Original Research

Journal of Primary Care & Community Health
Volume 12: 1–5

DOI: 10.1177/21501327211050569
journals.sagepub.com/home/jpc
SAGE

Antibody Response to SARS-CoV-2: A Cohort Study in Qatar's Primary Care Settings

Mohamed Ahmed Syed[1], Hamda Abdulla A/Qotba[1], Ahmed Sameer Al Nuaimi[1], Gheyath K. Nasrallah[2], Asmaa Ali J. F. Althani[2], Abduljaleel Abdullatif Zainel[1], Hanan Khudadad[1], Tamara Marji[1], Shajitha Thekke Veettil[1], AlAnoud Saleh AlFehaidi[1], Ameena Ibrahim Yfakhroo[1], Meshal Abdulla AlMesaifri[1], Tholfakhar Talib Al-Baghdadi[1], Hanan Al Mujalli[1], Samya Ahmad Al Abdulla[1], and Mariam Ali Abdulmalik[1]

Abstract

Background: Globally, countries are rolling out Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) quarantine policies and vaccination programs. Research studies are needed in helping understand the likelihood of acquired immunity to reinfection and identify priority groups for vaccination to inform them. This study aimed to assess period prevalence and longitudinal changes in antibody levels after SARS-CoV-2 infection in Qatari primary care settings. **Methods:** A cohort study design with 2 data collection phases was undertaken—Phase 1 (conducted in July 2020) and Phase 2 (conducted in October 2020). A stratified random sampling technique by age, gender and nationality was utilized to identify the study sample. The total sample size required for the study was estimated to be 2102. Participants were invited to an appointment where they were administered a questionnaire and provided samples for polymerase chain reaction and Immunoglobulin G immunoassay tests. **Results:** A total of 943 individuals participated in both Phase 1 and Phase 2. In this cohort, seroprevalence of SARS-CoV-2 was found to be 12% (N = 113) in Phase 1 and 17.2% (N = 162) in Phase 2. Of the 113 participants who were seropositive in Phase 1, 38.1% (CI 29.5-47.2%, N = 43) had a reduction, 54.9% (CI 45.7-63.8%, N = 62) had no change, and 7.1% (CI 3.4-12.9%, N = 8) had an increase in IgG titer in Phase 2. All (N = 18) participants aged 10 to 17 years retained their antibodies. The proportion of men who retained their antibodies was slightly higher compared to women—92.5% (N = 74) and 87.9% (N = 29) respectively. Similarly, symptomatic individuals (97.8%; N = 45) had a higher antibody retention compared with asymptomatic individuals (86.4%; N = 57). **Conclusions:** This study provides preliminary information on the longitudinal changes in antibody levels after SARS-CoV-2 infection. These findings will help inform quarantine policies and vaccination programs.

Keywords

primary health care, SARS-CoV-2, epidemiology

Dates received 2 September 2021; revised 13 September 2021; accepted 15 September 2021.

Introduction

As of August 2021, 202 146 929 cases and 4 285 421 deaths related to Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) have been reported globally.[1] The virus continues to spread in the community in all regions except South-East Asia.[1]

Real time polymerase chain reaction (RT-PCR) testing is considered the gold standard to detect SARS-CoV-2 in clinical practice.[2] However, limited RT-PCR testing capacity together with mild or asymptomatic infections contributed to under-ascertainment of infections in many countries.[3-5]

[1]Department of Clinical Research, Primary Health Care Corporation, Doha, Qatar
[2]Biomedical Research Centre, Qatar University, Doha, Qatar

Corresponding Author:
Mohamed Ahmed Syed, Department of Clinical Research, Primary Health Care Corporation, Al Meena Street, P.O. Box 26555, Doha, Qatar.
Email: ahmed.sy3d@gmail.com

Seroprevalence surveys are therefore a better approach to accurately estimate infection and transmission.[6] Furthermore, antibody response against SARS-CoV-2 remain poorly understood.[7]

Early evidence from serial cross-sectional studies suggests antibody titers wane over time following SARS-CoV-2 infection.[8] This study aimed to assess period prevalence and longitudinal changes in antibody levels after SARS-CoV-2 infection in Qatari primary care settings. A number of coronavirus disease 2019 (COVID-2019) vaccines are in clinical trials[9] and several others are already available. Globally, as countries roll out SARS-CoV-2 quarantine policies and vaccination programs, the findings of this study will contribute to understand the likelihood of acquired immunity to reinfection and identify priority groups for vaccination.

