Article

Profile of serological (IgM/IgG) and virological markers of COVID-19 in some private universities in Cameroon during the pandemic.

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Abstract:

Background: COVID-19 remains a rapidly evolving and deadly pandemic worldwide. This necessitates the continuous assessment of existing diagnostic tools for robust, up-to-date and cost-effective pandemic response strategy. We sought to determine the infection rate (PCR-positivity) and degree of spread (IgM/IgG) of SARS-CoV-2 in three university settings in Cameroon **Method:** Study volunteers were recruited from November 2020 to July 2021 among COVID-19 non-vaccinated students in three Universities from two regions of Cameroon (West and Centre). Molecular testing was performed by RT-qPCR on nasopharyngeal swabs and IgM/IgG antibodies in plasma were detected using the Abbott Panbio IgM/IgG rapid diagnostic test (RDT) at the Virology Laboratory of CREMER/IMPM/MINRESI. The molecular and serological profiles were compared and, $p<0.05$ considered statistically significant. **Results:** Amongst the 291 participants enrolled (mean age 22.59±10.43 years), 19.59% (57/291) were symptomatic and 80.41 %(234/2691) asymptomatic. Overall COVID-19 PCR-positivity rate was 21.31% (62/291), distributed as follows: 25.25% from UdM-Bangangte; 27.27% from ISSBA-Yaounde and 5% from IUEs/INSAM-Yaounde. Women were more affected than men (28.76% [44/153] vs. 13.04% [18/138], $p<0.0007$) and they significantly expressed more IgM+/IgG+ (15.69% [24/153] vs. 7.25% [10/138], $p<0.01$). Participants from Bangangté, the nomadic, and the "non-contact cases" mainly presented an active infection compared to those from Yaoundé ($p= 0.05$; $p=0.05$ and $p=0.01$ respectively). Overall IgG seropositivity (IgM-/IgG+ and IgM+/IgG+) was 24.4% (71/291). A proportion of 26.92% (7/26) presenting COVID-19 IgM+/IgG- had negative PCR versus 73.08% (19/26) with positive PCR, $p<0.0001$. Furthermore, 17.65% (6/34) with COVID-19 IgM+/IgG+ had negative PCR as compared to 82.35% positive PCR (28/34), $p<0.0001$. Lastly, 7.22% (14/194) with IgM-/IgG- had a positive PCR. **Conclusion:** This study calls for a rapid preparedness and response strategy in higher institutes in case of any future pathogen with pandemic or epidemic potentials. The observed disparity between IgG/IgM and viral profile supports prioritizing assays targeting the virus (nucleic acid or antigen) for diagnosis and antibody screening for sero-surveys.

Keywords: COVID-19, serological markers (IgM/IgG), Prevalence, private universities, Cameroon

1. Introduction

Since March 2020, the world is facing a biological threat caused by the emergence of a new virus: The Severe Acute Respiratory Syndrome-Coronavirus 2 (SARS-CoV-2) [1]. Named by the International Committee on Taxonomy of Viruses (CITV), SARS-CoV-2 is a 30 kb enveloped virus with a helical capsid whose genome consists of single-stranded, non-segmented, positive polarity ribonucleic acid (RNA) [2]. It has four essential structural proteins: spike surface protein (S), envelope protein (E), membrane protein (M), and nucleocapsid protein (N) [3]. To usurp the human organism, its spike protein (S) binds by affinity and avidity forces to cellular angiotensin-converting enzyme 2 (ACE 2) receptors mainly expressed by respiratory epithelial cells from the nasal mucosa and secondarily by type 2 pneumocytes hence its tropism for the respiratory tract and thus the preferential pulmonary involvement where SARS-CoV-2 causes emerging and potentially lethal atypical pneumonitis [4].

Since its appearance almost four waves of SARS-CoV-2 have been experienced so far [5]. As of 27 November 2022, the world has recorded 637 million confirmed cases and 6.6 million deaths globally [5]. In general, the United States of America (USA) represents so far the most affected country in the world with above 98,972,375 cases [6]. In Africa, COVID has affected all 47 African Region countries with 8.887.814 cumulative cases, which represented around two percent of the infections around the world [7]. South Africa is the most drastically affected country, with more than 3.6 million infections, followed by Cameroon with 123 993 cases of COVID-19, of which 1965 died and above 7774 were cured [7].

