International Journal of Community Medicine and Public Health
Gupta P et al. Int J Community Med Public Health. 2026 Apr;13(4):1922-1929
http://www.ijcmph.com
pISSN 2394-6032 | eISSN 2394-6040

DOI: https://dx.doi.org/10.18203/2394-6040.ijcmph20261033

Original Research Article

Post-vaccination SARS-CoV-2 IgG spike antibody responses and risk factors among healthcare workers: a cross-sectional serological study

Puneet Gupta, Manjot Singh, Sandeep Dogra*

Department of Microbiology, Government Medical College, Jammu (J&K), India

Received: 14 February 2026
Accepted: 09 March 2026

***Correspondence:**
Dr. Sandeep Dogra,
E-mail: vrdlgmc@gmail.com

ABSTRACT

Background: Healthcare workers (HCWs) are considered at high risk of SARS-CoV-2 infection due to direct exposure to patients. Vaccination has been recommended as the main protective strategy against SARS-CoV-2 severity and even death among HCWs and the geriatric population.
Methods: In the current cross-sectional serological study, demographic details, risk factors and blood samples were collected from 1044 HCWs working at Government Medical College and its associated hospitals (GMC&AHJ), Jammu (J&K). Levels of SARS-CoV-2 spike antibody levels assay were determined after six months of the 2nd dose of the COVISHIELD vaccine using the chemiluminescent microparticle immunoassay method (CMIA).
Results: SARS-CoV-2 IgG spike antibodies were detected in 97.4% of HCWs. SARS-CoV-2 IgG spike seropositivity was found to be higher among females than males. SARS-CoV-2 IgG spike antibody levels were found to be statistically significantly higher in age group 1 (18–30 years) compared to age group 2 (18–50 years) and age group 3 (50 years and above) (both $p<0.01$) in males and females. IgG spike antibody titers were found significantly higher in those who were SARS-CoV-2 positive before vaccination than those who were not, whereas the presence of comorbidity, high BMI and smoking has adversely lowered the SARS-CoV-2 IgG spike antibody titer in the present study.
Conclusions: It was observed that SARS-CoV-2 IgG spike seropositivity remained in almost all participants even after six months of vaccination. However, it was observed that risk factors such as smoking, High BMI, and comorbidity have detrimental effects on IgG spike antibody titer.

Keywords: COVISHIELD, HCWs, IgG spike antibody, Post vaccination, SARS-CoV-2

INTRODUCTION

COVID-19 pandemic caused by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) has deleterious effect on health services and economy worldwide. Covid-19 pandemic has already affected more than 217 million people and caused more than 4.5 million deaths worldwide, as of 30th Aug 2021. India accounts for total no of 3.7 million COVID-19 cases with 0.4 million deaths on 30th August 2021.[1-3] Vaccines have been shown to lower the severity and mortality due SARS-CoV-2 infection in India, the SARS-CoV-2 vaccination campaign started on January 11, 2021, in a phased manner with priority given to HCWs, then to high-risk groups (Sanitation workers, Geriatric population, person with co morbidities, elderly person) and finally the entire population.[4,5] This strategy uses two doses of ChAdOx1 nCoV-19 Corona Virus Vaccine (Recombinant) under the trade name of COVISHIELD, manufactured in India by Serum Institute of India through license from Astrazeneca-Oxford.[6] One dose of 0.5 ml COVISHIELD vaccine contains 5×1010 viral particles (vp) given 28 days apart intramuscularly to the recipients. COVISHIELD is replication deficient adenoviral vector based recombinant vaccine that expresses spike protein of SARS-CoV-2.[7] COVID-19 vaccination boosts immune response by providing Anti-S-IgG antibody, having neutralizing effects and providing protection against SARS-CoV-2 infections.[8] SARS-CoV-2 IgG spike antibody titers act as indicator for effectiveness of

COVID-19 vaccines.[9,10] Immunological response of COVID-19 vaccines has been well described in vitro but in real-world various risk factors affecting the SARS-CoV-2 IgG spike antibody titers are yet to be explored. Only few reports elucidate the long-term durability of SARS-CoV-2 IgG spike antibody in response to Covisheild vaccination.

