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Original Article

Seroprevalence of COVID-19 and associated factors in a medical institution in Pakistan

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الملخص

أهداف البحث: هذه الدراسة تبحث في ارتباط التدابير الوقائية مع الإيجابية المصلية لمرض كوفيد-١٩.

طرق البحث: أجريت هذه الدراسة المقطعية في كلية الطب في المستشفى العسكري المشترك خريان، باكستان في سبتمبر ٢٠٢٠. وتم تسجيل ما مجموعه ٤٤٢ مشاركا من ثلاث طبقات مختلفة (أعضاء هيئة التدريس والطلاب والإدارة/ الموظفين والفنيين) باستخدام أسلوب مناسب لأخذ العينات. تم استخدام طريقة اختبار للكشف السريع عن الأجسام المضادة. اختبار أيكروما وهو جهاز تشخيصي في المختبر يساعد على تشخيص عدوى فيروس كورونا الجديد بتعاقب سريع من خلال قياس الأجسام المضادة؛ الغلوبولين المناعي G والغلوبولين المناعي M لمرض كوفيد-١٩. وهو كشف نوعي للأجسام المضادة للغلوبولين المناعي G و M في الدم. وكان الجهاز المستخدم للتحليل النوعي نظام المناعة الفلورسنت الآلي مع حساسية سريرية ٩٥.٨٪ وخصوصية سريرية ٩٦.٧٪. واستُخدمت استبانة ذاتية الإدارة لجمع البيانات.

النتائج: شملت الدراسة ما مجموعه ٤٤٢ مشاركا؛ ٤٠(٩٪) أعضاء هيئة التدريس، ٢٩٩ (٦٧٪) الطلاب و١٠٣ (٢٣.٣٪) الموظفون الإداريون/الفنيون. ما يصل إلى ١٤.٩٪ من المشاركين كانت لديهم أعراض، و٣٢.٤٪ تستخدم دائما الكمامة و١٤٪ لم يرتدوا الكمامة. وعلاوة على ذلك، قام ٦٩.٧٪ بغسل أيديهم بشكل متكرر لمدة ٢٠ ثانية و٧٥.٦٪ كانوا على وعي بالتباعد الاجتماعي. أظهر الاختبار ما مجموعه ١٦.٩٦٪ نتيجة إيجابية للأجسام المضادة الغلوبولين المناعي G. وعلاوة على ذلك، فإن معظم الموظفين الإداريين والتقنيين، الذين كانت نتيجة الفحص لديهم إيجابية بالنسبة للغلوبولين المناعي G، كانوا غير

مُعدين (٦٨.٤٢٪). تم العثور على ارتباط كبير بين ارتداء الكمامة، وغسل اليدين، والتباعد الاجتماعي والعدوى بمرض كوفيد-١٩.

الاستنتاجات: أظهرت هذه الدراسة ارتفاع معدل الانتشار المصلي حيث تم إجراؤها قرب نهاية الموجة الأولى من جائحة مرض كوفيد-١٩. ما زلنا بعيدين عن تحقيق حصانة القطيع. وعلاوة على ذلك، فإن الامتثال الصارم للتدابير الوقائية هو الوسيلة الوحيدة للنجاح حتى تطوير لقاح فعال.

الكلمات المفتاحية: مرض كوفيد-١٩؛ جائحة؛ الانتشار المصلي؛ مناعة القطيع؛ التدابير الوقائية

Abstract

Objective: This study investigates the association of preventive measures with coronavirus disease (COVID-19) seropositivity.

Methods: This cross-sectional study was conducted at the Combined Military Hospital Kharian Medical College, Pakistan, in September 2020. A total of 442 participants from three different strata (faculty, students, and administration/technical staff) were enrolled using a convenient sampling technique. A rapid antibody testing method was used to detect antibodies. The Ichroma™ COVID-19 Ab test is an in vitro diagnostic device that helps in the rapid identification of COVID-19 by measuring the levels of IgG and IgM antibodies against severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in the blood. An automated fluorescent immunoassay system (AFIAS-6), with a clinical sensitivity of 95.8% and specificity of 96.7%, was used for qualitative analysis. A self-administered questionnaire was used to collect data, and data analysis was performed using SPSS version 25.

