Background

In December 2019 a series of pneumonia cases due to novel coronavirus were identified. The disease was named COVID-19 and its agent named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) on February 11, 2020 by the World Health Organization (WHO) naming assignment committee.

Anti-SARS-CoV-2 IgG status among frontline health workers involved in COVID-19 survey at Jodhpur, Rajasthan, India

Vidhi Jain¹, Salman Khan¹, Neetha T. Ramankutty¹, Kirti Vishwakarma¹, Akhil D. Goel¹, Suman Saurabh¹, Pankaj Bhardwaj¹, Manoj K. Gupta¹, Sanjeeta Dara², Ashok Kumar², Praveen Sharma¹, Vijaya Lakshmi Nag¹, Sanjeev Misra¹

¹All India Institute of Medical Sciences, Jodhpur, Phase II, Basni, Jodhpur, Rajasthan, ²College of Nursing, All India Institute of Medical Sciences, Jodhpur, Phase II, Basni, Jodhpur, Rajasthan, India

Abstract

Background: Asymptomatic carriers are responsible for the consistent spread of coronavirus disease 2019 (COVID-19) in the community. The Government of India has deputed house-to-house survey teams to aid in identifying asymptomatic individuals and their susceptible contacts. We selected door-to-door survey teams of a COVID-19 red zone in western India and determined their infection control practices and anti-severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) immunoglobin G (IgG) status.

Materials and Methods: This single-day prospective cross-sectional study was conducted by the Department of Microbiology of a tertiary care hospital of Jodhpur, in collaboration with the Rajasthan State Health Services. Participants were asked to fill out a questionnaire regarding personal protective equipment (PPE) use after written informed consent. Venous blood samples were collected and Kavach enzyme-linked immunosorbent assay (ELISA) (J Mitra and Co.) was performed to determine anti-SARS-CoV-2 IgG status.

Results: Out of the total 39 participants, IgG antibody was detected in four. Of them, three reported mild symptoms in the past. Out of two previously real-time polymerase chain reaction (RT-PCR) SARS-CoV-2-positive participants, only one had detectable IgG antibodies (Ab) in serum. Cloth mask was used by 24, N95 mask by 11, and surgical masks by four.

Conclusion: Anti-SARS-CoV-2 IgG Abs were detected among four members of house-to-house COVID-19 survey teams in Jodhpur. Most of the team members used cloth masks, whereas the Government of India guidelines has recommended triple-layered surgical masks as minimum essential PPE for healthcare workers in India. More such studies should be conducted to ascertain infection prevention and control practices among such vulnerable frontline workers in our country.

Keywords: Community workers, COVID-19, ELISA, field workers, frontline workers, house-to-house survey, India, Kavach ELISA, SARS-CoV-2, serosurvey

Background

In December 2019 a series of pneumonia cases due to novel coronavirus were identified. The disease was named COVID-19 and its agent named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) on February 11, 2020 by the World Health Organization (WHO) naming assignment committee.
It soon spread to the entire world including India. The first laboratory-confirmed case of SARS-CoV-2 in the country was reported on January 30, 2020 in Kerala. The patient was a student who had returned from Wuhan. As of September 23, 2020, India had reported 5,646,010 positive COVID-19 cases, making it the country with the second-highest caseload, only after the United States.

The number of symptomatic patients of COVID-19 is just the tip of the iceberg. As per the national estimates, for every confirmed COVID-19 case on August, 26 to 32 infections went undetected. Such unrecognized carriers of SARS-CoV-2 serve as potential spreaders in the community. To tackle this, a protocol for the door-to-door surveys was initiated by the central government and implemented through the state health system. Apparently, asymptomatic family members and close contacts of COVID-19 were screened by means of thermal scanning and a standard questionnaire. Another objective was to identify the at-risk or vulnerable population like older age group (>60 years) individuals, people with comorbidities, and pregnant ladies among the exposed. Such on-site surveys greatly extended contact tracing of patients with COVID-19.