HCWs are considered as most vulnerable cohort with high risk of SARS-CoV-2 infection and also represent a source of transmission with in clinical settings and surroundings during the SARS-CoV-2 pandemic. Majority of SARS-CoV-2 studies of Health-care workers (HCWs) involves assessment of Seroprevalence and Seroconversion rate among Health-care workers around the world.[11-13] With sparse reports of seroprevalence of SARS-CoV-2 IgG spike antibody post vaccination among HCWs worldwide.[14-16]

In India, there are only few reports of seroprevalence of SARS-CoV-2 IgG spike antibody among HCWs after two doses of vaccination.[17] To our knowledge, Current study is the first ever study from northern region of India particularly from Jammu region of UT of Jammu and Kashmir (J&K) aimed to evaluate SARS-CoV-2 IgG spike antibody titers and risk factors associated among HCWs after two doses of COVISHIELD vaccination. In the present study, we have assessed SARS-CoV-2 IgG spike antibody titers and risks factors associated with Low antibody responses among HCWs of Government Medical College (GMC) and its Associated Hospitals, Jammu (J&K) administered with two doses of Covishield after a span of six months The present study was conducted at Govt. Medical college (GMC) Jammu and its associated hospitals in Jammu (J&K) during 1st of Aug, 2021 and 30th of Aug, 2021.

METHODS

Study design and participants

HCWs of both genders, 18 years of age or older of Govt. Medical college (GMC) Jammu and its associated hospitals who underwent two doses of Covisheild vaccine between the 29th January and 28th of February 2021, were included in the study following informed written consent. Information about demographic details such as age, gender, SARS-CoV-2 infection status, smoking habit and comorbidities such as diabetes, hypertension, cardiovascular disease and chronic kidney disease of participants were gathered using self-administered questionnaire at the time of recruitment.

To evaluate the body mass index (BMI) of participants, their heights and weights were measured on a standard scale using a measuring instrument. Participants having body mass index (BMI) values as (18.5–24.9), (25–29.9) and (>30) were considered as Normal, Overweight and Obese respectively. Present study has been approved by the Institutional Ethics Committee of Government Medical College (GMC), Jammu (J&K). None of the individuals included in this study reported any COVID-19 infection during this one month.

Sample collection

Blood samples were obtained from all the participants after 180 days of 2nd dose of Covisheild vaccine to determine anti-SARS-CoV-2 spike-RBD antibodies. Blood samples from all participants were collected in vacuum tubes containing separator gel and serum was isolated by centrifugation within 2h of collection and stored at − 20 °C until further analysis of samples.

Quantitation of antibodies against SARS-CoV-2 spike protein

Anti-SARS-CoV-2 spike-RBD levels were measured with chemiluminescent microparticle immunoassay method (CMIA) using the quantitative SARS-CoV-2 IgG II Quant Assay (Abbott) and Architect i2000SR immunoassay analyser (Abbott) to evaluate the immune status of individuals induced by vaccination. Positive diagnostic levels for SARS-CoV-2 antispike IgG antibodies were defined as >50 AU/ml whereas results below the cutoff value were reported as nonreactive and interpreted as negative.

Since the protective antibody level is not yet known, the value of the low anti- RBD IgG sample (250 AU/ml) Equivalent of the “First WHO International Reference Panel for anti-SARS-CoV-2 immunoglobulin (NIBSC code: 20/268),” is accepted as cutoff level for low antibody status in our study. Individuals having IgG antibody titers ≤ 250 AU/ ml were considered in high risk where as individuals having IgG antibody titers ≥250 AU/ were considered in low-risk group.

Statistical analysis

In descriptive statistics, qualitative variables were reported as absolute number and percentage whereas as quantitative variables reported as ean, standard deviation (SD), minimum (Min) and maximum (Max). Distribution of Anti- Spike IgG antibody titers for selected socio-demographic variables was performed using non-parametric tests such as or Mann-Whitney U test for two groups and Kruskal– Wallis more than two groups and Wilcoxon rank-sum test in dependent groups, as appropriate. Anti- Spike IgG antibody titers were converted to dichotomous variables as low and high.

