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RESEARCH ARTICLE

Prevalence of SARS-CoV-2 and Associated Factors Among Individuals During the Second Wave of Infection in Yaounde, Cameroon

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ABSTRACT

Background: **The first case of new severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was reported in Cameroon on March 5, 2020, in Yaounde. Since then, viral propagation occurred nationwide with a higher burden in urban settings and limited evidence on transmission patterns. Our objective was to determine the prevalence of SARS-CoV-2 and associated factors among individuals in urban settings of Cameroon during the second wave of the pandemic.**

Methods: **A population-based cross-sectional survey was conducted from January 18 to April 26, 2021, among 807 consenting individuals living in four major districts of the city of Yaoundé. Out of 711 nasopharyngeal swabs collected, 671 tests were performed by SARS-CoV-2 ribonucleic acid (RNA) extraction and real time-polymerase chain reaction (RT-PCR) at the National Public Health Laboratory (NPHL). Data were analysed using SPSS v21.0, with $p < 0.05$ considered statistically significant.**

Results: **Overall SARS-CoV-2 RNA positivity rate was 11.62% (78/671), without any significant difference between males and females with 10.9% versus 12.20% respectively (OR = 0.87, p = 0.5). However, clinical status was associated with SARS-CoV-2 RNA positivity rate in symptomatic (26.3%) *vs.* asymptomatic (9.7%) individuals (Odds Ratio [OR] = 3.30, p = 0.0001). Other factors associated with SARS-CoV-2 RNA positivity include exposure to more than 15 min with confirmed cases, wearing a non-conventional facemask ($p < 0.05$), the practice of occasional hand hygiene before and after contact with patients (OR = 3.60, $p < 0.0001$) or always as recommended (OR = 0.28, p = 0.0001), hand hygiene before and after occasional contact with objects (OR = 2.05, p = 0.0043) or always as recommended (OR = 0.48, p = 0.0027), surgical mask (OR = 0.17, p = 0.013) and standard mask (p = 0.026).**

Conclusion: **From this urban setting of Cameroon, coronavirus disease 2019 (COVID-19) reached an alert burden (10%–20%) during the second wave of the pandemic at the district level. Interestingly, SARS-CoV-2 infection was driven by the presence of symptoms, close contact with confirmed cases, limited adherence to recommended barrier measures, and the use of non-conventional facemasks.**

Keywords: Associated factors, health district, prevalence, SARS-CoV-2.

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1. Introduction

COVID-19, caused by the SARS-CoV-2, has become a public health problem worldwide since December 2019 [1]. SARS-CoV-2 represents the third coronavirus-related threat to global health in recent decades, after SARS-CoV and the Middle East Respiratory Syndrome (MERS) [2]. Appearing for the first time in the Republic of China (in Wuhan, capital of Hubei province), SARS-CoV-2 very quickly spread across the globe, causing many deaths [3], [4]. In April 2020, approximately 1,844,863 confirmed cases of COVID-19 and 117,021 deaths were recorded [1]. Additionally, on December 19, 2021, over 273 million cases and over 5.3 million deaths from the COVID-19 pandemic were reported globally, with the highest weekly incidence in European (279,9 new cases per 100,000 inhabitants) and American regions (88,5 new cases per 100,000 inhabitants) [5]. Despite these alarming and worrying figures, sub-Saharan Africa (SSA) remains the area of the globe which records a low number of cases of patients from the COVID-19 pandemic, especially with a very low mortality compared to other regions [6]. As of July 8, 2020, all countries in the African region had a total of 395,024 cases and 7,376 deaths [1].

