)	32 (4.1)	54 (7.0)	6.66	0.0359 ns	20 (2.6)	66 (8.5)	43.33	<0.0001****	25 (3.2)	61 (7.9)	15.34	0.0005***
Semi-Urban	219 (28.2)	58 (7.5)	161 (20.7)			106 (13.6)	113 (14.5)			117 (15.1)	102 (13.1)		
Rural	472 (60.8)	113 (14.5)	359 (46.2)			286 (36.8)	186 (23.9)			234 (30.1)	238 (30.6)		
State of Residence													
Akwa-Ibom	133 (17.1)	33 (4.3)	100 (12.9)	5.59	0.3485ns	69 (8.9)	64 (8.2)	2.92	0.7119 ns	65 (8.4)	68 (8.8)	0.76	0.9793 ns
Bayelsa	73 (9.4)	23 (3.0)	50 (6.4)			41 (5.3)	32 (4.1)			37 (4.8)	36 (4.6)		
Cross River	109 (14.0)	23 (3.0)	86 (11.1)			51 (6.6)	58 (7.5)			50 (6.4)	59 (7.6)		
Delta	272 (35.0)	69 (8.9)	203 (26.1)			144 (18.5)	128 (16.5)			129 (16.6)	143 (18.4)		
Edo	113 (14.5)	37 (4.8)	76 (9.8)			63 (8.1)	50 (6.4)			57 (7.3)	56 (7.2)		
Rivers	77 (9.9)	18 (2.3)	59 (7.6)			44 (5.7)	33 (4.3)			38 (4.9)	39 (5.0)		

Within characteristic, percentages may not add up to exactly 100 due to rounding up.
Significance Level: *=$p<.05$; **=$p<.01$; ***=$p<.001$; ****=$p<.0001$; ns=Not significant ($p>.05$).

Table 4
Multivariable logistic regression model of COVID-19 pandemic knowledge, awareness and preventive practice among CMO in the South-South Region of Nigeria[π].

Characteristic	Knowledge			Awareness			Preventive Practice		
	aOR	95% CI	P-value	aOR	95% CI	P-value	aOR	95% CI	P-value
Age Category (Years)									
15 –25 (Ref)				1.00	––	––	1.00	––	––
26–35				2.41	1.59–3.64	<0.0001****	23.48	9.81–56.21	<0.0001****
36–45				2.86	1.74–4.68	<0.0001****	34.18	12.75–91.64	<0.0001****
46+				0.80	0.42–1.53	0.4936ns	50.57	17.42–106.81	<0.0001****
Type of Family									
Monogamy (Ref)	1.00	––	––				1.00	––	––
Polygamy	1.77	1.02–3.07	0.0394*				2.55	1.53–4.24	0.0003***
Number of Children									
0 (None) (Ref)	1.00	––	––						
1–2	0.41	0.23–0.71	0.0018**						
3–4	0.66	0.39–1.10	0.1102ns						
5+	087	0.47–1.61	0.6594ns						
Occupation									
Government worker (Ref)	1.00	––	––	1.00	––	––			
Self-Employed	1.93	1.13–3.30	0.0155*	3.18	1.72–5.85	0.0002***			
Years of Experience									
< 5 (Ref)	1.00	––	––	1.00	––	––			
5 – 7	1.65	1.12–2.45	0.0120**	1.89	1.31–2.73	0.0006***			
8+	1.81	1.03–3.20	0.0402*	1.29	0.77–2.13	0.3315ns			
Average Daily Income									
N1,000-N2,000 (Ref)				1.00	––	––	1.00	––	––
N3,000-N4,000				1.96	1.21–3.18	0.0064**	1.11	0.65–1.92	0.6992ns
Number of Dependent(s)									
0 (Ref)							1.00	––	––
1–3							0.04	0.02–0.09	<0.0001****
4–6							0.01	0.00–0.02	<0.0001****
7+							0.00	0.00–0.01	<0.0001****
Place of Residence									
Urban (Ref)	1.00	––	––	1.00	––	––	1.00	––	––
Semi-Urban	1.42	0.78–2.57	0.2480ns	0.12	0.06–0.23	<0.0001****	0.21	0.11–0.41	<0.0001****
Rural	1.61	0.94–2.77	0.0839ns	0.09	0.05–0.17	<0.0001****	0.22	0.12–0.41	<0.0001****