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Results: In total, 442 participants were included in the study: 40 (9%) faculty members, 299 (67%) students, and 103 (23.3%) administrative/technical staff. As many as 14.9% of the participants were symptomatic; 32.4% always used masks, and 14% never wore masks. Furthermore, 69.7% of participants frequently washed their hands for 20 s, and 75.6% were aware of social distancing. A total of 16.96% of participants tested positive for IgG antibodies. Moreover, most of the administration/technical staff who tested positive for IgG were asymptomatic (68.42%). A significant association ($p < 0.001$) was found between following the safety guidelines (wearing masks, handwashing, and social distancing) and the occurrence of COVID-19.

Conclusion: This study showed a higher seroprevalence rate than other studies as it was conducted toward the end of the first wave of the COVID-19 pandemic. However, we are still far from achieving herd immunity. Furthermore, strict compliance with preventive measures is the only way to ensure safety until an effective vaccine is developed.

Keywords: COVID-19; Herd immunity; Pandemic; Preventive measures; Seroprevalence

Introduction

As of November 2020, the novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has infected over 50 million people worldwide. The resulting yet poorly understood disease, coronavirus disease (COVID-19), has claimed 1.25 million lives worldwide.[1] In Pakistan, a total of 343,000 cases and approximately 7,000 deaths have been reported since March 2020.[2] Although effective in curbing the spread of the infection, the almost 6-month-long "smart lockdown" imposed by the government of Pakistan dealt a heavy blow to the country's economic, commerce, and education sectors and did not provide a practical and permanent solution for safe resumption of pre-lockdown activities.[3]

Without a clear therapeutic strategy in place and an effective and widely available vaccine still in the preliminary stages of development, the importance of rapid, ubiquitous, cost-effective, and reliable diagnostic and screening tests is evident.[4] There are two main approaches for testing patients for COVID-19: molecular tests that detect viral RNA and serological tests that assess the host response to the virus.[5] Real-time reverse-transcriptase PCR (RT-PCR), despite being the most extensively used molecular method of diagnosing COVID-19, is not free of limitations, such as inconstant diagnostic precision as the disease progresses, expensive and scarcely available testing kits and equipment, and inability to provide information regarding previous SARS-CoV-2 infection.[6]

As the country begins to tentatively lift restrictions on commercial establishments and educational institutions, determining the actual number of individuals infected in the past few months is vital for disease surveillance, contact tracing, assessing the possibility of herd immunity, and being better equipped to control further spread of the disease.[7] It is presumed that a significant population in Pakistan that has been infected with SARS-CoV-2 has recovered and currently possesses some degree of immunity.

Seroprevalence studies offer insights into how well containment strategies, such as wearing masks, hand washing, and social distancing, are working to control transmission.[10] This study aims to estimate the seroprevalence of COVID-19 and the preventive measures taken.

Materials and Methods

A cross-sectional study was carried out at the CMH Kharian Medical College. The study was conducted after the reopening of the Medical Institute in September 2020.

Samples were collected using a convenient sampling technique. An a priori sample size estimation method was employed to calculate the sample size; 442 participants from three different strata (faculty, students, and administration/technical staff) were enrolled in the study. A rapid antibody testing method was used to detect the level of antibodies. The Ichroma™ COVID-19 Ab test was used as an in vitro diagnostic medical device. It detects IgG and IgM antibody levels in patients with early/mild, asymptomatic, or acute SARS-CoV-2 infection with a clinical sensitivity and specificity of 95.8% and 97.0%, respectively.[8,9] An IgG level ≥ 1.1 was considered a positive result, and an IgG level <0.9 was considered a negative result.[11] The procedure was performed by trained lab personnel from a local company dealing with medical equipment, while considering biosafety measures.

A self-administered questionnaire was used to collect data after obtaining informed consent from the participants. The confidentiality of the participants was ensured. The statistical software SPSS version 25 (Statistical package for social sciences by IBM) was used for data analysis. Frequency and percentage were calculated for qualitative variables. The chi-square test was used, and a p-value ≤ 0.05 was considered significant.

Results

In total, 442 participants were included in the study: 40 (9%) faculty members, 299 (67%) students, and 103 (23.3%) administration/technical staff members (Figure 1).
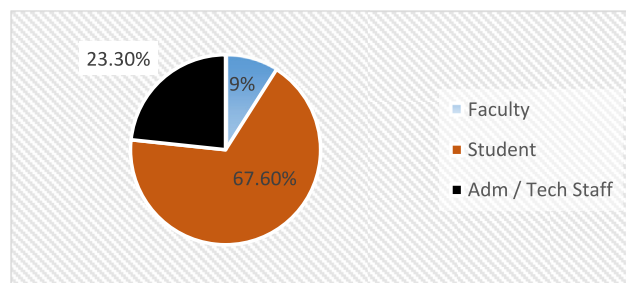

Figure 1: Distribution of participants.