SARS-CoV-2 attacks the upper and lower respiratory tract (nose, pharynx, bronchi, and bronchioles), and the infection spreads through respiratory droplets, contact with contaminated liquids, and surfaces contaminated with the virus [7]. Also, asymptomatic people are likely to transmit the infection, and people who have not reported being near a known case have also been infected [8]. Several studies have shown that advanced age, gender, and comorbidities such as hypertension, cardiovascular disease, diabetes, cancer, renal failure, and HIV/AIDS are risk factors for serious illness linked to COVID-19 [9]–[11]. So, to contain the spread of COVID-19, the WHO calls for the strengthening of essential protection measures (compulsory wearing of masks, social distancing), strengthening preventive hygiene (systematic hand washing with water and soap, hand disinfection), and getting vaccinated [1]. Despite these protective measures recommended by the World Health Organization (WHO), the chain of transmission is still not broken due to the non-compliance with these measures observed mainly in countries with limited resources, such as Cameroon, with the immediate consequence of the spread of the disease and the appearance of new cases.

During the second wave of infection (from February 11 to June 6, 2021), Cameroon recorded 52,271 cases, 4,675 hospitalizations with 1,111 cases on oxygen, 835 deaths, and a fatality rate estimated at 1.6%. Original lineage (70%), alpha variant (20%) and beta variant (10%) viruses were in circulation [12]. In April 2022, the country recorded 119,544 confirmed cases with approximately 1,927 deaths [12]. In Cameroon, like the majority of countries worldwide, health personnel were exposed to a higher risk of SARS-CoV-2 infection despite individual means of protection during the first month of the pandemic [13]. The study conducted by Nguépy *et al*. [14] found that 780 healthcare workers had been infected with SARS-CoV-2, and 21 deaths were recorded. Another study carried out by Fai *et al*. found a seroprevalence of 20.0% for immunoglobulins M (IgM) and 24.0% for immunoglobulins G (IgG) in the general population with the rates of IgM (5.3%) and IgG (2.3%) in the health personnel [15]. The SARS-CoV-2 (COVID-19) situation report (SITREP) in Cameroon only gives the number of health personnel infected and the number of deaths reported without however specifying the body to which it belongs, the gender, and the service [12]. Moreover, the few available data have focused on the proportion of health personnel infected but have not determined the prevalence and associated factors with this global infection. It is therefore necessary to carry out new investigations on the circulation of the coronavirus in hospitals and in community settings. In this context, it would be relevant to ascertain the burden of SARS-CoV-2 and its major determinants in urban settings during the second wave of COVID-19 within the Cameroonian context. Furthermore, understanding these risk factors for SARS-CoV-2 infection will enable local factors favouring the spread of COVID-19 in Cameroon in order to design locally specific preventive measures for better control of the pandemic. Such lessons and experiences shared will help mitigate future outbreaks and prepare for the emergence of any future pathogen with pandemic or epidemic potential. The present study, therefore, aimed to determine the prevalence of SARS-CoV-2 and local drivers of transmission among individuals during the second wave in the urban context of Cameroon, a tropical setting in sub-Saharan Africa.

2. Materials and Methods

2.1. Study Design and Setting

This population-based cross-sectional survey was conducted to determine the prevalence of SARS-CoV-2 and associated factors among individuals in urban settings of Cameroon. From January 18 to April 26, 2021, 671 adult individuals were recruited in four health districts of Yaounde (Biyem-Assi Health District, Djoungolo Health District, Mvog-Ada Health District, and Nkolndongo Health District). These health districts are among the thirty-two in the centre region of Cameroon and were chosen in view of the high number of COVID-19 cases reported during the pandemic. The nasopharyngeal samples were collected at the study site and transported to NPHL for analysis.

2.2. Participants

After administrative authorisations and ethical approvals for the study, an invitation to 807 potential participants was made through administrative notes and a study information sheet. We included 671 individuals from four health districts of Yaounde (Biyem-Assi health district, Djoungolo health district, Mvog-Ada health district, and Nkolndongo health district). There was no predefined participant recruitment, as the sampling was based on who presented at the screening site and volunteered to participate in the study. The participants were informed about the objectives of the study and were requested to freely sign a consent form before being recruited for the study. A standardized questionnaire was administered to collect sociodemographic data, associated factors, and clinical data. The questionnaire was pre-tested in COVID-19 sampling sites, health facilities, and public and private training schools of the Ministry of Public Health (MPH).