Abbreviations: aOR=Adjusted Odds Ratio; 95%CI: 95% Confidence Interval; Ref: Referent.
Significance Level: *=$p<.05$; **=$p<.01$; ***=$p<.001$; ****=$p<.0001$; ns=Not significant ($p>.05$).
[π] Only variables that met the model entry criteria of $P<.10$ in the bivariate analysis were included in the multivariable logistic regression model. In addition, variables that were found to be biased, zeroed or unstable during preliminary runs were removed. Only variables that made the final model for each measure (Knowledge, Awareness and Preventive Practices) are shown in the Table.

Discussion

Motorcycles became means of commercial transportation in South-South Nigeria in the late 1980s and remain the only means of transportation and livelihood in some rural areas. While it has been described as the most dangerous means of transportation because it is prone to accidents which can be fatal [19,20], it is likely that the advent of COVID-19 pandemic brings to bear another risk dimension. Our study noted that 60.8% of the CMOs in the South-South region operate in the rural areas. Although, the majority of the CMOs (73.9%) had good knowledge about COVID-19, the general awareness, and actual preventive practices among them varied widely by characteristics. CMOs who reside in urban and semi-urban areas were more aware of the COVID-19 and adopted more preventive strategies compared to those in the rural settings. Similar phenomenon has been reported in other cross-sectional studies of COVID-19 knowledge, attitude, and practices in the general public in Nigeria and other countries [21–24].

Despite the fact that the CMOs knew that they could be infected or could infect others, only 37.8% of them reported using face mask regularly while operating as motorcyclists. Several studies support the use of facemasks to provide source control and reduce transmission in the community [25–28]. Since the operational setting does not permit social distancing, there is the possibility that the CMOs may serve as reservoirs for community transmission of COVID-19. For instance, if one CMO is infected, besides the family members, several passengers are at risk of infection and many more persons who come in contact with passengers could equally be exposed to COVID-19 infection. The implication is that almost an entire community can contract SARS-CoV-2 within a very short time through the activities of one infected CMO. Considering the current low testing capacity in Nigeria, not everyone possibly infected is getting tested. No doubt, the fear of the outrageous cost of private testing centers amidst the current economic crisis induced by the pandemic [29,30] keep many CMOs away from getting tested, thereby continuing to sustain the cycle of infection within the community.

Majority of the CMOs live in the rural areas of the states with very poor healthcare facilities and have no idea which healthcare facility to visit for the purpose of testing or treatment should they develop symptoms suggestive of COVID-19.

No state in the South-South region of Nigeria has enough COVID-19 rapid response squads, testing centers, isolation and treatment centers that can match with the projections should there be a surge in the number of COVID-19 cases. Thus, the findings of the current study should serve as a wake-up call for governments at all levels, not only in the South-South region of Nigeria, but across the six geopolitical zones of the country to enforce wearing of face masks by all CMOs in order to curb community transmission of COVID-19. Compulsory and proper wearing of face masks, particularly among the CMOs who do not believe in the existence of COVID-19 will require enforcement and enlightenment campaigns [31]. Due to the global shortfall in medical supplies, surgical masks are not only scarce, but are expensive [30] and far beyond the reach of many CMOs. To augment this shortfall, several types of locally made face masks, many of them below standard are in circulation.

Most of the CMOs who live in rural areas move to nearby cities during the day to do business because there are more passengers in the urban areas. This daily commute by CMOs could lead to community transmission of COVID-19 from the cities to the rural areas and vice versa. On the average, the CMOs had a good knowledge about COVID-19 infection but less than half knew the signs and symptoms and other means of infection and the importance of wearing facemasks to prevent inhalation of droplets from infected individuals. Our finding is similar to those reported in a previous research [32]. Unfortunately, good knowledge of COVID-19 did not translate to good preventive action considering that about 62% of our study participants did not wear facemasks in public. Unprotected nose and mouth are easy ways for the spread of respiratory droplets containing SARS-CoV-2 [33]. The number of people infected with SARS-CoV-2 in the first 100 days of infection reduced significantly in HKSAR, Southern China where more than 96% of the people complied with wearing of face masks [34]. Equally worrisome is that only 52.3% of the correspondents' family members encouraged the CMOs to wear their facemasks while carrying out their daily livelihood. This may be associated with the fact that none of the participants had ever seen anyone affected with SARS-CoV-2 within their locality, making them to believe in the non-existence of COVID-19 in their community.