Many aspects of COVID-19 remains unknown as it is asymptomatic in about 50% of cases where the subject recovers spontaneously (acute or moderate form) [8]. Never-the-less, in these acute forms, symptoms such as cough, moderate fever, asthenia, headache, and loss of taste and/or smell may be noted [9]. In addition, in the absence of a cure, the contamination of the subject evolves into an infection characterized by the appearance of symptoms. These symptoms appear progressively and correlates with the severity of the SARS-CoV-2 infection, which is the severe form [9]. This severe form would be the result of a particular exaggerated inflammatory reaction charac-terized by a cytokine storm [3]. Subjects of younger age are described as less likely to develop severe COVID-19 forms than adults.

Transmission of SARS-CoV-2 in the young depends on the local transmission rates; the types of variants circulating; the epidemiology of COVID-19 among children, adolescents, and adults; vaccine coverage for those eligible; and mitigation measures in place to prevent transmission [10]. At the heart of the COVID-19 pandemic, population re-striction measures, including school closures and the introduction of barrier measures were practiced worldwide to curb the spread of the pandemic [11]. Some evidence indicates that SARS-CoV-2 might spread more easily within high school settings than in elementary school settings [12], [13], [14], [15] suggesting that SARS-CoV-2 transmission among children and adolescents is relatively rare, particularly when prevention strategies were in place[16]. However, close contact with persons with COVID-19, attending gatherings, and having visitors at home can increase its trans-mission rate [17]. In Cameroon, epidemiological data of COVID-19 infection in elementary as well as high School are rare. To limit the spread of the pandemic, easy access to testing is important. However, the available diagnostic tools have not been in many settings. This study sought to determine the infection rate (PCR-positivity) and spread (IgM/IgG) of SARS-CoV-2 in settlements around 3

Cameroonian universities as well as suggest a suitable diagnostic algorithm to SARS-CoV -2 there-in.

2. Materials and Methods

A. Study design and population

A multicenter cross-sectional study was conducted from September 28, 2020 to September 06, 2021, among 291 students in three privates universities from two regions of Cameroon: Université des Montagnes (UdM-Bangangté) located in Bangangté, in the west region; the Higher Institute of Biological and Applied Sciences (ISSBA-Yaounde) and the Estuary Academy and Strategic Institute (IUEs / INSAM-Yaounde), located both in Yaounde, in the central region. Several reasons guided the choice of these two towns (regions): i) Both are the most populated and highly heterogeneous cities in their respective regions; ii) Yaounde, the capital city of Cameroon is bigger than Bangangte and is equipped with an international airport of entry of foreigners; iii) Yaounde was one of the starting point of the COVID-19 and thus, was among the first site endorsed by the Ministry of Public Health for molecular diagnostic and management of COVID–19 cases; iv) Unlike Bangangte, Yaounde was basically among the two first sites of multifunctional reference laboratories for SARS–CoV–2 molecular detection in Cameroon before extension to others cities across country thereafter.

After obtaining the required administrative authorizations, we included in the study all students aged>18 years old from those three private universities (symptomatic and/or not) who signed the inform consent. Conversely, patients who declined invitation and refused to sign informed consent form were excluded. Additionally, those admitted at intensive care units, and individuals who declined either blood stick or nasopharyngeal swab were also excluded. From each participant, blood was collected by a prick on the middle finger and nasopharyngeal swab respectively for SARS-CoV-2 IgM/IgG antibodies and RNA detection. The protocol of sample collection was performed WHO guidelines for COVID-19 samples collection. And samples were transferred using a cooler at +4°C to the Center for Research on emerging and reemerging Diseases (CREMER).

An individual was considered symptomatic when he/she had at least three COVID-19-related symptoms such as taste disorders, loss of smell, fever, dry cough, breathing/shortness of breath, chest pain/pressure, aches and pains, sore throat, diarrhea, conjunctivitis,headache(https://www.who.int/health-topics/coronavirus#tab=tab_3). The study aim was well explained to all the participants, those who agreed to participate were recruited consecutively and filled the structured questionnaire with a member of the research team. Information on participant's sex, age, university, history of COVID-19 symptoms, treatment, and comorbidity were collected. B. Ethics Approval and Consent

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The research proposal was evaluated, and the ethical clearance was obtained from the Institutional Review Board (IRB) of the National Ethics Committee for Human Health Research (N°: 2020/05/1218/CE/CRERSHC/SP from 06th May 2020). Additionally, we obtained authorization from the directors of the three Universities selected. An information note was given to all the eligible participants, who then provided their written informed consent before enrollment into the study. The confidentiality of study participants was secured by the use of identification codes.