Methods

Study Setting, Design, and Population

The study was conducted in Primary Health Care Corporation (PHCC). PHCC is public health sector organization that delivers primary care to approximately 70% of the Qatar's population through 27 health centers. A longitudinal study design with 2 data collection phases was employed—Phase 1 (conducted in July 2020) and Phase 2 (conducted in October 2020). Individuals registered with a mobile number on PHCC electronic medical records and aged $\geq$10 years were eligible for inclusion. Individuals with difficulties related to mobility and communication, bleeding disorders, and mental disabilities were excluded.

A stratified random sampling technique was utilized to identify the study sample. Sixteen strata were defined using age, gender, nationality, and their sub-categories (see Supplemental Tables S1-S4). The total sample size required for the study was estimated to be 2102. Individuals were invited to participate using Short Message Service (SMS) messages on their mobile phones. Participants who attended their appoint in Phase 1 were re-invited to participate in Phase 2. This paper reports findings from Phase 2.

Study Locations and Data Collection

Participants were invited to an appointment at 1 of 3 selected PHCC health centers (Qatar University, Al Wakrah and Al Wajbah) identified for the study which operated in 2 shifts (8 am-2 pm and 4 pm-8 pm). An electronic interview-based questionnaire was administered with questions on socio-demographic factors, previous RT-PCR status, COVID-19 related symptoms and contact with suspected or confirmed cases. Nasal and oropharyngeal swab and blood samples were also collected at the appointment.

Data Analysis

All data was collated at the end of phase 2. It was subject to quality assurance. For the purposes of this study, "point prevalence" was defined as the number of active SARS-CoV-2 infections (identified by RT-PCR) over the total sample size while "period prevalence" was defined as the total number of SARS-CoV-2 infections (either identified by RT-PCR or serology [IgG]) over the total sample size. Initial analysis was undertaken to establish the point and period prevalence.

Statistical analyses were done using IBM SPSS version 23 computer software (IBM Statistical Package for Social Sciences) in association with Microsoft Excel. Chi-square test of independence was used to assess the statistical significance of associations between categorical variables. Wilcoxon signed ranks test was used to assess the statistical significance of median change in an ordinal level variable (antibody titer) in paired observations. The 95% confidence interval of a proportion was used to calculate the expected range in the reference population.

Laboratory Procedures

Nasal and throat swabs were labelled and transported from the study location to the referral laboratory for the state of Qatar at the end of each shift and analyzed by RT-PCR. Similarly, blood samples were labelled and transported every 24 h to Qatar University's Biomedical Research Centre laboratory. Plasma was separated by centrifugation and 150 µL of plasma was used for detection of anti-SARS-CoV-2 Immunoglobulin G (IgG) using the CL-900i Chemiluminescence Immunoassay System (Mindray Bio-Medical Electronics Co, Shenzhen, China) according to the manufactures instructions.

Patient and Public Involvement

Patients or the public were not involved in the design, or conduct, or reporting, or dissemination plans of our research.

Ethical Considerations

The study was reviewed and approved by PHCC's Independent Review Board (PHCCDCR202005047). Informed assent was obtained from parent and/or legal guardian of participants aged 10 to 18 years and informed consent was obtained from participants aged 18 or over.

Results

Results from Phase 1 of the study are included in the supplementary file (see Supplemental Tables S5-S7) and published elsewhere.[10]

Table 1. Overview of Sample Recruited.

	Phase 1 total N = 2044		Phase 2 total N = 943		
	N	%	N	%	*P*
Age group (years)					
10-17	352	17.2	142	15.1	.018 [NS]
18-39	910	44.5	383	40.6	
40-59	656	32.1	353	37.4	
60+	126	6.2	65	6.9	
Gender					
Female	943	46.1	425	45.1	.59 [NS]
Male	1101	53.9	518	54.9	

Table 2. Antibody Titers.

Serum IgG titer (N = 113)	Phase 1		Phase 2	
	N	%	N	%
Negative	0	0	10	8.8
Undiluted	72	63.7	64	56.6
1:8 dilution	4	3.5	12	10.6
1:16 dilution	14	12.4	18	15.9
1:32 dilution	16	14.2	9	8
1:64	7	6.2	0	0

Wilcoxon signed ranks test = 0.002; a statistically significant reduction in average titer of IgG antibodies observed in phase 2.

Sample Recruitment

About 2044 (97.2% of planned sample) participated in Phase 1 and 943 (46.1% of the sample from Phase 1) participated in Phase 2. No significant differences were seen by age and gender between the 2 phases (see Table 1).