Furthermore, all our respondents knew they could be infected or infect others but were not willing to stop the business and would not be happy if government stopped them from working because of non-compliance with the directive on the use of facemasks [35]. While some state governments have placed a ban on the operation of motorcyclists following the COVID-19 infection surge, especially in the big cities, the absence of economic support poses a major challenge. These may not be the best approach to curb the pandemic, as majority of our CMOs are self-employed with motorcycle operation being the only source of livelihood for them and their dependents. Prohibition of commercial motorcycle operation in the absence of an alternative source of livelihood, may have a significant impact on survivability of the operators and their families. Instead of placing a ban, the relevant government agencies should work collaboratively with the CMO Unions to develop policy guidelines and safety measures for the CMOs. This is very crucial as majority of our respondents asserted that the distance between them and their passengers was less than 3 feet. None of the responders had an idea about the location of the hospital to visit in case of suspected COVID-19 infection. This highlights the existence of COVID-19 information gaps between the government and the populace. This could also be attributed to mere ignorance and purposeful intentions to flout government directives [36].

Typically, the distance from the head of the rider to the heads of the two passengers carrying operator is approximately 30 cm and 75 cm, respectively. The CMO also often moved at about 40 km/hour particularly during interstate travels. Consequently, the wind hitting the head of the passenger carries along with it, exhaled air and particles from the mouth, nose and eyes of the rider to the two passengers faces. It is obvious that these particles and air may contain harmful organisms which are inhaled by the passenger at a great speed. If the CMO is infected with SARS-CoV-2, the potential to transmit it to the passengers is therefore extremely high. It is not clear if passengers can be protected from SARS-CoV-2 infection if both rider and passengers wear facemasks. What is clear is that there are several types of facemasks in the market, each one with different pore size. The sizes of these pores are far larger than viruses. Accordingly, the route of transmission and the immune response of the individual as well as the extent of exposure to the microbes determine the rate of infection with viruses including SARS-CoV-2. Person-to-person transmission of SARS-CoV-2 through respiratory droplets, contact and fomites have since been established [15,37]. Individuals infected with SARS-CoV-2 may be asymptomatic or symptomatic [38]. The symptoms of mild COVID-19 are non-debilitating and have no radiological features. In moderate COVID-19, fever, respiratory and radiological features are the main symptoms; severe conditions present with either tachypnoea or oxygen saturation. Respiratory failure, septic shock and or multi organ failure have been reported in the critical stage of the disease [38]. Although, a critically ill COVID-19 individual may not ride a motorcycle, mild symptomatic individuals can travel on motorcycles and transmit the virus rapidly through airborne when on a high speed. The situation in the South-South Nigeria may not be different from what is obtained in other developing countries where motorcycles serve as means of transportation. As we enter the phase of community transmission of SARS-CoV-2, the WHO [39] and other related agencies are bracing up for the challenges ahead including those that may arise from commercial motorcycle operations, especially in the South-South region of Nigeria. It is projected that there will be an exponential increase in the number of COVID-19 cases in the next few months in places where commercial motorcycle business exists. This is because if one CMO contracts the virus, the rider can transmit it to several passengers in a day, who will in turn transmit it to his family members, friends and co-workers leading to further transmission in the communities. Therefore, understanding how, when and in which settings infected people transmit the virus is important for developing and implementing control measures to break the chains of transmission of this deadly virus.

Study limitations and strengths

Like any study, this study has some limitations. First, our study was a cross-sectional survey conducted across six states in the South-South region of Nigeria with different cultural settings, and political and leanings. Due to the variations in the timing of lockdown by the different states within the region, it was not possible to administer the questionnaire simultaneously in the study areas. Accordingly, it was staggered between May 4th, 2020 and June 15th, 2020 (approximately 6 weeks). Thus, there is the possibility of sampling bias and the likelihood of overestimation or underestimation of the strength of some measures' associations. Second, several characteristics and behaviors were self-reported, hence, there could be potential response biases due to recall and social desirability. Consequently, definite causality cannot be inferred, and the generalizability of our findings may be limited only to the South-South region of Nigeria.