Low antibody response was evaluated by Univariate and Multivariable binary logistic regression analysis with various risk factors namely: Age group, gender, BMI, Smoking status nationality, previous COVID infection and comorbidity as dependent variables. All statistical analysis were conducting using a STATA software (Version 14.0, Stata Corp and p value<0.05 was considered statistically significant.

RESULTS

In present study, we assessed SARS-CoV-2 IgG antibody titers in total of 1044 HCWs of GMC Jammu and its associated hospitals who received two doses of Covishield vaccine prospectively. Occupational infection in HCWs play a vital role in transmission of communicable disease during epidemics.[18] Although several studies have reported SARS-CoV-2 IgG seroprevalence and serconversion among HCWs. To our knowledge current study provides the first insights into long term repertoire of SARS-CoV-2 IgG antibody titers in HCWs after two doses of vaccination in Jammu district of UT of Jammu and Kashmir.

Baseline characteristics and IgG spike antibody levels after six months of two doses of vaccination have been summarized in Table 1. Current cohort had a slightly greater representation for male individuals, 50.86% (531/1044) than females 49.4% (513/1044). Females had higher median (IQR) SARS-CoV-2 IgG levels than males (304 (172-552) AU/ml vs (288 (184-410) AU/ml) which is statistically significant (p<0.001) as well. Older adults generally exhibit a weaker immune reaction to vaccinations compared to their younger counterparts. The age distribution of cohort under study was as follows: 18–30 years old, n=206 (19.73%), 30–50 years old, n=701 (67.14%), 50 years and older, n=137 (32.12%). The SARS-CoV-2 IgG level showed a positive correlation among different age groups. Patients aged 18-30 years had significantly higher median (IQR) SARS-CoV-2 IgG levels than adolescents aged 31 to 50 years (333 (250-615) AU/ml vs 308 (152-468) AU/ml. P. p<0.001) and patients aged 50 years and above (333 (250-615) AU/ml vs 212 (128-296) AU/ml, p<0.001). The SARS-CoV-2 IgG level showed a positive correlation among different age groups. Difference in IgG antibody titers were found to be statistically significant (P<0.001) among all the three age groups in present study.

In the present cohort, 29.2% (05 /1044) and 70.8% (739/ 1044) of the participants were found to be SARS- Cov-2 naïve and SARS- Cov-2 infected respectively. Participants with prior COVID-19 infection had higher median (IQR) SARS-CoV-2 IgG levels than SARS- Cov-2 naïve (388 (284-553) AU/ml vs 124 (83.5-163) AU/ml) which is found to be statistically significant (p<0.001) as well. Amongst 1044 health care workers (HCWs), 23.18% (242/1044) had comorbidity where no comorbidity had been found in 802 (76.82%) of the individuals. Participants with comorbidity had higher median (IQR) SARS-CoV-2 IgG in comparison to participants having no comorbidity (353 (216-536) AU/ml VS 219 (143-271) AU/ml,) which is also statistically significant (p<0.001). Out of 1044 health care workers, 7% (73/1044) were smokers where 93% (971/1044) were non-smokers. Non-smokers had higher median (IQR) SARS-CoV-2 IgG in comparison to smokers (307 (192-480) AU/ml VS 209 (209-325) AU/ml, p<0.001) which is statistically significant as well.

Risk factors of low antibody after six months of two doses of vaccination have been summarized in table 2. In the present study individuals having IgG antibody titers ≤250 Au/ ml were considered in high risk where as individuals having IgG antibody titers ≥250 Au/ were considered in low-risk group. Out of 1044 health care workers, 36.78 % (384/1044) and 63.22 % (660/1044) belong to high-risk group respectively. Low risk group had higher median (IQR) SARS-CoV-2 IgG in comparison to high-risk group (417(311-583) VS 134 (88-201)) which is statistically significant as well (p<0.001).

