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Pattern and Sero-prevalence of Covid-19 Screening among Patients in a Tertiary Hospital, South-western Nigeria

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Abstract

Background: The global pandemic due to the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and its related COVID-19 infection has placed more demand and responsibility on clinical laboratories for screening and confirmatory tests. The serological tests for screening appear to be of great benefit in resource poor settings like ours to facilitate diagnosis and monitoring of COVID-19 infection. We therefore, determined the pattern and the sero-prevalence of SARSCoV-2 based on requests received at the Point of Care Testing Unit of the OAUTHC, Ile-Ife.

Methods: A total of 1653 results of SARS-CoV-2 serology requests were assessed in this descriptive study. All requests received within a period of six months were analyzed for age, gender, sources and immunoglobulin pattern for sero-prevalence using descriptive statistics. Requests were categorized into pediatric and adult age groups, while results were compared between male and female gender.

Results: Requests from children and adults accounted for 284 and 1369 respectively in a male to female ratio of 1.07:1 in children and 1:1.07 in adults. There was a bimodal mean age of 8.6±0.35years and 34.2±0.7years in children and adults respectively. The highest requests were from surgery and emergency units accounting for 28% and 26% respectively. Adult females had a higher IgG sero-prevalence while adult males reacted more to IgM. Overall sero-prevalence of SARS-CoV-2 was 26.3% giving 20% and 27% for children and adults respectively.

Conclusion: The sero-prevalence of SARSCoV-2 was higher among adult population and female gender appeared to be a modifying factor.

Keywords: COVID-19, Serology, Screening

1. Background

Up to now, there's no solid evidence to prove that an outbreak of acute respiratory disease reported in December 2019 was from Wuhan district of Huben Province of China. The aetiology of the disease was unknown until its genome was identified and deposited on GenBank (MN908947) by Zhang et al [1]. This 2019 novel Coronavirus (2019-nCoV) was renamed by the Coronavirus Study Group of the International Committee on Taxonomy of Viruses (ICTV) as severe acute respiratory syndrome coronavirus 2 (SARS-Cov-2) [2]. Although, the novel CoV was first reported in China, it has spread globally with high mortality and morbidity rates. In April 2020, it was reported that the total number of confirmed cases in Nigeria was 873 with 28 deaths while the global figure was 1, 978,769 with 125,196 mortality. The values had increased by June 30, 2020 with confirmed cases above 10 million and more than 500 deaths globally [3-4].

In Nigeria, a low-medium income country (LMIC) with grossly mismanaged health resources and poor health indices, the first case of COVID-19 infection was reported on 27th of February. Due to increasing spread of the virus, 25,694 cases and 590 deaths were recorded by mid-2020 [5-6]. The disease is observed to be more common among males [7-9], while mortality is higher in elderly patients with co-morbidities and frontline health workers [10]. However, prevalence appears lower in children [8,11-12]. Respiratory symptoms remain the predominant form of presentation following a 2-week incubation period. Although, some infected patients may be asymptomatic, symptoms like fever, cough and respiratory difficulty were found in 95%, 50% and 33% of symptomatic cases respectively [13-14].

Due to the high spread of the virus, the need for mass screening has placed more demand on clinical laboratories to facilitate diagnosis and monitoring. Most countries have also mandated screening as part of travel regulations. SARS-CoV-2 being a rapidly spreading viral infection necessitates diverse heterogeneous approaches to its diagnosis. The gold standard for the diagnosis of COVID-19 recommended by WHO, is the molecular technique approach using the real time polymerase chain reaction (RT-PCR) to identify the viral genes E, RdRp and N [15-16]. In the United States of America, a combination of viral N1/2/3 gene and P gene is widely in use [15]. However, due to limited molecular laboratory facilities to screen a large population like that of Nigeria, other approaches employed were the use of rapid diagnostic testing (RDT) kits to detect the combination of IgG/M antibodies by immunoasay or by targeting the viral E gene for screening, with only a positive test necessitating confirmation by RT-PCR. Previous studies reported a high sensitivity (87.3-88.7%) and even higher specificity (90.6-98.6%) for both IgM and IgG to emphasize the analytic and diagnostic utility of the RDT kits [17-18]. Based on this, we assessed the serology pattern of requests for SARSCoV-2 and determined the sero-prevalence of positive SARSCoV-2 results.