2.3. *Sample Size Calculation*

The minimum sample size was calculated using the Cochran's [16] formula:

$$N = \frac{Z^2 \times P(1 - P)}{d^2} \quad (1)$$

where:
N = minimal sample size,
Z = standard deviation of 1.96 (95% confidence interval),
P = prevalence of SARS-CoV-2 (COVID-19) (29.0%) [17],
d = error (d = 5% = 0.05).

2.4. *Collection and Transport of Biological Samples*

Nasopharyngeal samples were collected from the nasopharynx using a sterile swab by trained laboratory personnel into a coded 1 ml tube containing a sample of conserving solution (Sansure Biotech Inc, China), following the manufacturer's instructions. The samples were taken to the various COVID-19 sample collection sites designated by the MPH. The samples taken and accompanied by the sample slip were transported using a cooler from the sampling site to the NPHL. The transport of the samples was done according to the principle of triple packaging [18].

2.5. *Laboratory Testing*

SARS-CoV-2 RNA was detected in respiratory specimens using RT-PCR methods on QuantStudio™ 7 Flex of Applied Biosystems (manufactured by Life Technologies Corporation Holdings Ltd., 180 Oyster Point Boulevard, South San Francisco, CA 94080, United States of America, Reference: 4484643, Serial Number: 278873586, Date of manufacture: 2020-08-24) by using commercial kits, DaAn Gene (Co., Ltd., No.19, Xiangshan Road, Science Park, High & New Technology Development District Guangzhou, Guangdong 510665, China, reference: Cat.#DA-930, LOT 2021059) according to the manufacturer's instructions. This RT-PCR is a triplex that targets the OFR1ab and N genes of SARS-CoV-2 and an endogenous human fragment. The results obtained were interpreted according to the variation of cycle threshold (Ct) values categorized into three groups. For a positive result, the Ct value was less than 30 (Ct<30 cycles) representing a high risk and susceptibility of virus transmission for the orf1ab and n genes of sars-cov-2. The Ct value between 30–37 was interpreted as an intermediate result and the ct>37 results were interpreted as negative transmission for ORF1ab and N.

2.6. *Statistical Analysis*

Data management and tabulation were carried out using Microsoft Excel v2016, and all statistical analyses were performed. A descriptive statistical analysis was performed to describe the characteristics of the study population. The quantitative variables, such as age and Ct values, were described by the mean with standard deviation (SD) or median with interquartile range, as well as the frequencies. The qualitative variables were defined in terms of absolute and relative frequencies. The prevalence of SARS-CoV-2 in the study population was calculated by dividing the number of positive samples by the total sample size. The association between the variables was determined by the chi-square test in a 2 × 2 contingency table and by binary logistic regression in univariate and multivariate analysis. The degree of association between the variables was assessed by the odds ratio (OR) with 95% confidence intervals (95% CI), the chi-square test, and the p-value generated with SPSS v 21.0 analysis software and the online interactive software. A P-value of less than 5% was statistically significant.

2.7. *Ethical Considerations*

The study obtained ethical clearance from the National Ethics Committee for Human Health Research (Reference number: 2020/05/123/CE/CNERSH/SP from May 6, 2020). An information sheet was given to all the eligible individual, who then provided their verbal and written informed consent prior to participating in the study. The confidentiality of the data collected was ensured by assigning a unique identifier code to each study participant. Moreover, the risks and benefits of the study were explained to each participant.