The state government initiated house-to-house surveys in all parts of the city. As all schools were officially closed during the lockdown period, government school teachers and booth level officers (BLOs) were teamed up with healthcare workers to perform the fieldwork of the door-to-door survey. A booth level officer or BLO is a local government/semi-government official, who usually plays a pivotal role for the Election Commission of India by working at the grassroots level. Being familiar with the local electors and generally a voter in the same polling area, he/she assists in updating the list and information of the voters. Teachers, Anganwadi workers, Patwaris, Panchayat Secretaries, Village Level Workers, Electricity Bill Readers, Postmen, Auxiliary Nurses, Health workers, Mid-day meal workers, Corporation Tax Collectors, and Clerical Staff, etc., can be appointed as BLOs. (BLO handbook of Rajasthan accessible at https://ceorajasthan.nic.in/Publications.aspx). The BLO team has been smartly repurposed for COVID-19 house-to-house surveys for tackling the pandemic.

Local teachers belonging to a particular area were chosen, as they would know their locality population best. This would help in overcoming timidity and language barrier, which often affect such surveys if carried out by healthcare workers alone. Although the survey team was not expected to come in direct contact with any symptomatic patient with COVID-19, they were provided with PPE like gloves, triple-layered surgical masks, and alcohol-based hand sanitizers. There was no mandatory quarantine for these workers.

The Indian Council of Medical Research (ICMR) recommends sero-surveillance for frontline workers of India, who form a vulnerable population group for COVID-19 exposure, using the indigenously developed Kavach enzyme-linked immunosorbent assay (ELISA). Our study was based in Jodhpur, located in the western state of Rajasthan. The city had been categorized as a red zone early during the course of the COVID-19 pandemic in India. Within Jodhpur, a locality called Pratap Nagar had been one of the first to report closely clustered cases in April 2020. The frontline workers of this locality were at high risk of unknowingly coming in contact with asymptomatic SARS-CoV-2-infected patients during their field duties, they were considered a vulnerable group. We aimed to assess the status of anti-SARS-CoV-2 IgG antibodies (Ab) among them. A detailed questionnaire was used to assess their infection control practices during duty hours.

**Material and Methods**

This single-day prospective cross-sectional study was carried out by the Department of Microbiology of a tertiary care hospital of Jodhpur, in collaboration with the State Health Services of Rajasthan. The Primary Health Centre at Pratap Nagar was selected as the site of sample collection as it is the reporting site of all household survey teams. The study participants included all school teachers and nurses who were involved in the door-to-door survey on that day and were willing to know their anti-SARS-CoV-2 antibody status.

The participants were asked to fill a questionnaire after providing written informed consent. About 3–5 mL of venous blood sample was collected in gel clot-activated plain vials and dispatched to the laboratory in an upright position, on the same day, maintaining the proper cold chain. After centrifugation, separated serum specimens were stored at 2–8°C.

The ICMR-NIV COVID Kavach ELISA kit (J Mitra & Co. Pvt. Ltd, New Delhi, India), a whole viral lysate ELISA based on anti-SARS-CoV-2 IgG capture, was performed according to the manufacturer’s instructions. Briefly, the SARS-CoV-2-antigen-coated wells of microwell strips were washed with wash buffer three times. The separated serum from centrifuged blood sample was inactivated at 56°C for 30 min and added to the test wells along with positive and negative controls. This was followed by incubation at 37°C for 1 h to allow the IgG antibodies from the serum to bind to the antigen. Wells were washed again and anti-human IgG horseradish peroxidase (HRP) was added in each well followed by similar incubation for 1 h. Wells were washed again, followed by the addition of chromogen/substrate into each well. The microtiter plate was placed in a humidity chamber and incubated at room temperature (25°C) for 10 min in dark. Stop solution was added at the end of 10 min. The optical density was measured using a spectrophotometer at 450 nm and results were recorded as positive, negative, or indeterminate. The indeterminate results were repeated by the same ELISA procedure and the results of retesting were considered final.
Results

A total of 39 participants belonging to various house-to-house survey teams of Pratap Nagar area of Jodhpur were enrolled in the study on September 2, 2020. They consisted of one doctor, nine nurses, and 29 booth level officers comprising eight senior supervisors, 18 teachers, two assistants, and one social worker.

The results of Kavach ELISA showed anti-SARS-CoV-2 IgG antibody detection among four participants (10.25%). A single indeterminate result from the first run turned negative in the repeat run. Out of the two previously SARS-CoV-2-positive participants, only one had detectable IgG Ab in serum, whereas the other was seronegative.