C. Determination of Minimum Sample Size

The minimum sample size was obtained using the standard formula:

n= z2.p (1-p)/m2, with "z" = the standard deviation of 1.96 (95% confidence interval); "p"= seroprevalence of SARS-CoV-2 antibodies found in Cameroon (IgM: 20% and IgG: 24%) [9], "m"=degree of precision (0.05) and "n"= minimum sample size.

D. Sample Collection and Conservation

Eligible participants who gave their approval were subjected to the collection and blood and a nasopharyngeal fluid.

1. Blood Sampling

Blood was collected according to the aseptic and barrier measures of COVID-19. One drop of whole blood was required for the "on-site" testing according to the SOP presented to us by the " Abbott PanbioTMCOVID-19 " rapid diagnostic test kit (Panbio COVID-19 IgG/IgM Rapid Test | Point-of-Care – Abbott (globalpointofcare.abbott))

2. Nasopharyngeal sampling

Safety procedures were performed according to procedural references for safe nasopharyngeal swab collection previously described [18], [19]. Samples collected on nasopharyngeal swabs were moved to collection tubes containing a viral transport medium by breaking the swab at the groove. Sealed state and labeling was checked, and surface disinfection was performed [20].

3. Samples Transportation

Antibodies testing was performed on-site, whereas nasopharyngeal swabs were transported to CREMER, Yaounde for diagnosis. All Viral transport mediums containing nasopharyngeal swabs were temporarily stored between 2-8°C immediately after collection. Nasopharyngeal swabs collected at ISSBA-Yaounde and IUEs/INSAM in Yaounde were directly transferred to CREMER, and analyzed within 48 hours. On the other sites, samples collected in Banganté were firstly frozen (-20°C) in the Laboratory of UdM-Bangangte, then transferred once per week between 2-8°C to the virology laboratory CREMER located in Yaounde(~ 400 km away) where they were analyzed upon arrival.

4. COVID-19 Testing

SARS-CoV-2 IgG/IgM antibodies were detected in whole blood using Panbio™ COVID-19 IgG/IgM Rapid Test Device, REF: ICO-T40203, LOT: COV0052132, Expiration: 2021-04-30) according to the manufacturer's instructions. The Panbio™ COVID-19 IgG/IgM Rapid Test is an immunochromatographic lateral flow test kit used for the qualitative detection of IgG and IgM antibodies to SARSCoV-2 in human serum, plasma, venous, and capillary whole blood. In this study, all Panbio™ COVID-19 IgG/IgM Rapid Tests were performed on-site using capillary whole blood. That technique is reported to have a specificity of 99.4% and a sensitivity of 98.2% [21].

Molecular diagnosis of SARS-CoV-2 was performed using realtime RT-qPCR [22]. In all, viral genome was detected by the analysis of the RdRp, E, et N genes using a DaAnGene® kit (DaAn Gene Co., Ltd, Guangzhou, Guangdong, China) after RNA extraction. Amplification of the SARS–CoV–2 genes were performed on a QuantStudioTM 7 real time thermocycler (Applied Biosystems, Massachusetts, USA). Cycling conditions were as follows: reverse transcription (45 °C/15 seconds) followed by initial denaturation (95 °C/2 minutes), and 45 cycles of [denaturation (95 °C/15 seconds), annealing (60 °C/30 seconds), and extension (72 °C/60 seconds)]. Internal control was included in each amplification. Cycle threshold (Ct) value was used to determine viremia and classified patients (negative or positive) as reported previously [22]. The prevalence of SARS–CoV–2 infection was defined as the proportion of individuals with positive RT–qPCR.