2. Methods

This was a descriptive analytical study involving a total of 1653 requests for SARS-CoV 19 antibody screening tests at the Postgraduate Laboratory of the Department of Chemical Pathology, Obafemi Awolowo University Teaching Hospitals Complex (OAUTHC), Ile-Ife. The period of assessment was between May and December, 2020. The SARS CoV-2 antibody reagent test kits were purchased from CTK biotechnology Inc., 13855 Stowe Drive Poway, California 92064, USA with reference SB-RO180C, Lot numbers SO11428-204 and FO417R8BO2V. The assay method is based on lateral flow immunoassay technique for qualitative detection of SARS-CoV-2 IgG and IgM antibodies in serum.

The request forms were screened assessed for the information on sources such as private or public health care facility, clinic or ward, demography, background clinical details while the results of the antibody screening were analyzed to determine the immunoglobulin types found in the positive results. Data was analyzed by Statistical Package for Scientific Solutions (SPSS) version 20 (IBM, USA) using descriptive statistics.

3. Results

There was a bimodal mean age of 34.2±0.7 and 8.6±0.35 and a male to female ratio of 1:1.07

and 1.07:1 for adults and children respectively (table 1). There was a slight female preponderance (50.9%) for requests when compared with requests from males (47.2%). The requests received were mainly from patients attending the OAUTHC within the period of assessment and accounted for 93.5% while 6.5% requests were from private facilities. The Department of Surgery contributed highest to SARSCoV-2 serology requests followed by the Emergency and the Pediatrics Departments accounting for 28%, 26% and 14% respectively. Surprisingly, the General Out-Patient Department (GOPD) had the least number of requests (table 2).

The results of SARS-CoV-2 screening showed 432 positive cases reflecting a sero-prevalence of 26.3%. Requests from the emergency room had the highest sero-positive rates 135 (31.3%) when compared to other sources. Total IgM sero-positivity was higher (318) than the total IgG (290) sero-positivity. Both IgM and IgG antibodies were positive in 174, while isolated IgM or IgG were positive for 143 and 115 requests respectively (table 3). However, children had a higher sero-positive IgG (18.0%) than IgM (15.1%) while IgM sero-positivity remained higher in adults than in children (19.4% vs 17.3%) irrespective of sex (table 4).

Females had a higher sero-positive rate 51.9% (230) than males in both children and adults except for IgM which was higher in adult males (table 4).

Table 1: Demography, Sources of Requests and Status of SARSCoV-2 Serology

SARS-CoV 2 Request	**Adults** (%)	**Children (%)**	**Total (%)**
	n = 1369 (82.8)	n= 284 (17.2)	n = 1653 (100)
Mean Age (years)	34.2 ±0.7	8.6 ±0.35	
Sex	**Frequency (%)**	**Frequency (%)**	
Male	653 (47.7)	145 (51.1)	
Female	716 (52.3)	139 (48.9)	
Total	1369 (100)	284 (100)	

SOURCES OF SARS-CoV 2 REQUESTS

Department	**Frequency (%)**	**SARSCoV 2 Positive (%)**	**Total IgG Positive (%)**	**Total IgM Positive (%)**
Emergency	442 (26.7)	135 (8.17)	89 (5.38)	98 (5.93)
Surgery	481 (29.0)	128 (7.74)	94 (5.69)	93 (5.63)
Pediatrics	234 (14.2)	45 (2.72)	33 (2.0)	31 (1.88)
*Other	221 (13.4)	62 (3.75)	40 (2.42)	43 (2.60)
GOPD	49 (3.0)	06 (0.36)	04 (0.24)	05 (0.30)
Private Hospital	107 (6.5)	23 (1.39)	12 (0.73)	18 (1.09)
Medicine	119 (7.2)	33 (1.99)	18 (1.09)	30 (1.81)
Total	1653 (100)	432 (26.1)	290 (17.55)	318 (19.24)