The participant responses to the detailed questionnaire are summarized in Table 1. A majority of them (36) were asymptomatic except three members who had mild symptoms like fever, cough, headache, body ache, and sore throat. A positive history of contact with laboratory-confirmed asymptomatic patients with COVID-19 was reported by eight participants. A history of travel outside Jodhpur was elaborated by 14, half of who travelled in their personal vehicle, whereas the rest used public transport like bus or train. While going to work, 24 participants reported the use of cloth masks, 11 used N95 masks, and four preferred using surgical masks. Four had been taking hydroxychloroquine prophylaxis. Among the participants, two had tested positive for SARS-CoV-2 by rRT-PCR, 1 month ago.

Discussion

The Government of India had ordered a nationwide lockdown on March 24, 2020, to limit the movement of people as a preventive measure against the COVID-19 pandemic in India, sparing only essential services.

Jodhpur, also known as the Blue city, is the second-largest city of the Indian state of Rajasthan. Being a popular tourist destination for both national and international travelers, made it exceptionally vulnerable to the SARS-CoV-2 pandemic. The first confirmed case of COVID-19 in Rajasthan state was reported on March 2, 2020 among some Italian tourists, around a month before the official national lockdown.[8] Jodhpur reported its first case on March 21, 2020, in a 37-year-old male,[9] which categorized the city as a COVID-19 red zone.

Various measures have been taken by the government to curtail the spread of the virus in the state, in accordance with the test-trace-isolate strategy of the Ministry of Health and Family Welfare (MOHFW), Govt. of India.[10] There are many studies from different countries regarding seroprevalence among hospital-based healthcare workers. A study done under the Indian Council of Medical Research (ICMR) showed that 4.8% of the total SARS-CoV-2 infected patients were healthcare workers.[11] Other frontline workers too, have been toiling throughout the lockdown, but there is a paucity of studies focused on those involved in fieldwork during the pandemic.

Table 1: Participant responses to the structured questionnaire regarding the risk factors predisposing to COVID-19 exposure (between 1st March 1, 2020 and September 1, 2020)

| Responses                                      | No. of participants | Percentage |
|------------------------------------------------|---------------------|------------|
| Gender                                         |                     |            |
| F                                              | 14                  | 35.90%     |
| M                                              | 25                  | 64.10%     |
| Primary occupation of house-to-house survey team members |                     |            |
| Doctor                                         | 1                   | 2.50%      |
| Nurse                                          | 9                   | 23.07%     |
| Senior supervisor                              | 8                   | 20.51%     |
| Teacher                                        | 18                  | 46.29%     |
| Assistants                                     | 2                   | 5.13%      |
| Social worker                                  | 1                   | 2.50%      |
| Ever suffered from symptoms related to COVID‑19 |                     |            |
| Yes                                            | 3                   | 7.69%      |
| No                                             | 36                  | 92.31%     |
| Contact with a lab-confirmed case of COVID‑19   |                     |            |
| Yes                                            | 8                   | 20.51%     |
| No                                             | 31                  | 79.49%     |
| History of travel outside Jodhpur              |                     |            |
| Through personal vehicle                       | 7                   | 17.95%     |
| Through public transport                       | 7                   | 17.95%     |
| No                                             | 25                  | 64.10%     |
| Type of face mask used during house-to-house survey |                     |            |
| Cloth mask                                     | 24                  | 61.54%     |
| N95 mask                                       | 11                  | 28.21%     |
| Surgical mask                                  | 4                   | 10.25%     |
| Duration of involvement in house-to-house survey work |                 |            |
| <2 weeks                                       | 0                   | 0          |
| 2-3 weeks                                      | 3                   | 7.69%      |
| >3 weeks                                       | 36                  | 92.31%     |
| Hydroxychloroquine prophylaxis use (even single dose) |             |            |
| Yes                                            | 4                   | 10.25%     |
| No                                             | 35                  | 89.75%     |
| Anti-SARS-CoV-2 IgG antibody                    |                     |            |
| Positive                                       | 4                   | 10.25%     |
| Negative                                       | 35                  | 92.31%     |
In the present study, we detected seropositivity of 10.25%. Our results were comparable with the studies by He et al.\textsuperscript{12-16} from China and Chibwana et al.\textsuperscript{13} from Malawi (11.7% and 12.3%, respectively). Higher seropositivity was observed by Mosclosa et al.\textsuperscript{14} in the United States (14%) and Grant et al.\textsuperscript{15} from United Kingdom (31.64%), whereas Dimcheff et al.\textsuperscript{16} from the United States showed a much lower (4.9) seropositivity [Figure 1].