Body mass index (BMI) distribution of present cohort was as follows Group 1 termed as Normal with BMI range of 18.5 to 24.9, n=477 (45.68%), Group 2 termed as Overweight with BMI range of 25.0 to 29.9, n=490 (46.93%) where Group 3 termed as Obese with BMI range of 30 and above, n=77 (7.37%). Median IgG level of 348 (228-534) AU/ ml, 289 (145-434) AU/ml and 212 (124-336) AU/ml was found in BMI group 1 BMI group 2 BMI group 3 respectively. The SARS-CoV-2 IgG levels showed a negative correlation with BMI (p<0.001). Participants having Normal BMI had significantly higher median (IQR) SARS-CoV-2 IgG levels than overweight (348(228-534) vs 289(145-434), p<0.001) and obese participants (348 (228-534) vs 212 (124-336), p<0.001). Difference in IgG antibody titers were found to be statistically significant among three different BMI groups in present study (p<0.001).

In the present study, 5.5%% (58 /1044) of the participants were non responder where 94.5% (986 /1044) of the participants were responder respectively. Responder showed higher median (IQR) SARS-CoV-2 IgG titers in comparison to non-responder 312 (213-483) vs 44 (38-45)) which is statistically significant as well (p<0.001). In present study individuals having IgG antibody titers ≤250 AU/ ml were considered in high risk where as individuals having IgG antibody titers ≥250 AU/ were considered in low-risk group. Bivariate logistic regression was carried out to assess the effect of age, gender, previously SARS COV-2 positive, co-morbidity, smoking status and body mass index (BMI) on the likelihood of low antibody titers. Although females have 5% lower odds of having low antibody in comparison to Males but no association between sex and low antibody titers have been assessed in our study. Age group 2 (31-50 years) and age group 3 (50 years and above) have 1.54 times and 5.02 times the odds of having low antibody levels in comparison to age group 1 (18-30 years). SARS- CoV-2 positive participants have 13% lower odds than SARS- CoV-2 naive participants. Comorbidity and smoking attributes to 4.3 times and 2.14 times odds of having low antibody levels in comparison to participants without co morbidity and smoking habit. BMI group 2 (Obese) and BMI group 3 (Overweight) have 1.74 times and 2.62 times the odds of having low antibody levels in comparison to BMI group 1 (Normal). Bivariate logistic regression showed statistically significant differences among Age groups (18-30, 31-50,

50 and above) (p<0.001). Previously SARS- COV-2 status (p<0.001), Co morbidity (p<0.001), Smoking status (p<0.001), and BMI (p<0.001) except gender (p>0.001). Caglayan et al also reported overweight, as risk factor for low antibody levels in univariate regression analysis. Multivariable logistic regression analysis revealed that presence of comorbidity (OR: 17.19, 95% CI:9.67-30.53, P<0.001) and previously SARS- Cov-2 positive (OR: 0.005, 95% CI:0.002-0.01, p<0.001) and being in the Age group 3(50 years and above) (OR: 0.47; 95% CI:0.18-1.20, p<0.001), were determined as independent predictors for low antibody levels.

Table 1: Baseline characteristics and igG spike antibody levels after six months of two doses of vaccination.

Age groups (in years)	N (%)	Antibody level AU/ml Median (IQR)	P value
18-30	206 (19.73)	333 (250-615)	
31-50	701 (67.14)	308 (152-468)	
50 and above	137 (132.12)	212 (128-296)	<0.001
Sex			
Male	531 (50.86)	288 (184-410)	
Female	513 (49.14)	304 (172-552)	0.002
COVID-19 positive			
No	305 (29.21)	124 (83.5-163)	
yes	739 (70.79)	388 (284-553)	
Comorbidity			
No	802 (76.82)	353 (216-536)	
Yes	242 (23.18)	219 (143-271)	<0.001
Smoking status			
No	971 (93.00)	307 (192-480)	
Yes	73 (7.00)	209 (209-325)	0.016
BMI			
1	477 (45.68)	348 (228-534)	
2	490 (46.93)	289 (145-434)	
3	77 (7.37)	212 (124-336)	<0.001
Risk factor			
High	384 (36.78)	134 (88-201)	
low	660 (63.22)	417 (311-583)	<0.001
IgG efficacy			
Responder	986 (94.44)	312 (213-483)	
Non responder	58 (5.56)	44 (38-45)	<0.001

Table 2: Risk factors of low antibody levels by univariate and multivariate logistic regression models.