Prevalence

In the cohort of 943 individuals (Phase 2 cohort), point prevalence of SARS-CoV-2 by RT-PCR test was found to be 5.6% (N = 53) in Phase 1 and 9.1% (N = 86) in Phase 2. Similarly, prevalence of SARS-CoV2 by serology was found to be 12% (N = 113) in Phase 1 and 17.2% (N = 162) in Phase 2. The proportion of detecting SARS-CoV-2 infection by serology compared to RT-PCR was approximately 2:1. The period prevalence was 13.6% in Phase 1 and 19.1% in Phase 2.

Between the 2 phases, 5.9% (N = 49) participants became seropositive. The highest incidence was seen in individuals aged 18 to 39 years (10% CI 7.2-13.7 %, N = 33) and the lowest incidence was seen in individuals aged 10 to 17 years (2.4% CI 0.7-6.4 %, N = 3). 7.5% (CI 5.3-10.3 %, N = 32) new cases were men while 5.2% (CI 3.3-7.7 %, N = 2) were women.

Antibody Retention and Titers

Of the 113 participants who were seropositive in phase 1, 38.1% (CI 29.5-47.2 %, N = 43) had a reduction, 54.9% (CI 45.7-63.8 %, N = 62) had no change and 7.1% (CI 3.4-12.9 %, N = 8) had an increase in IgG titer at Phase 2. Of the participants with a reduction in titer, 8.8% (N = 10) converted to seronegative at Phase 2. 63.7% (N = 72) and 56.6% (N = 64) participants were positive with no dilution while 6.2% (N = 7) and no participants were positive at 1:64 dilution in Phase 1 and 2 respectively (see Table 2).

Antibody Retention by Age, Gender, and COVID-19 Symptoms

Of the 113 individuals who were seropositive in Phase 1, 100% (N = 18) of those aged 10 to 17 years retained their antibodies. In other age groups it ranged between 81.3% and 92.3% (see Table 3). About 92.5% (CI 85.2-96.8 %, N = 74) men and 87.9% (CI 73.7-95.8, N = 29) women retained their antibodies. Similarly, 86.4% (CI 76.6-93 %, N = 57) of asymptomatic and 97.8% (CI 88.4-99.9 %, N = 45) of symptomatic individuals retained their antibodies.

Discussion

Summary

Antibody response to SARS-CoV-2 infection is not sufficiently understood. This study provides a preliminary overview using a population-based sample followed up over an 8-month period. In the cohort of 943 participants, period prevalence of SARS-CoV-2 was 13.6% and 19.1% participants in Phase 1 and 2 respectively. These prevalence figures are higher in comparison to the 10% reported in majority of United States jurisdictions.[11]

Strengths and Limitations

The use of a randomly selected representative sample is a strength of the study. This approach allows translation of findings to the overall PHCC registered population. While efforts were made to limit the losses to follow up, only 46.1% of the sample from Phase 1 participated in Phase 2. This is a limitation of the study. Nevertheless, no significant differences in age and gender were seen between Phase 1 and Phase 2 participants. The use of SMS may not have been an optimal approach to invite participants. It could have resulted in a bias toward participants who were more technology savvy to be recruited and also resulted in losses to follow up. However, using this approach required minimal resources which were scare during the pandemic.

Table 3. Antibody Retention by Age, Gender, and COVID-19 Symptoms.

		IgG retained at phase 2		
	Total N	N	% (95% CI)	*P*
Age group (years)				
10-17	18	18	100 (**)	.09 [NS]
18-39	50	47	94 (84.8-98.3)	
40-59	32	26	81.3 (65.4-91.8)	
60+	13	12	92.3 (69.3-99.2)	
Total	113	103	91.2 (84.9-95.4)	
Gender				
Women	33	29	87.9 (73.7-95.8)	.47[NS]
Men	80	74	92.5 (85.2-96.8)	
COVID-19 symptoms				
Asymptomatic	66	57	86.4 (76.6-93)	.045
Symptomatic	47	45	95.7 (86.4-99.3)	

**denotes it cannot be calculated; NS = Not significant.

Comparison With Existing Literature

The duration and strength of immunity following an infection are important factors in relation to reinfection and potential durability of vaccine protection. In the 113 participants who were seropositive in Phase 1, a reduction in IgG titer was observed in 38.1% and only 8.8% converted to seronegative in Phase 2. 56.6% participants in Phase 2 were found to be positive with no dilution indicating a low concentration of antibodies. Previous studies that have shown antibodies against SARS-CoV and Middle East respiratory syndrome coronavirus (MERS-CoV) last for at least 1 year.[12,13] The findings from this study indicate that while antibodies decay overtime they may last a similar duration as SARS-CoV.