The seropositivity detected in our study may not necessarily reflect SARS-CoV-2 exposure entirely attributable to the house-to-house survey duty, but the possibility cannot be ruled out. Owing to the low number tested, the results must be inferred carefully.

As per the participant responses to the questionnaire, the majority were asymptomatic. All were using some or the other PPE during their survey work, with maximum individuals preferring a cloth mask. This was contrary to the MOHFW guidelines, which recommend a triple-layered surgical mask for the frontline health workers involved in survey activities for COVID-19. The reason for noncompliance with guidelines may have been the nonavailability of PPE, lack of awareness, or personal preference. A study done by Liu et al.\textsuperscript{17} on 420 frontline healthcare workers treating patients with COVID-19 showed that PPE if used properly was very effective in preventing the spread of SARS-CoV-2.\textsuperscript{18}

In a study conducted by the ICMR during May 2020 in India, of the 378 healthcare workers evaluated, 68 had never used any mask, and 57 were not using any form of PPE at all.\textsuperscript{19} In another Indian study by Supheha et al.,\textsuperscript{20} 60 out of 375 did not use masks, whereas the rest complied with wearing triple-layered surgical masks.\textsuperscript{14} In our study, masks were used by all frontline workers, the commonest being cloth mask. Face masks are widely accepted to be the most protective component of PPE for protection against SARS-CoV-2. The government of India has laid down guidelines for the rational use of PPE in different settings.\textsuperscript{19}

Although a complete PPE gear with a cover-all suit, N95 masks, face shield, protective boots, and double gloves is certainly protective, the same may not be practically usable in field settings, especially during the hot summer months of Jodhpur, which is a part of the Thar desert. While N95 masks have been widely established as the most practical and protective component of PPE, a recent study by Bhaskar et al.\textsuperscript{21} has strongly supported the use of face shields among community health workers in India, with a proven reduction in the risk of exposure. We recommend a minimum PPE gear consisting of the N95 mask, face shield, with or without gloves, for house-to-house survey teams for protection against COVID-19 exposure. There should be proper training imparted regarding PPE donning, doffing, and hand hygiene use among all field workers. It is not uncommon to find even trained individuals reducing their compliance with hand hygiene and mask-wearing practices, once the cases in the community decline. In case PPE use is suboptimal, vulnerable occupational groups like primary care physicians, police personnel, and other frontline workers remain at risk of occupational exposure to COVID-19. Therefore, constant encouragement, motivation, and regular audits are needed for the safety and well-being of such occupational groups.

The anti-SARS-CoV-2 IgG seroprevalence in the Indian population has increased enormously from 0.73% in the first national seroprevalence survey (May 11 and June 4) to 7.1% in the second one (August 17 to September 22).\textsuperscript{22} A considerable section of the population still remains susceptible to the virus and is, hence, at risk. Infection prevention measures like hand hygiene, physical distancing, and universal mask use still remain the best preventive practices for tackling the COVID-19 pandemic.

**Conclusion**

Anti-SARS-CoV-2 IgG Abs were detected among the considerable proportion of frontline workers involved in door-to-door COVID-19 survey teams in Jodhpur, Rajasthan. Participant responses showed suboptimal compliance with PPE guidelines for healthcare workers issued by the Government of India. More studies need to be conducted to ascertain both seroprevalence and infection control practices among such frontline workers in all parts of our country. Until a safe and effective vaccine becomes available, frontline workers will remain susceptible to COVID-19, and strong infection prevention precautions such as universal use of medical masks and face shields, etc., are still the mainstay for protection against the virus.

**Ethical approval**

The study was approved by the ethical committee, AIIMS Jodhpur vide IEC approval No. AIIMS/RES/2020/4547, dated 13.05.2020.

**Financial support and sponsorship**

The study was funded through an intramural research grant by AIIMS Jodhpur.