With respect to factors related to COVID-19, 14.9% of the participants were symptomatic, 32.4% always used a mask, and 14% never wore a mask. A total of 69.7% of participants washed their hands frequently for 20 s, and 75.6% had awareness regarding social distancing (Table 1). The seroprevalence trend of COVID-19-related antibodies showed 16.96% positivity for IgG antibodies (Table 2).

Most of the administration/technical staff who tested positive for IgG were asymptomatic (68.42%) (Table 3). Seven faculty members tested positive for IgG, and they

Table 1: Factors related to COVID-19 (N = 442).

Factors	Percentage (N)
Symptomatic	
Yes	14.9% (66)
No	85.1% (376)
Family members had symptoms in the past 6 months	
Yes	16.0% (70)
No	84% (367)
Wearing a mask	
Always	32.4% (143)
Most of the time	29.9% (132)
Sometimes	23.8% (105)
Never	14.0% (62)
Using sanitiser	
Always	28.3% (125)
Most of the time	34.8% (154)
Sometimes	23.1% (102)
Never	13.8% (61)
Hand washing	
Yes	69.7% (308)
No	30.3 (134)
Maintaining social distance	
Yes	75.6% (334)
No	24.4% (108)

Table 2: IgG results in different groups.

IgG status	Faculty	Student	Administration/technical staff	Total
Positive	7 (17.5%)	49 (16.3%)	19 (18.4%)	75 (16.96%)
Negative	33 (82.5%)	250 (83.6%)	84 (81.5%)	367 (83.03%)
Total	40	299	103	442

Table 3: IgG positivity in symptomatic and asymptomatic COVID-19 patients.

	IgG-positive	Symptomatic	Asymptomatic	Total number of IgG-positive patients
Faculty	7	7 (100%)	0 (0%)	7
Student	49	49 (100%)	0 (0%)	49
Administration/technical staff	19	6 (31.57%)	13 (68.42%)	19

Table 4: Association of IgG status with various factors.

Factors	IgG-positive	IgG-negative	p-value
Symptoms			
Yes	51.5% (34)	48.4% (32)	<0.001
No	10.9% (41)	89.0% (335)	
Wearing a mask			
Always	0.69% (1)	99.3% (142)	<0.001
Most of the time	12.8% (17)	87.1% (115)	
Sometimes	24.7% (26)	75.2% (79)	
Never	48.3% (31)	48.3% (31)	
Hand Washing			
Yes	5.1% (16)	94.8% (292)	<0.001
No	44% (59)	55.9% (75)	
Maintaining social distance			
Yes	11.9% (40)	88% (294)	<0.001
No	32.4% (35)	67.5% (73)	

were all symptomatic, tallying the percentage of symptomatic faculty members to 100%. Similarly, 49 students tested positive for IgG, and they were all symptomatic, tallying the percentage of symptomatic students to 100%. In contrast, only 31.57% of the administration/technical staff members were symptomatic (Table 3). A significant association (p < 0.001) was found between adhering to safety measures (wearing masks, handwashing, social distancing) and the occurrence of COVID-19 (Table 4).

Discussion

The COVID-19 pandemic has led to a dramatic loss of human life worldwide, and the most drastic effects initially reported are linked to respiratory distress.[12] Responding swiftly to the pandemic by enforcing preventive protocols and estimating the extent of severity of infection are the only measures that can be adopted until safe and efficient vaccines are made available.

Kharian, a tehsil located in Gujrat District, has the highest number of people constantly moving to and from European countries, such as Spain, Italy, Norway, England, and Middle Eastern countries. Many Pakistanis living overseas and Pakistanis of the above-mentioned nationalities have been linked to the increased spread of COVID-19 in the periphery of Gujrat District in the time period from February to May 2020.[13] We know from the literature that seroprevalence studies have been conducted in hotspot areas to identify the trend of asymptomatic population counteracting the disease and to get an overview of the extent of the spread of infectious disease, particularly in the presence of asymptomatic patients.[14]

In our study, we aimed to determine the seroprevalence of COVID-19 and study associated factors at the end of the first wave of the pandemic after the institute reopened. Among the 442 participants, 16.96% tested positive for IgG (Table 2), and , 14.9% were symptomatic (Table 1)[15].