3. Results

3.1. *Characteristics of Study Population*

A total of 671 individuals were enrolled in this study, with a majority of females (56.18%; n = 377) *vs.* 43.82% (n = 294) for males. The ages of the individuals varied from 21 to 95 years old, with an average age of 30.48 years old (SD +/− 11.99). The median age was 26.0 years (Interquartile range [IQR]: 23.0–33.0), and the age group of 21–46 years was the majority (88.67%; n = 595). 71.39% (n = 479) were health workers and 28.61% (n = 192) in the community. Laboratory personnel (21.31%; n = 143) were more represented in terms of hospital service. Regarding clinical status, the majority of individuals were asymptomatic (88.67%; n = 595) (see Table I).

3.2. *Distribution of SARS-CoV-2 ARN Detection According to Characteristics of Study Population*

SARS-CoV-2 ARN positivity rate was 11.62% (95% CI: 9.35%–14.35%; n = 78). SARS-CoV-2 RNA positivity rate was higher in females with 12.2% (46/377) vs. 10.9% (32/294) in males (OR = 0.87, p = 0.500). The prevalence also varied with age group, from 11.1% (66/595) between 21–46 years to 20% (2/10) in the age group 71–95 years (p = 0.500). Our findings show that clinical status was significantly associated with SARS-CoV-2 infection.

TABLE I: Distribution of SARS-CoV-2 RNA Detection According to the Characteristics of the Study Population

Variables	SARS-CoV-2 RNA detection		Overall (N = 671)	Odds Ratio (OR), 95% CI	p
	RNA –ve (%) 593 (%)	RNA +ve (%) 78 (%)			
Gender					
Female	331 (87.8)	46 (12.2)	377	0.87 (0.54–1.41)	0.500
Male	262 (89.1)	32 (10.9)	294		
Age (years)					
21–45	529 (88.9)	66 (11.1)	595	1.50 (0.77–2.92)	0.220
46–70	56 (84.8)	10 (15.2)	66	0.70 (0.34–1.45)	0.340
71–95	8 (80)	2 (20)	10	1.92 (0.40–9.22)	0.730
Clinical status					
Asymptomatic	537 (90.3)	58 (9.7)	595	3.30 (1.85–5.89)	<0.001
Symptomatic	56 (73.7)	20 (26.3)	76		
Site of data collection					
Reception	10 (83.3)	2 (16.7)	12	1.53 (0.32–7.13)	0.920
Administration	12 (85.7)	2 (14.3)	14	1.27 (0.27–5.80)	0.750
Community	172 (89.6)	20 (10.4)	192	0.84 (0.49–1.44)	0.530
External consultation	38 (82.7)	3 (7.3)	41	0.58 (0.17–1.93)	0.520
Hygiene	40 (86.67)	6 (13.04)	46	1.15 (0.47–2.89)	0.750
Physiotherapy	64 (87.67)	9 (12.32)	73	1.07 (0.51–2.26)	0.870
Laboratory	122 (85.3)	21 (14.7)	143	1.42 (0.83–2.43)	0.190
Medicine	86 (93.5)	6 (6.5)	92	0.49 (0.20–1.16)	0.100
Pharmacy	49 (84.5)	9 (15.5)	58	1.44 (0.68–3.07)	0.330

Note: RNA –ve: RNA Negative; RNA +ve: RNA Positive; OR: Odds Ratio.

Thus, the SARS-CoV-2 RNA positivity rate was higher in symptomatic (26.3%; 20/76) compared to asymptomatic individuals (9.7%; 58/595), OR = 3.30 (95% CI: 1.85–5.89; $p < 0.001$). Meanwhile, in the hospitals milieu, reception personnel were the most susceptible to infection with 16.7% (2/12), followed respectively by pharmacy personnel with 15.5% (9/58) and laboratory personnel with 14.7% (21/143) (p = 0.600). Furthermore, the SARS-CoV-2 RNA positivity rate was more frequent in individuals from the hospital milieu, with 12.1% (58/479) and no statistically significant difference (p = 0.300) (see Table I).