**Conflicts of interest**

There are no conflicts of interest.
References

1. Lu H, Stratton CW, Tang Y-W. Outbreak of pneumonia of unknown etiology in Wuhan, China: The mystery and the miracle. J Med Virol 2020;92:401-2.
2. Naming the coronavirus disease (COVID-19) and the virus that causes it. Available from: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/naming-the-coronavirus-disease-(covid-19)-and-the-virus-that-causes-it.
3. India-situation-report-1 by WHO. Available from: 11.WHO India situation report 1. Available from: https://www.who.int/docs/default-source/wrindia/india-situation-report-1.pdf?sfvrsn=5ca2a672_0.
4. India: WHO Coronavirus Disease (COVID-19) Dashboard. Available from: https://covid19.who.int.
5. ICMR second serosurvey results. Available from: https://www.ndtv.com/india-news/coronavirus-icmr-second-sero-survey-1-in-15-individuals-aged-10-years-and-above-estimated-to-be-exposed-by-august-2020-2302767.
6. Lee S, Meyler P, Mozel M, Tauh T, Merchant R. Asymptomatic carriage and transmission of SARS-CoV-2: What do we know? Can J Anaesth 2020;67:1424-30.
7. Sapkal G, Shete-Aich A, Jain R, Yadav PD, Sarkale P, Lakra R, et al. Development of indigenous IgG ELISA for the detection of anti-SARS-CoV-2 IgG. Indian J Med Res 2020;151:444-9.
8. India will be under complete lockdown for 21 days: Narendra Modi. Available from: https://economictimes.indiatimes.com/news/politics-and-nation/india-will-be-under-complete-lockdown-starting-midnight-narendra-modi/articleshow/74796908.cms.
9. Jodhpur’s first Covid-19 patient recovers, uncle dies in Spain. Available from: https://www.hindustantimes.com/india-news/jodhpur-s-first-covid-19-patient-recoveres-uncle-dies-in-spain/story-aPTugarOV7z0Pni45PL1T.html.
10. Available from: https://www.mohfw.gov.in/pdf/3ContainmentPlanforLargeOutbreaksOfCOVID19Final.pdf.
11. ICMR COVID Study Group, COVID Epidemiology and Data Management Team, COVID Laboratory Team, 1 Virus Research and Diagnostic Laboratory Network (VRDLN) Team. Laboratory surveillance for SARS-CoV-2 in India: Performance of testing and descriptive epidemiology of detected COVID-19, January 22-April 30, 2020. Indian J Med Res 2020;151:424-37.
12. He L, Zeng Y, Zeng C, Zhou Y, Li Y, Xie X, et al. Positive rate of serology and RT-PCR for COVID-19 among healthcare workers during different periods in Wuhan, China. J Infect 2021;82:e27-8.
13. Chibwana MG, Jere KC, Kamng’ona R, Mandolo J, Katunga-Phiri V, Tembo D, et al. High SARS-CoV-2 seroprevalence in Health Care Workers but relatively low numbers of deaths in urban Malawi. medRxiv 2020;2020.07.30.20164970. doi: 10.1101/2020.07.30.20164970.
14. Moscola J, Sembajwe G, Jarrett M, Farber B, Chang T, McGinn T, et al. Seroprevalence of SARS-CoV-2 antibodies in healthcare personnel in the New York city area. JAMA 2020;324:893-5.
15. Grant JJ, Willmore SMS, McCann NS, Donnelly O, Lai RWL, Kinsella MJ, et al. Seroprevalence of SARS-CoV-2 antibodies in healthcare workers at a London NHS Trust. Infect Control Hosp Epidemiol 2021;42:212-4.
16. Dimcheff DE, Schildhouse RJ, Housman MS, Vincent BM, Markovitz E, Chensue SW, et al. Seroprevalence of Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2) infection among VA healthcare system employees suggests higher risk of infection when exposed to SARS-CoV-2 outside of the work environment. Infect Control Hosp Epidemiol 2020;42:392-8.
17. Liu M, Cheng S-Z, Xu K-W, Yang Y, Zhu Q-T, Zhang H, et al. Use of personal protective equipment against coronavirus disease 2019 by healthcare professionals in Wuhan, China: Cross sectional study. BMJ 2020;369:m2195.
18. MOHFW. Guidelines on rational use of Personal Protective Equipment. Available from: https://www.mohfw.gov.in/pdf/GuidelinesOnRationalUseOfPersonalProtectiveEquipment.pdf.
19. Chatterjee P, Anand T, Singh KJ, Rasaily R, Singh R, Das S, et al. Healthcare workers and SARS-CoV-2 infection in India: A case-control investigation in the time of COVID-19. Indian J Med Res 2020;151:459-67.
20. Supehia S, Singh V, Sharma T, Khapre M, Gupta PK. Rational use of face mask in a tertiary care hospital setting during COVID-19 pandemic: An observational study. Indian J Public Health 2020;64(Supplement):S25-S7.
21. Bhaskar ME, Arun S. SARS-CoV-2 infection among community health workers in India before and after use of face shields. JAMA 2020;324:1348-9.