*Opthalmology, Obstetrics and Gynaecology, Ear/Nose and Throat

Table 2: Assessment of SARS-CoV 2 IgM and IgG Positive Results

Source	**Isolated IgM F (%)**	**Isolated IgG F (%)**	**Combined IgM/G F (%)**	**Total IgM/G F (%)**
Paed	12 (8.4)	14 (12.2)	19 (10.9)	45 (10.4)
A/E	46 (32.2)	36 (31.3)	53 (30.5)	135 (31.3)
GOPD	02 (1.4)	01 (0.9)	03 (1.7)	06 (1.4)
Med	15 (10.5)	4 (3.5)	14 (8.0)	33 (7.6)
Surgery	35 (24.5)	36 (31.3)	57 (32.8)	128 (29.6)
Others	22 (15.4)	19 (16.5)	21 (12.1)	62 (14.4)
Private	11 (7.6)	05 (4.3)	07 (4.0)	23 (5.3)
Total	143(100)	115(100)	174(100)	432(100)

Table 3: Analysis of SARS-CoV 19 results in pediatric age group

		Males n = 145	Females n = 139	Total n = 284
		F (%)	F (%)	F (%)
STATUS	Negative	121 (83.4)	105 (75.5)	226 (79.6)
	Positive	24 (16.6)	34 (24.5)	58 (20.4)
Total IgG	Negative	126 (86.9)	114 (82.0)	240 (84.5)
	Positive	19 (13.1)	25 (18.0)	44 (15.5)
Total Ig M	Negative	128 (88.3)	118 (84.9)	246 (86.6)
	Positive	17 (11.7)	21 (15.1)	38 (13.4)
IgM/G	Negative	121 (83.4)	105 (75.5)	226 (79.6)
Isolated IgM	**Positive**	5 (3.4)	9 (6.5)	14 (4.9)
Isolated IgG	**Positive**	7 (4.9)	13 (9.4)	20 (7.0)
Combined IgM/G	**Positive**	12 (8.3)	12 (8.6)	24 (8.5)

Table 4: Analysis of SARS-CoV 19 results in adult age group

		Males n = 653	Females n = 716	Total n = 1369
		F (%)	**F (%)**	**F (%)**
STATUS	Negative	475 (72.7)	520 (72.6)	995 (72.7)
	Positive	178 (27.3)	196 (27.4)	374 (27.3)
Total IgG	Negative	531 (81.3)	592 (82.7)	1123 (82.0)
	Positive	122 (18.7)	124 (17.3)	246 (18.0)
Total IgM	Negative	512 (78.4)	577 (80.6)	1089 (79.5)
	Positive	141 (21.6)	139 (19.4)	280 (20.5)
IgM/G	Negative	475 (72.7)	520 (72.6)	995 (72.7)
Isolated IgM	**Positive**	57 (8.7)	72 (10.1)	129 (9.4)
Isolated IgG	**Positive**	39 (6.0)	56 (7.8)	95 (6.9)
Combined IgM/G	**Positive**	82 (12.6)	68 (9.5)	150 (11.0)

4. Discussion

The mean age of the adult population in this study reflects the active age group reported with the highest sero-prevalence of SARSCov-2 [19].

The highest number of requests were from the surgery and A/E units, both accounted for more than half of the total requests received for the period of study. This suggests that these two units have very high patient load. They both yielded more than half of the positive results, which may be consequent on the patient load and the fact that A/E remains the first point of care even for referrals. Also, that referrals from other centers may be to A/E. This therefore, suggests that there may be a potential burden of SARSCoV-2 among patients presenting at these units and that a high index of suspicion would be required. Consequently, all patients attending the surgery unit should be screened as 1 in every 4 patients appeared to be exposed to SARSCoV-2. A similar pattern was found among the pediatric population in which 1 out of every 5 children screened was positive.