E. Data analysis

The analyses were done using the software package Stat view 5.1 for Windows (SAS Institute Inc, USA). The continuous variables are presented in terms of mean ± Standard deviation (Std) and categorical variables in absolute number (proportion in %). The associations between the SARS-CoV-2 positivity or serological profile and demographic and clinical characteristics were investigated by Chi-Square (Pearson or for trend) test, Mann Witney or Kruskal-Wallis test as appropriate. The univariate and multivariate regression analyses were conducted to identify factors independently associated with the risk of SARS-CoV-2 infection and serological profile. Only participants with all informations were included during analysis. For all the analyses, the significance level was set at p<0.05.

3. Results

3.1. *Determination of baseline characteristics of the study population*

A total of 291 participants in three universities was were surveyed between September 28, 2020, to September 06, 2021, in of Yaoundé and Bangangté. Males and females had similar representation in the study with sex ratio of 1:1. The mean age of the study participant was 22.59years old [min 18, max 27] and the age range [21-24[years was most represented (41.24 %). The majority of these students were from the city of Bangangté 68.04% while 31.96% were from Yaoundé. Based on clinical presentation, almost all our most of the participants were asymptomatic (80.41%vs 19.59%symptomatic) with less comorbidity (4.13%). It appears that the majority of the population have not haven't yet been in closed contact with an infected person (80.76%). In addition, most were sedentary[2] (93.13% vs. 6.87% nomadic[1]) and had not yet taken any drugs against COVID-19 (98.63%) (see Table 1).

Table 1 : Sociodemographic Characteristics of the Study population

Variables		n	Percentage (%)
Age range (year)	18-21	81	27.84
	21-24	120	41.24
	24-28	90	30.93
Gender	Male	138	47.42
	Female	153	52.58
Location	Yaounde	93	31.96
	Bangangte	198	68.04
Clinical status	Symptomatic	57	19.59
	Asymptomatic	234	80.41
Comorbidities	Yes	12	4.12
	No	279	95.88
Case- contact	Yes	56	19.24
	No	235	80.76
Nomadic[1]	Yes	20	6.87
	No	271	93.13

Treatment	Yes	4	1.37
	No	287	98.63

1. **Nomadic:** participant who have moved out of their town in the past two weeks prior enrollement into the study; 2. **Sedentary**: No migation experienced out of the town within the past two weeks. .

3.2. Prevalence of SARS-CoV-2 in students and associated risk factors

The overall prevalence of SARS-CoV-2 (positive PCR)among students was 21.31%. However, the PCR positivity rates differed across universities as follow; UdM-Bangante: 25.25% (50/198), IUEs/INSAM-Yaounde: 5% (3/60), and ISSBA-Yaounde: 27.27% (9/33). The identification of risk factors (sociodemographic and clinical characteristics) by binary logistic regression showed that females were more affected by SARS CoV-2 infection than male by two-fold (28.76% vs 13.04%; OR=2.21, 95%CI=1.5-4.5; P=0.0007). Similarly, students in the city of Banganté were almost two times more affected by COVID-19 than students from Yaounde (25.25%vs 12.9%; OR=1.95, 95%CI=1.2-3.8; P=0.01) (See table 2).

Table 2 : Risk factor of infection with COVID-19 in the Study Population

Variables	N	Positive PCR n(%)	ORa	IC95%	P-value
Age range (year)					
[18-21 [	81	15 (18.52)	Ref		
[21-24 [	120	31 (25.83)	1.81	0.8-3.7	0.11
[24-28 [	90	16 (17.78)	1.09	0.4-2.5	0.83
Sexe					
Female	153	44 (28.76)	Ref		
Male	138	18 (13.04)	2.21	1.5-4.5	**0.0007**
Location					
Bangangte	198	50 (25.25)	Ref		
Yaounde	93	12 (12.90)	1.95	1.2-3.8	**0.01**
Clinical status					
Asymptomatic	234	53 (22.65)	Ref		
Symptomatic	57	9 (15.79)	0.64	0.3-1.4	0.2
Comorbidities					
No	279	58 (20.79)	Ref		
Yes	12	4 (33.33)	1.14	0.3-4.3	0.84
Case-contact					
No	235	52 (22.13)	Ref		
Yes	56	10 (17.86)	0.61	0.3-1.4	0.25
Nomadic					
No	271	57 (21.03)	Ref		
Yes	20	5 (25)	1.82	0.5-6.1	0.33
Treatment					