Despite these limitations, our study has several important strengths. Our study is the first ever known study conducted to assess the COVID-19 knowledge, awareness, and preventive practices among CMOs in Nigeria and their potentials to serve as reservoir for the transmission of COVID-19 in the communities. In addition, findings from the current study would lay a strong foundation for the development of more practical and specific guidelines and policies that will benefit both CMOs and their passengers, and thus, help to prevent and control the transmission of COVID-19 in South-South region of Nigeria. Furthermore, our survey was conducted in-person, which afforded us the opportunity to reach many individuals with limited internet knowledge and/or access who could have been missed in an online survey. Our study ultimately provides valuable information to support COVID-19 related decision making for public health stakeholders in the South-South and other regions of Nigeria, which, along with the world, is facing one of the most dire public health threats in over a century.

Summary and conclusion

The findings of our study indicate that the CMOs' knowledge of COVID-19 does not translate to effective adoption of preventive practices. For instance, despite the fact that all participants (100%) indicated that wearing facemasks while on duty would prevent the spread of COVID-19, only 37.8% of them reported practically wearing facemasks during the hours of operation. However, COVID-19 awareness among the CMOs in the South-South region was significantly associated with good implementation of the recommended preventive practices. Under the operating circumstances of the CMOs, where social distancing cannot be observed, airborne transmission with an infected person seems unavoidable. Consequently, there is a high potential that this group may serve as a reservoir for the community transmission of COVID-19, even with the adoption of recommended preventive measures including the use of facemasks or face coverings. The government should work with the motorcycle unions and Ministries of Transport and Health to develop and enforce more practical guidelines that will prevent the transmission of COVID-19 and associated illness and death. This could include mandatory screening of CMOs and provision of free facemasks and face shields, sanitizers, and simple equipment such as infrared scanner for taking the temperature of passengers before they can ride the motorcycle. There is strong need for future research to assess the impact of COVID-19 pandemic and government policies on CMOs' productivity and lost wages, health status, and vaccination uptake, especially considering their daily exposure to different passengers, some of who may themselves be infected with COVID-19.

Authors' notes

GA, AE, EO, and SI conceived and designed the study. FO, TA, CAO, SSE and OM assisted with data management and statistical analysis, interpreted the results, and prepared the initial draft of the manuscript. All authors participated in the critical review and revision of the article for important intellectual contents pertaining to their specialties. All authors read and approved the final version of the article for publication. The findings and conclusions reached in this article are solely the responsibility of the listed authors and do not necessarily represent the official position of the respective institution or organization that the authors are affiliated.

Funding support

This research did not receive any financial support from funding agencies in the public, commercial, or not-for-profit sectors.

Declaration of Competing Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Acknowledgements

The authors would like to thank the commercial motorcycle operators in the various states that make up the South-South region of Nigeria who participated in the survey. Our sincere appreciations goto the research assistants who in compliance with the recommended COVID-19 guidelines took the risk of being out in the commercial motorcycle operational areas to

administer the questionnaire. The authors are grateful to Miss May Aideloje and Mr. Sunday Umukoro for providing the logistical support in the riverine areas of the region. The authors are also appreciative of the statistical support received from the Hatfield International Biometrical Services center, Houston, TX, USA.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.sciaf.2021.e01065.