3.3. Distribution of SARS-CoV-2 ARN Detection by Associated Factors

This distribution shows that the SARS-CoV-2 RNA positivity rate was statistically associated with prolonged contact (>15 minutes) with contact case (OR = 2.98, p = 0.001). Regarding the wearing of face masks during contact with the patient, the SARS-CoV-2 RNA positivity rate was statistically associated in participants with surgical masks (OR = 0.069, $p < 0.001$) and fabric masks (OR = 5.39, $p < 0.001$). Concerning hand hygiene before and after your contact with the patient, the SARS-CoV-2 RNA positivity rate was statistically associated from time to time (OR = 3.60, $p < 0.001$) and Always, as recommended (OR = 0.48, p = 0.003). According to the type of personal protective equipment used, the SARS-CoV-2 RNA positivity rate was higher in participants who used a fabric mask (15.8%) without any significant association (OR = 1.56, p = 0.12) (see Table II).

4. Discussion

The current study aimed to determine the prevalence of SARS-CoV-2 and associated factors among individuals during the second wave of infection in four health districts of Yaounde using RT-PCR. Of the 671 individuals tested, the overall prevalence of SARS-CoV-2 RNA infection in this study was 11.62%. Studies conducted in Yaounde by Mbarga *et al*. [19] and Boum *et al*. [17] found a high prevalence of 82.74% and 29%, respectively, using PCR. This could be justified by the fact that their study had been carried out during the first wave of the epidemic in Cameroon. However, this SARS-CoV-2 RNA positivity rate obtained in our study is close to that found by Fokam *et al*. [20], who obtained a SARS-CoV-2 positivity rate of 12.7% by PCR, signifying a decrease of COVID-19 prevalence in Cameroon during the second wave of infection.

SARS-CoV-2 RNA positivity rate was slightly higher in female individuals at 12.2% *vs*. 10.9% in male individuals, with no statistically significant difference. Compared to other studies, our findings are contrary to several studies that have shown that men, due to their biological characteristics, risk behavior, and roles in society, were more susceptible to COVID-19 infection than women [21], [22]. This difference could be due to the fact that our study population is made up mostly of female individuals. In addition, the study done by Boniol *et al*. [23] showed that globally, women represent approximately 70% of frontline health workers, therefore, would be more exposed to the virus in health facilities and would statistically represent a greater proportion of people infected with SARS-CoV-2. Regarding the age group, the SARS-CoV-2 RNA positivity

TABLE II: Distribution of SARS-CoV-2 RNA Detection by Associated Factors

Variables		SARS-CoV-2 RNA detection		Overall (N = 671)	Odds Ratio (OR), 95% CI	p
		ARN –ve (%) 593 (%)	ARN +ve (%) 78 (%)			
Exposure >15 min with confirmed case	Do not know	287 (85.4)	49 (14.6)	336	1.80 (1.10–2.95)	0.016
	No	272 (94.1)	17 (5.9)	289	0.32 (0.18–0.57)	<0.001
	Yes	34 (73.9)	12 (26.1)	46	2.98 (1.47–6.05)	0.001
Wearing a face mask during contact with the patient	Surgical mask	20 (90.9)	2 (9.1)	22	0.069 (0.015–0.31)	<0.001
	NA*	559 (89.4)	66 (10.6)	625	0.33 (0.16–0.67)	0.001
	No	0 (0.0)	1 (100)	1	–	0.005
	Fabric mask	14 (60.9)	9 (39.1)	23	5.39 (2.25–12.92)	<0.001
Hand hygiene before and after your contact with the patient	From time to time	76 (73.79)	27 (26.21)	103	3.60 (2.13–6.08)	<0.001
	Most of the time	108 (85.04)	19 (14.96)	127	1.44 (0.82–2.52)	0.190
	NA*	163 (89.56)	19 (10.44)	182	0.84 (0.49–1.46)	0.500
	Always, as recommended	246 (94.98)	13 (5.02)	259	0.28 (0.15–0.52)	<0.001
Hand hygiene before and after your contact with the object	From time to time	127 (81.94)	28 (18.06)	155	2.05 (1.24–3.39)	0.004
	Most of the time	54 (85.71)	9 (14.29)	63	1.30 (0.61–2.75)	0.48
	Always, as recommended	412 (90.95)	41 (9.05)	453	0.48 (0.30–0.78)	0.003
Type of personal protective equipment used	Protective gloves + gown + Fabric mask	378 (86.7)	58 (13.3)	436	1.64 (0.96–2.81)	0.06
	Surgical mask	76 (97.4)	2 (2.6)	78	0.17 (0.04–0.74)	0.013
	Fabric mask	96 (84.2)	18 (15.8)	114	1.56 (0.87–2.74)	0.120
	Standard mask	43 (100)	0 (0.0)	43	–	0.026