No	287	61 (21.25)	Ref		
Yes	4	1 (25)	1.70	0.15-18.7	0.66

PCR= Polymerase Chain Reaction; ORa=Ajusted Odds Ratio

3.3. IgM/IgG serological profile and their associated factors

From the rapid serological testing (IgM/IgG), we noticed an overall IgM (IgM+/IgG- and IgM+/IgG+) and IgG (IgM-/IgG+ and IgM+/IgG+) seropositivity of 20.62 % (60/291) and 24.4% (71/291) respectively. Also, 11.68% (34/291) and 8.93% (26/291) of our participants had typical progressive (IgM+/IgG+) and acute (IgM+/IgG-) infection profiles. In addition, more than half of our participants did not have previous exposure to SARS-COV-2 (IgM- & IgG-) 66.67% (194/291) (figure 1). The identification of factors (socio-demographic and clinical predictors) associated with the serological profile showed that two time more females had the progressive (IgM+/IgG+) profile compared to males (15.69% vs 7.25%; OR=2, 95%CI=; p=0.02).

Students from the city of Bangangté in our sample had the majority of active infection (IgM+&IgG+) compared to those from Yaoundé (14.14% vs. 4.45%; OR=3.5, 95%CI=; p=0.05). Students reported as "case-contact" were the least affected by active infection (IgM+&IgG+) (7.14%, p=0.05); on the other hand, nomads were more affected by active infection (20%, p=0.01) than sedentary participants (table 4).
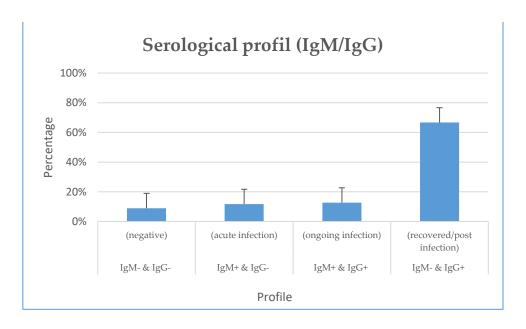

Figure 1: Overall IgM/IgG serological profile of the study participants

Table 4 : IgM/IgG profile by sociodemographic and clinical characteristics

Variables	Total (N)	IgM+&IgG+ n(%)	P-value	IgM+&IgG- n(%)	P-value	IgM-&IgG+ n(%)	P-value
Age range (year)							
[18-21 [	81	8 (9.88)	Ref	4 (4.94)	Ref	13 (16.05)	Ref
[21-24 [	120	16 (13.33)	0.26	11 (9.17)	0.5	13 (10.83)	0.31
[24-28 [	90	10 (11.11)	0.61	11 (12.22)	0.21	11 (12.22)	0.63
Gender							

Female	153	24 (15.69)	Ref	12 (7.84)	Ref	19 (12.42)	Ref
Male	138	10 (7.25)	**0.01**	14 (10.14)	0.77	18 (13.04)	0.92
Location							
Bangangte	198	28 (14.14)	Ref	21 (10.61)		23 (11.62 %)	Ref
Yaounde	93	6 (4.45)	**0.05**	5 (5.38)	0.11	14 (15.05 %)	0.74
Clinical status							
Asymptomatic	234	30 (12.82)	Ref	21 (8.97)	Ref	28 (11.97)	Ref
Symptomatic	57	4 (7.02)	0.15	5 (8.77)	0.67	9 (15.79)	0.6
Comorbidities							
No	279	34 (12.19)	Ref	23 (8.24)	Ref	34 (12.19)	Ref
Yes	12	0 (0.00)	0.97	3 (25.00)	0.12	3 (25.00)	0.11
Case-contact							
No	235	30 (12.77)	Ref	19 (8.09)	Ref	32 (13.62)	Ref
Yes	56	4 (7.14)	**0.05**	7 (12.50)	0.9	5 (8.93)	0.18
Nomad							
No	271	30 (11.07)	Ref	23 (8.49)	Ref	34 (12.55)	Ref
Yes	20	4 (20.00)	**0.01**	3 (15.00)	0.3	3 (15.00)	0.21
Treatment							
No	287	33 (11.50)	Ref	25 (8.71)	Ref	37 (12.89)	Ref
Yes	4	1 (25.00)	0.22	1 (25.00)	0.2	0 (0.00)	0.98