References

[1] WHO Coronavirus disease (COVID-19) Dashboard 2021 www.covid-19.who.int Accessed on April 25, 2021
[2] Nigeria Centre for Disease Control (NCDC). "Covid-19 situation report 147. July 24, 2020. Official Website of the Nigeria Centre for Disease Control." https://covid19.ncdc.gov.ng/. Accessed on April 25, 2021.
[3] Nigeria Centre for Disease Control (NCDC). COVID-19, Nigeria 2020 www.ncdc.gov.ng Accessed on September 30, 2021.
[4] F.F. Asekhame, M.D. Oisamoje, Ban on Commercial Motorcycle Operations in Benin City, Nigeria: an Appraisal of the Benefits and Business Opportunities, Dev. Count. Stud. 3 (14) (2013) 10–17.
[5] Leonard Adamu, Betty Edeghagba, Funke Olatomi, Obinna Ezeokoli, Aniekpeno Elijah, Microorganisms associated with commercial motorcycle helmets in Lagos metropolis, J. Microbiol. Biotech. Food Sci. 1 (5) (2012) 1179–1188.
[6] P.M.V. Martin, E. Martin-Granel, 2,500-year evolution of the term epidemic, Emerg. Infect. Dis. 12 (6) (2006) 976–980.
[7] V.G. Coronado, C.M. Beck-Sague, M.D. Hutton, et al., Transmission of multidrug-resistant Mycobacterium tuberculosis among persons with human immunodeciency virus infection in an urban hospital: epidemiologic and restriction fragment length polymorphism analysis, J. Infect. Dis. 168 (4) (1993) 1052–1055.
[8] A.B. Bloch, W.A. Orenstein, W.M. Ewing, Measles outbreak in a pediatric practice: airborne transmission in an office setting, Pediatrics 75 (4) (1985) 676–683.
[9] J. Fiegel, R. Clarke, D.A. Edwards, Airborne infectious disease and the suppression of pulmonary bioaerosols, Drug Discov. Today 11 (1–2) (2006) 51–57.
[10] J. Liu, X. Liao, S. Qian, J. Yuan, F. Wang, Y. Liu, et al., Community Transmission of Severe Acute Respiratory Syndrome Coronavirus 2, Shenzhen, China, 2020, Emerg. Infect. Dis. 26 (2020) 1320–1323.
[11] Report of the WHO-China Joint Mission On Coronavirus Disease 2019 (COVID-19) 16-24 February 2020, World Health Organization, Geneva, 2020 (available at https://www.who.int/docs/default-source/coronaviruse/who-china-joint-mission-on-covid-19-final-report.pdf Accessed on April 25, 2021.
[12] L. Hamner, P. Dubbel, I. Capron, A. Ross, A. Jordan, J. Lee, et al., High SARS-CoV-2 Attack Rate Following Exposure at a Choir Practice — Skagit County, Washington, March 2020, MMWR Morb. Mortal Wkly. Rep. 69 (2020) 606–610.
[13] L. Luo, D. Liu, X. Liao, X. Wu, Q. Jing, J. Zheng, et al., Modes of contact and risk of transmission in COVID-19 among close contacts (pre-print), MedRxiv (2020), doi:10.1101/2020.03.24.20042606.
[14] J. Gralton, E. Tovey, M.L. McLaws, W.D. Rawlinson, The role of particle size in aerosolised pathogen transmission: a review, J. Infect. 62 (1) (2011) 1–13.
[15] World Health Organization. Scientific Brief: transmission of SARS-CoV-2: implications for infection prevention precautions. July 2020. Available:https://www.who.int/news-room/commentaries/detail/transmission-of-sars-cov-2-implications-for-infection-prevention-precautions. Accessed on August 1, 2020.
[16] World Health Organization. Preparing for large-scale community transmission of COVID-19. Guidance for countries and areas in the WHO Western Pacific Region. 28 February 2020. Available: https://www.who.int/publications/i/item/preparing-for-large-scale-community-transmission-of-covid-19. Last Accessed on August 2, 2020.
[17] E. Erdfelder, F. Faul, A. Buchner, G*POWER: a general power analysis program, Behav. Res. Methods Instrum. Comput. 28 (1996) 1–11.
[18] National Bureau of Statistics, Nigeria, 2017. Available: https://www.nigerianstat.gov.ng/. Accessed on July 29, 2020.
[19] UN Cartographic Section. www.nationsonline.org/oneworld/map Accessed on July 25, 2020.