Note: RNA –ve: RNA Negative; RNA +ve: RNA Positive; OR: Odds Ratio; *NA: Non Applicable.

rate was more observed in the age group of 71–95 years with 20% *vs*. 15.2%; 11.1% for the age group of 46–70 and 21–45, respectively, meaning that COVID-19 infection varies with age group with alarming cases observed in elderly individuals. Although our results are not statistically significant, they nevertheless corroborate findings from other studies conducted around the world that have observed COVID-19 infection in the elderly [11], [24]. This finding could be explained by the immune status of these vulnerable people. Of note, the immune system decreases with age, leading to susceptibility to viral, bacterial, parasitic, and fungal infections [25]. In this study, 88.67% of participants were asymptomatic, and 11.33% had symptoms. Similar results were found by Fokam *et al*. [20], showing that 88.9% of participants were asymptomatic and 11.1% had at least one symptom related to COVID-19. Multivariate logistic regression analysis showed that clinical status was strongly associated with COVID-19 infection with a high RNA positivity rate in symptomatic individuals (26.3%) *vs*. 9.7% in asymptomatic individuals (OR = 3.30, p = 0.00002), indicating that individuals with symptoms are 3 times more likely to be infected with SARS-CoV-2. Our findings corroborate what was In addition, the study done by Boum *et al*. also showed that SARS-CoV-2 RNA positivity rate was more observed in symptomatic than in asymptomatic individuals [17]. Like several studies, our findings showed very silent circulation in the study population [20], [26].

No statistically significant difference was found between hospital, community-based individuals and the SARS-CoV-2 RNA positivity rate. However, the SARS-CoV-2 RNA positivity rate was more observed in individuals from the hospital settings, with 12.1%. Our findings were higher than those found by Barrett *et al*. [27], which showed that the prevalence of SARS-CoV-2 infection was higher among healthcare workers (7.3%) than in non-healthcare workers (0.4%). The reasons for this susceptibility of individuals from the hospital milieu are multiple. The insufficiency of standard personal protective equipment (PPE) and training in biosafety, the workload, and in our context, the quality of the PPE used, in particular fabric masks, prolonged exposure with infected cases [28]. SARS-CoV-2 RNA positivity rate was statistically associated with prolonged contact (>15 minutes) with a contact case, non-compliance with barrier measures (wearing a mask during contact, hand hygiene before and after your contact with the patient, type of PPE used), thus justifying the high prevalence of COVID-19 in this study population. This could be explained by the non-respect of the barrier measures recommended by the WHO [1].

5. Conclusion

From this urban setting of Cameroon, COVID-19 reached an alert burden (10%–20%) during the second wave of the pandemic at the district level. Interestingly, SARS-CoV-2 infection was driven by the presence of symptoms, close contact with confirmed cases, limited adherence to recommended barrier measures, and the use of non-conventional facemasks.

6. Recommendations

With the emergence of new variants such as the Omicron variant, it is necessary to continue to respect barrier measures (wearing face masks, social biological distancing, general hygiene, etc.) recommended by the WHO and the Centers for Disease Control and Prevention.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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