Requests were largely from patients seeking clinical care and these requests were sent as a pre-requisite to medical consultation and not due to

screening. The requests from outside facilities also showed the same reason which may reflect the fact that medical personnel were only taking necessary precautions as part of personal responsibility for their protection. Therefore, sending patients first for COVID 19 screening may be regarded as a precautionary measure to safeguard healthcare givers and protect other patients as well as the general facility [18]. The study revealed an overall SARSCoV-2 sero-prevalence of 26.4% with a higher (27.3%) sero-prevalence in adults than children (20.4%). The overall sero-prevalence and age pattern of sero-prevalence in this study is similar to reports by Majiya et al who reported a prevalence of 27.18% and 23.17% for males and females respectively with a higher prevalence in adults [19].

The sero-prevalence of either IgG or IgM sero-positivity appears the same irrespective of age or gender. However, the pattern of either a higher IgM or IgG sero-positivity appeared to be age dependent as children tend to have a higher IgG while there's a higher IgM in adults. It has been reported that IgM reactivity follows acute development of the immune response to the foreign agent compared to IgG which responds later and tends to follow a chronic pattern for a long term immunity [20]. This pattern is similar to higher IgM sero-positivity found in Italy among healthcare workers [21]. Sero-prevalence of Ig M and IgG in this study further buttress the fact that asymptomatic patients or those with subclinical infection among the patient population may serve as potential carriers of COVID-19 [21]. Thus, the pattern observed is that IgG or IgM alone may become readily positive and either of the two may be enough to suggest exposure to SARSCoV-2.

The slightly higher positive sero-prevalence found in females may be due to the relative higher proportion of female adult population. However, this appeared to be reversed among the pediatric group where there was a male preponderance. Nonetheless, females also had a higher positive sero-prevalence favoring the female gender was also noted in this group. This is contrary to a report from Niger State, Northcentral Nigeria where males had a higher sero-prevalence than females, although their sample size was small compared with that of this study [19]. Similarly, a higher prevalence of COVID-19 was found in males in Benin City, South-south Nigeria [3]. This may be due to confirmatory PCR test done in those studies, which is a limitation in this study.

The higher sero-positivity of SARS-CoV 2 among females appeared to be age independent as both female adults and children in this study had a higher proportion of sero-positivity when compared with their male counterparts. In a study by Zeng et al among 331 confirmed patients with SARS-CoV 2 severe infection, Ig G level was found to be higher among females than males which may suggest that female patients generated a relatively higher levels of SARS-Cov 2 IgG antibody and that IgG in females appeared to be stronger than that of males in the early phase of the infection [22]. Contrarily, higher sero-prevalence was reported for males in Niger State and Benin City which may be due to a male predominance in those studies [3, 19,23]. In other studies on the relationship between gender and SARS-Cov 2 serology, no association was found [24-25]. This may suggest that the female gender may be a risk factor for susceptibility to SARS-CoV-2 and that the older the female, the higher the risk. According to a study in North-central, Nigeria, female gender appears to be protective of COVID-19 due to lower mobility and activity [19] which characterize the environment of that study as against the more active and highly mobile nature of women in southern Nigeria. The probability that females have low immunity due to relatively low WBC count, may further explain the link between gender and COVID-19 infection. Therefore, gender may play a role in the immune response to COVID 19 infection either modulatory or modifying the susceptibility to the infection. This observation may suggest that for every male exposure there's twice the risk of infection in females. Based on the inconsistent findings on the role of gender in the development of SARSCoV-2 antibodies and the possibility of environmental influence, it may be difficult to justify this observation. Hence, further exploration studies are required to validate if truly, any relationship exists between COVID 19 infection and gender.

Limitation: the rapid diagnostic kit serology results could not be compared with results from PCR done in a separate facility with access restriction.

5. Conclusion

In conclusion, the overall prevalence of SARSCoV-2 based on rapid serology test in a tertiary health facility is 26.4%. The highest exposure was found among patients presenting at the surgery and A/E departments thus, necessitating more precautionary measures by the hospital staff as every 1 in 4 patients are most likely infected with the SARSCoV-2. It is therefore recommended that the hospital management makes available resources that are crucial to implementing these measures. Also, guidelines and regulations should be formulated and enforced at all high-risk stations/units/departments.

Conflicts of interests

The authors declare no conflict of interest

Authors' Contribution

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Adedeji T.A: conception, study design and manuscript writing

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