Younger population groups had the highest retention of antibodies (100% in 10-17-year-old and 94% in 18-39 years). These findings show higher retention rates than those in the REACT-2 study.[8] It reported antibody retention of 85.1% in 18 to 24-year old, 65.9% in 25 to 34 year, 77.9% in 45 to 54 year old, and 71.2% in 65 to 74 year old over a 3-month follow up period. This study found men retained antibodies better than women (92.5% and 87.9% respectively). However, in the REACT-2 study, antibody retention was reported to be higher (76.1%) in women compared to men (70.8%).

Implications for Research and Practice

The findings of the study demonstrates the usefulness of serology testing in comparison to RT-PCR testing in establishing prevalence of SARS-CoV-2. They have important implications when considering protection against reinfection with SARS-CoV-2 and the duration of vaccine protection suggesting boosters are required to provide long-lasting protection. Additional longitudinal studies are needed to determine the retention of antibodies with a longer follow up to inform quarantine policies and vaccination programs.

Acknowledgment

The authors would like to thank all patients who participated in the study for their willingness and trust, without them, this study could not have been realized.

Author Contributions

MAS, ASAN, and HAQ designed the study. AAJFA and GKN undertook laboratory-based serology for the samples collected. ASAN undertook data analysis. MAS prepared the first draft of the manuscript. All authors read, contributed, and approved the final version.

Declaration of Conflicting Interests

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

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This study was funded by PHCC (PHCCDCR202005047).The funders had no role in the design, analysis, interpretation, or writing.

Ethics Approval and Consent to Participate

The study was reviewed and approved by PHCC's Independent Review Board (PHCCDCR202005047). Informed assent was obtained from participants aged 10 to 18 years and informed consent was obtained from participants aged 18 or over. Only MAS, ASAN, and HAQ had access to the full study data. Overall, the study was conducted with integrity according to generally accepted ethical principles.

ORCID iD

Mohamed Ahmed Syed https://orcid.org/0000-0002-2396-3534

Supplemental Material

Supplemental material for this article is available online.

Availability of Data and Materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

References

1. World Health Organisation. COVID-19 weekly epidemiological update. 10 August 2021. Accessed August 17, 2021. https://www.who.int/publications/m/item/weekly-epidemiological-update-on-covid-19. . .10-august-2021
2. Surkova E, Nikolayevskyy V, Drobniewski F. False-positive COVID-19 results: hidden problems and costs. *Lancet Respir Med*. 2020;8(12):1167-1168.
3. Sakurai A, Sasaki T, Kato S, et al. Natural history of asymptomatic SARS-CoV-2 infection. *New Engl J Med*. 2020; 383(9):885-886.
4. Payne DC, Smith-Jeffcoat SE, Nowak G, et al. SARS-CoV-2 infections and serologic responses from a sample of U.S. Navy service members — USS Theodore Roosevelt, april 2020. *MMWR Morb Mortal Wkly Rep*. 2020;69(23):714-721.
5. Yousaf AR, Duca LM, Chu V, et al. A prospective cohort study in non-hospitalized household contacts with SARS-CoV-2 infection: symptom profiles and symptom change over time. *Clin Infect Dis*. Published online July 28, 2020. doi:10.1093/cid/ciaa1072
6. Havers FP, Reed C, Lim T, et al. Seroprevalence of antibodies to SARS-CoV-2 in 10 sites in the United States, march 23-may 12, 2020. *JAMA Intern Med*. 2020;180:1576.
7. Tang YW, Schmitz JE, Persing DH, Stratton CW. Laboratory diagnosis of COVID-19: current issues and challenges. *J Clin Microbiol*. 2020;58:e00512-e00520.
8. Ward H, Cooke G, Atchinson C, et al. Declining prevalence of antibody positivity to SARS-CoV-2: a community study of 365,000 adults. *medRxiv*. Published online October 27, 2020. doi:10.1101/2020.10.26.20219725.
9. Krammer F. SARS-CoV-2 vaccines in development. *Nature*. 2020;586:516-527.
10. Syed MA, Al Nuaimi AS, A/Qotba HA, et al. Epidemiology of SARS-CoV2 in Qatar's primary care population aged 10 years and above. *BMC Infect Dis*. 2021;21:645.
11. Bajema KL, Wiegand RE, Cuffe K, et al. Estimated SARS-CoV-2 seroprevalence in the US as of september 2020. *JAMA Intern Med*. 2021;181(4):450-460.
12. Cao WC, Liu W, Zhang PH, Zhang F, Richardus JH. Disappearance of antibodies to SARS-associated coronavirus after recovery. *N Engl J Med*. 2007;357:1162-1163.
13. Choe PG, Perera RAPM, Park WB, et al. MERS-CoV antibody responses 1 year after symptom onset, South Korea, 2015. *Emerg Infect Dis*. 2017;23:1079-1084.