[20] S. Oni, O. Fashina, Y.K. Olagunju, The Motorcycle Crash Characteristics in Lagos State, Nigeria J. Environ. Manage. Safe. 2 (2011) 1–15.
[21] National Highway Traffic Safety Administration (NHTSA)Traffic Safety Facts 2005: Motorcycles, NHTSA, Washington DC, 2007.
[22] Olapegba P.O., Ayandele O., Kolawole S.O., et al. A Preliminary Assessment of Novel Coronavirus (COVID-19) Knowledge and Perceptions in Nigeria Social Sciences & Humanities Open Epub ahead of print May 05, 2020 available at doi:10.2139/ssrn.3584408.
[23] Iloanusi, N.R., and Iloanusi S., Mgbere O., Ajayi A., and Essien, E.J. COVID-19 Related Knowledge, Attitude and Practices in a Southeastern City in Nigeria: a Cross-Sectional Survey. Available at SSRN: https://ssrn.com/abstract=3683766 or http://dx.doi.org/10.2139/ssrn.3683766.
[24] K. Austrian, J. Pinchoff, J.B. Tidwell, et al., COVID-19 related knowledge, attitudes, practices and needs of households in informal settlements in Nairobi, Kenya, Lancet Global Health (2020) Epub ahead of print April 14, 2020, doi:10.2139/ssrn.3576785.
[25] Wake AD. Knowledge, Attitude, Practice, and Associated Factors Regarding the Novel Coronavirus Disease 2019 (COVID-19) Pandemic, Infect. Drug Resist. 13 (27 Oct 2020) 3817–3832, doi:10.2147/IDR.S275689.
[26] C.M. Clase, E.L. Fu, M. Joseph, et al., Cloth Masks May Prevent Transmission of COVID-19: an Evidence-Based, Risk-Based Approach, Ann. Intern. Med. 173 (2020) 489.
[27] N.H.L. Leung, D.K.W. Chu, E.Y.C. Shiu, et al., Respiratory virus shedding in exhaled breath and efficacy of face masks, Nat. Med. 26 (2020) 676.
[28] M. Liang, L. Gao, C. Cheng, et al., Efficacy of face mask in preventing respiratory virus transmission: a systematic review and meta-analysis, Travel. Med. Infect. Dis. 36 (2020) 101751.
[29] D.K. Chu, E.A. Akl, S. Duda, et al., Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19: a systematic review and meta-analysis, Lancet 395 (2020) 1973.
[30] P.K. Ozili, T.K. Arun, Spillover of COVID-19: impact on the Global Economy, SSRN Electron. J. (2020), doi:10.2139/ssrn.3562570.
[31] Julius E., Nuugulu S., Julius L.H. Estimating the Economic Impact of COVID-19: a Case Study of Namibia. doi:10.13140/RG.2.2.30419.32806.
[32] Liu X., Zhang S. COVID-19: face Masks and Human-to-human Transmission. Influenza and other respiratory viruses, 2020; 14(4): 472–473. https://doi.org/10.1111/irv.12740.
[33] I.N. Ibeh, S.S. Enitan, R.Y. Akele, C.C. Isitua, F. Omorodion, Global Impacts and Nigeria Responsiveness to the COVID-19 Pandemic, Int. J. Healthc. Med. Sci. 6 (4) (2021) 27–45, doi:10.32861/ijhms.64.27.45.
[34] L. Labban, N. Thallaj, A. Labban, Assessing the level of awareness and knowledge of COVID 19 pandemic among Syrian, Arch. Med. 12 (2) (2021) 8.
[35] C. Huang, Y. Wang, Li X etal, Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China, Lancet 395 (2020) 497–506.
[36] V.C. Cheng, S. Wong, V.W. Chuang, S.Y. So, J.H. Chen, et al., The role of community-wide wearing of face mask for control of coronavirus disease 2019 (COVID-19) epidemic due to SARS-COV-2, J. Infect. 81 (1) (2020) 107–114.
[37] Gaziano C. Knowledge gap: History and Development. Wiley online library. https://doi/10.1002/9781118783764.wbieme0041
[38] J.W. Cabore, H.C. Karamagi, H. Kipruto, James Avoka Asamani, Benson Droti, et al., The potential effects of widespread community transmission of SARSCoV-2 infection in the World Health Organization African Region: a predictive model, BMJ Global Health 5 (2020) e002647, doi:10.1136/bmjgh-2020-002647.
[39] World Health Organization & People's Republic of China. Report of the WHO-China Joint Mission on Coronavirus Disease 2019 (COVID-19), 2019. Available: https://www.who.int/docs/defaultsource/coronaviruse/who-china-joint-mission-on-covid-19-finalreport.pdf. Accessed on April 25, 2021.