3.4. IgM/IgG serological profile and SARS-CoV-2 RNA detection

Comparing serological and molecular profiles we found that a proportion of 26.92% (7/26) presenting COVID-19 IgM+/IgG- had negative PCR compared to 73.08 % (19/26) for those with positive PCR (p<0.0001). Furthermore, 17.65% (6/34) negative PCR versus 82.35% (28/34) positive PCR were found in students with COVID-19 IgM+/IgG+, (p<0.0001). Lastly, 7.22% (14/194) with IgM-/IgG- had a positive PCR (see table 5).

Table 5 : Serological profile (IgM/IgG) and SARS-COV-2 RNA detection

Profil sérologique		PCR		OR	IC95%	P-value
	N	Negative n(%)	Positive n(%)			
IgM- & IgG- *(negative)*	194	180 (92.98)	**14 (7.22)**	Ref		
IgM+ & IgG- *(acute infection)*	26	**7 (26.92)**	19 (73.08)	34.9	[12.5-97]	**<0.0001**
IgM+ & IgG+ *(ongoing infection)*	34	**6 (17.65)**	28 (82.35)	60	[21.3-169]	**<0.0001**
IgM- & IgG+	37	36 (97.3)	**1 (2.7)**	0.36	[0.05-2.8]	0.33

(recovered/post

infection)

key: PCR = Polymerase chain reaction ; OR = Odds-ratio ; IC= confidence Intervalle; Inf=Infection

4. Discussion

During this study conducted in three private universities in Cameroon (UdM-Bangangte, IUEs/INSAM-Yaounde, and ISSBA-yaounde), 291students were enrolled. The mean age was 22.59±10.43 years old [min 18, max 27], females were predominant compared to males (52.58% vs. 47.42%) and the majority of the population resided in the city of Bangangté (68.04% vs. 31.96% in Yaounde). Approximately 3/4 of the overall study population was asymptomatic (80.41%). This high number of asymptomatic participants must be related to the young age of the study population (mean=22 years). In fact, studies conducted worldwide presented COVID-19 as an asymptomatic disease in more than 85% of young subjects [23].

The overall prevalence of COVID-19 by RT-qPCR was 21.31% (62/291), with 25.25% at UdM-Bangangte, 27.27% at ISSBA-Yaounde, and 5% at IUEs/INSAM-Yaounde private Universities. Similarly, students of Banganté had twice as many cases of COVID-19 than those in Yaoundé (25.25% vs. 12.90%, p =0.01). These disproportionate prevalences between private High Schools in Yaounde and Bangante could be explained by the fact that Yaoundé was among the cities considered as the starting point of the COVID-19 epidemic in Cameroon in early 2020 and thus, the initial point of the anti-COVID response [24]. The spread of the pandemic through smaller cities like Bangangte was amplified by their lower response capacity. The detection of SARS-CoV-2 in these two cities of Cameroon informs us of the importance of the continuous application of barrier measures to prevent the spread of SARS-COV-2. Our findings portraying women to be twice as affected as men (28.76% vs. 13.04%, p<0.0007) and was differed from several studies [25], [26], [27], [28]. Studies reported that even when men and women have the same prevalence, men with COVID-19 are more at risk for worse outcomes and death, independent of age [29]. Furthermore, most of the COVID-19 cases confirmed by RT-qPCR were asymptomatic (22.65% vs. 15.79%symptomatic). No severe case was reported in this study. This could be due to the relative young age of the study population. However, there is evidence that asymptomatic SARS-CoV-2 carriers can transmit the virus [30].

We noted a predominance of IgG (24.40 %) compared to IgM (20.62 %). Similar trends have already been reported with higher IgG level in the general population in USA [31], Cameroon [7], [32], [33], [34], Congo [35], India [36] and Brazil [37] as well as in students in Spain [38]. In fact, experience earned from the kinetics of antibody response from other viral infections taught us that unlike IgM that appears in the acute phase of infection, IgG is the marker of the chronic infection and should appear later on in greater amount. Only 12.71% of our participant presented the IgM-/IgG+ profile. This serological profile in this study should reflect recovering or post infectional immunity as a result of infection with SARS-CoV-2 since none of our participant were vaccinated.