Our study showed a slightly high seroprevalence compared to a nationwide study conducted in Spain in April by Pollán et al., which showed an overall seroprevalence of 5%, with a 2% prevalence of IgG antibodies against SARS-CoV-2 in asymptomatic individuals; the seroprevalence was

reported to be 5% higher in Madrid, a hotspot area compared to the coastal areas of Spain.[16]

In a study conducted in a county in Los Angeles, the seroprevalence of anti-SARS-CoV-2 antibodies was 4.34%,[17] and in May, the seroprevalence in university students was 4%.[18] This is in line with the previously reported results by a study conducted in Santa Clara County and Los Angeles County, where the mean estimated prevalence was 4.65%.[17] The high seroprevalence (16.96%) (Table 2) in our study might be associated with the overlapping of the end of the first wave of COVID-19 and the start of the second wave.[19]

In addition, blood sample analysis in 3,300 people in Santa Clara County in early April showed a seroprevalence of 2.8%.[20] Low prevalence in both the student population and general population of Santa Clara County revealed that SARS-CoV-2 was not circulating in the student population before the closure of the campus in mid-March 2020; this shows that the general population has been adhering to preventive strategies and is not being exposed to the virus unnecessarily.

Serological surveys are the best means for estimating the prevalence of an infectious disease, particularly in the presence of asymptomatic patients.[21] Our study reported an increased number of individuals who tested positive for IgG antibodies against SARS-CoV-2 and were asymptomatic. Compared to that in the above studies, the high prevalence in our study can be attributed to the timing of testing, as the tests were conducted in September, when the frequency of testing had increased relative to that during the start of the pandemic.

In addition, the high seroprevalence in our region is similar to the increased infection rate among ethnic minorities living in overcrowded, high-density areas. One major difference between our study and those conducted in Europe and the USA might be the population density, i.e., the number of people living in a stipulated space. Overcrowding in the subcontinent region might have led to a high number of seropositive individuals, despite adequate compliance to preventive measures.

Limitations

The results of seroprevalence studies depict the exposure to a specific disease but do not reflect the true incidence of that disease.[22]

Conclusion

This study showed a slightly higher seroprevalence than other studies as it was conducted at the end of the first wave of the COVID-19 pandemic; however, we are still far from achieving herd immunity. Furthermore, strict adherence to preventive measures is the only way to control infection spread until the development of vaccines.

Recommendations

It is recommended that patients be followed-up biannually to monitor antibody levels and to check for reinfection.[23] Adherence to preventive protocols should also be monitored.

Conflict of interest

The authors have no conflict of interest to declare.

Authors contributions

IN conceptualised the study, analysed the data, and formulated and proofread the initial draft; AFA collected the data, contributed to the introduction, and proofread the draft; AMK conceptualised the study, contributed to the discussion and conclusion, and proofread the draft; IN contributed to the methodology, formulated the graphics, and proofread the draft; MSA contributed to data collection, methodology, and proofreading; MZA contributed to the collection of data and proofreading. All authors critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

References

1. Roser M, Ritchie H, Ortiz-Ospina E, Hasell J. *Coronavirus disease (COVID-19)−Statistics and research*. Our World in data; 2020 Mar.
2. Khan F, Saeed A, Ali S. Modelling and forecasting of new cases, deaths and recover cases of COVID-19 by using vector autoregressive model in Pakistan. **Chaos, Solit Fractals 2020 Nov 1**; 140: 110189.
3. Anser MK, Yousaf Z, Khan MA, Nassani AA, Abro MM, Vo XH, et al. Social and administrative issues related to the COVID-19 pandemic in Pakistan: better late than never. **Environ Sci Pollut Control Ser 2020 Sep**; 27(27): 34567−34573.
4. Cheng MP, Papenburg J, Desjardins M, Kanjilal S, Quach C, Libman M, et al. Diagnostic testing for severe acute respiratory syndrome−related coronavirus-2: a narrative review. **Ann Intern Med 2020**; 13. M20-1301.
5. Patel R, Babady E, Theel ES, Storch GA, Pinsky BA, George KS, et al. Report from the American Society for Microbiology. **COVID-19 international summit, 23 march 2020: value of diagnostic testing for SARS−CoV-2/COVID-19**, vol. 26; 2020. 11(2):e00722-20.
6. Bastos ML, Tavaziva G, Abidi SK, Campbell JR, Haraoui LP, Johnston JC, et al. Diagnostic accuracy of serological tests for covid-19: systematic review and meta-analysis. **BMJ 2020**; 1: 370.
7. Aleta A, Martín-Corral D, y Piontti AP, Ajelli M, Litvinova M, Chinazzi M, et al. Modelling the impact of testing, contact tracing and household quarantine on second waves of COVID-19. **Nat Hum Behav 2020**; 4(9): 964−971.
8. Trivedi SU, Miao C, Sanchez JE, Caidi H, Tamin A, Haynes L, et al. Development and evaluation of Multiplexed Immunoessay fo simultaneous detection of serum IgG Antibodies to six human coronaviruses. **Sci Rep 2019**; 9: 1390.