Concerning symptomatic subjects, Only 9 over 57 (15.78%) were PCR positive whereas 31.57% (18/57) were presenting at least one COVID-19 IgM and or IgG antibody [31.57% (18/57)]. SARS-CoV-2 Prevalence [39], [40], [41], [42] as well as IgM/IgG antibodies detection [43], [44], [45] vary according to identified symptoms. In fact, COVID-19 share similar flu-like symptoms make it difficult to differentiate from other respiratory diseases [46], [47], [48]. Thus, the need of standard method looking for SARS-COV—2 RNA such

RT-PCR for its diagnosis in clinical practice [49]. Furthermore, as compared to PCR, antibodies tests look for antibodies in the blood that fight the virus that causes COVID-19 [50]. The presence of antibodies such IgM/IgG does not always signs infection as they can also be detected in the blood of people who have recovered from COVID-19 or people who have been vaccinated against COVID-19[50]. That is why anti-SARS-CoV-2 IgM and IgG antibodies have been expected to be useful as complementary tests, in addition to RT-PCR, for the diagnosis of COVID-19[43].

Four serological profiles were identified: 12.71% IgM-/IgG+, 11.68% IgM+/IgG+, 8.93% of IgM+/IgG-, 66.67 % of IgM-/IgG-. Similar results have been reported in Congo [35], in the USA [31], and in Cameroon [32], [33] with a sample size of 684, 368, 291 and 971 respectively. No association has been found between serological profiles and all the socio-demographic characteristics. Our results diverge from those of Congo where hospitalizations due to COVID-19 were correlates to immune response [35]. However, our findings are similar to other studies in Cameroon reporting this association [32], [33]. The differences seen between Cameroon and Congo may be accounted by the difference in sample size and study context. In fact, the study in Congo was done on 684 travelers [51] and those in Cameroun by Nguwoh [32] and Nwosu [33] were conducted on 368 and 971 health care workers. Moreover, more than half of our study participants did not have previous exposure to COVID (IgM- & IgG-) 66.67% (194/291). This large proportion of non-exposure could reflect the success of the nationwide measures implemented by the Cameroonian government to stall COVID-19 transmission [24].

In this study, about 1/4th (26.92%) of the patients with serological markers of acute COVID-19 infection (IgM+IgG-) and 1/5th(17.65%) with serological markers of ongoing COVID-19 infection (IgM+IgG+)had a negative PCR result (p<0.0001). The difference observed between antibodies and PCR is logical and supported by previous findings [16], [33], [52], [54], [55]. The observed disparity between serologic (IgG/IgM) and molecular (PCR) profiles could be accounted for the acute nature of such an infection with an incubation time of 2-14days, which differs from the peak production of IgM and IgG (~10-14days) [52], [55]. This further supports the use of PCR for diagnosis and Antibodies for sero-surveys.

Only 2.7% of the participants with serological markers of postinfectional immunity (IgM-IgG+) still had positive PCR results. In fact, the IgM-IgG+ is the conventional serological profile of past exposure to infections, or chronic infection, an indicator of cure, or natural immunization [56]. Finally, 7.22% (14/194) of the participants negative by IgM- and IgG- had a positive PCR result. These may be false-negative or evidence that these are early infections with levels of antibodies that cannot be detected by the serological tests we used [35]. Moreover, it could be related to seroconversion, a period the onset of antibody production which will the rise to detectable [57], [58]. In addition, numerous studies have already reported a low sensitivity of the COVID IgM/IgG serological tests compared to techniques such as ELISA or LUMINEX [59]–[63] suggesting a continuous readaptation of prefabricated RDTs in the emergency anti-COVID response is needed, especially as circulating strains arise and cause new waves.

5. Conclusions

During the COVID-19 pandemic, there was an upsurge (above 20%) of COVID-19 confirmed cases within the University settings of Cameroon, calling for a increased preparedness and rapid response strategies to implement in higher institutes in case of any

new pathogen with pandemic or epidemic potentials arises. The observed disparity between IgG/IgM and viral profile supports prioritizing assays targeting the virus (nucleic acid or antigen) for diagnosis and antibody screening for sero-surveys.

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