9. Haug LR, Chiu CM, Yeh SH, Huang WH, Hsueh PR, Yang WZ, et al. Evaluation of antibody responses against SARS Coronaviral Nucleocapsid or spike proteins by immunoblotting or ELISA. **J Med Virol 2004**; 73: 33.

10. Workshop summary, Institute of Medicine (US) Forum on microbial threats *Ethical and Legal considerations in mitigating pandemic disease*. Washington DC: National Academics Press US; 2007. ISBN-13: 978-0-309-10769-3ISBN-10: 0-309-10769-5.

11. Ichromax COVID-19 Ab, boditech [INS-WH-EN] ichroma COVID-19 Ab (Rev. 00).pdf (labindustrias.com).

12. Zhu N, Zhang D, Wang W, Li Xingwang, Yang B, Song J, et al. A novel Coronavrus from patients with pneumonia in China, 2019. **N Engl J Med 2020**; 382(8): 727−733.

13. *Village locked down for two weeks.The Dawn News*; February 16, 2020. Village locked down for two weeks - Newspaper - DAWN.COM.

14. Eckerle I, Meyer B. SARS Cov 2 seroprevalence in COVID-19 hotspots. **Lancet 2020**; 396(10250): 514−515.

15. Smith B, Sullivan E, Bauman A, Powell-Davies G, Mitchell J. Lay biliefs about the preventability of major health conditions. **Health Educ Res 1999**; 14(3): 315−325.

16. Pollán M, Pérez-Gómez B, Pastor-Barriuso R, Oteo J, Hernan MA, Olmeda MP, et al. Prevalence of SARS-CoV-2 in Spain (ENE-COVID): a nationwide, population-based seroepidemiological study. **Lancet 2020**; 396(10250): 535−544. https://doi.org/10.1016/S0140-6736(20)31483-5. published online July 6.

17. Sood N, Simon P, Ebner P, Eichner D, Reynolds J, Bendavid E, et al. Seroprevalence of SARS-CoV-2 specific antibodies among adults in Los Angeles county, California on April 10-11, 2020. **J Am Med Assoc 2020**; 323(23): 2425−2427.

18. Tilley K, Ayvazyan V, Martinez L, Nanda N, Kawaguchi ES, Gorman MO, et al. A cross-sectional study examining the seroprevalence of severe acute respiratory syndrome coronavirus 2 antibodies in a university student population. **J Adolesc Health 2020**: 1−6.

19. Ali A, Bai J, Ma Z. COVID-19: is a second wave hitting Europe? **BMJ 2020**; 371: m4113. https://doi.org/10.1136/bmj.m4113.

20. Bendavid E, Mlaney B, Sood N. COVID-19 antibody seroprevalence in Santa Clara county, California. **Med Rxiv 2020**. https://doi.org/10.1101/2020.04.14.20062463.04.14.20062463.

21. Metcalf CJE, Farrar J, Cutts FT, Basta NE, Graham AL, Lessler J, et al. Use of serological surveys to generate key insights into the changing global landscape of infectious disease. **Lancet 2016**; 388: 728−730.

22. Winter AK, Martinez ME, Cutts FT, Moss WJ, Ferrari MJ, McKee A, et al. Benefits and challenges in using seroprevalence data to inform models for measles and rubella elimination. **J Infect Dis 2018**; 218(3): 355−364.

23. L Huillier AG, Meyer B, Andrey DO, Siegrist CA, Kaiser L. Antibody persistence in the first 6 months following SARS-CoV-2 infection among hospital workers: a prospective longitudinal study. **Clin Microbiol Infect 2020**: 20. 1198-743X(21)00031-8.