Age groups (in years)	Univariate unadjusted odd ratio	95% CI	P	Multivariate adjusted odd ratio	95% CI	P
18-30	1					
31-50	1.54	1.08-2.18	0.015	0.31	0.16-0.59	0.118
50 and above	5.02	3.14-8.01	<0.001	0.47	0.18-1.20	0.045
Sex						
Male	1			1		
Female	1.05	0.82-1.35	0.671	1.21	0.80-1.85	0.353
COVID-19 positive						
Yes	1			1		
No	0.013	0.01-0.02	<0.001	0.005	0.002-0.01	0.013
Comorbidity						
No	1			1		
Yes	4.3	3.21-5.89	<0.001	17.19	9.67-30.53	0.015
Smoking status						
No	1					
Yes	2.14	1.39-3.29	0.084	1.35	0.56-3.27	0.503
BMI						
1	1			1		
2	1.74	1.33-2.28	<0.001	1.29	0.83-2.00	0.493
3	2.62	1.61-4.28	<0.001	1.79	0.80-4.01	0.153

DISCUSSION

HCWs are highly susceptible to SARS-CoV-2 infection because of their direct interaction with patients. There is a need of enhanced protective immunity among HCWs for SARS-CoV-2 in healthcare settings for future preparedness of SARS-CoV-2 outbreaks. Developing an effective vaccine is a crucial way to control the ill effects of SARS-CoV-2 among HCWs, Immuno-compromised and geriatric population. Various research studies have shown that mRNA-based vaccines are very effective and completely safe. Spike protein S is the main target for developing SARS-CoV-2 vaccines, determining SARS-CoV-2 infectivity and provoking the body's immune response.[19] Post vaccination titers of SARS-CoV-2 IgG spike-antibody among HCWs is a vital indicator of protective immunity which is still poorly understood. Determining SARS-CoV-2 IgG spike antibody levels after immunization and association of risk factors with titers of IgG spike antibody among HCWs are crucial for improving preparedness for future pandemics.

Screening trials have demonstrated that SARS-CoV-2 IgG spike-antibodies lasted for at least six months after from two doses of vaccination but at varying levels and with different maintenance pattern.[20] In present cohort, we have evaluated the titers of SARS-CoV-2 IgG spike-antibody and their relation with clinical parameters like age, sex and prior COVID-19 infection among HCWs of GMC Jammu and its associated hospitals after six months of two doses of COVISHIELD vaccination. COVID-19 vaccinations triggered the formation of SARS-CoV-2-IgG spike antibodies. The seroprevalence of SARS-CoV-2- igG spike antibodies showed significant variation across the globe. Authors have found seroprevalence of among HCWs in the present study. Seroprevalence of 73.8% and 81.1% for anti-SARS-CoV-2 antibodies was found in African countries such as Nigeria and Kenya respectively whereas the seroprevalence of more than 90% was reported for countries such as Chile, French and Slovakia among general population.[11-13,15,16,19] Elangovan et al has reported the SARS-CoV-2- IgG spike seroprevalence of 91.7% for HCWs after two doses of vaccination.[17] HCWs' repeated exposures to pathogen due to interactions with patients could account for the high seropositivity rates in current study. Hossain et al also attributed high seroprevalence of IgG SARS-CoV-2 antibody among HCWs due to direct contact with patients.[21] Our results are similar with findings of various researchers (Bay ram who have also reported seropositivity ranging between 90-99% after two doses of CoronaVac vaccination.[20,22]

In the present study, statistically significant higher median titers of SARS-CoV-2 IgG spike-antibody were found in females in comparison to males. Various reports have also reported higher antibody response to mRNA vaccines in females in comparison to males.[23,25] Substantial studies have also reported higher median antibody levels in woman than males although the result was not statistically significant.[26,27] The results are in concordance with findings of Robbiani et al which found that antibody titers are lower in men in comparison to females.[28] Various researchers also showed higher probability of having high antibody titers in females than males.[29,30] Findings are similar to other studies depicting females have statistically higher and more level of SARS-CoV-2 IgG spike-antibody in comparison to males.[31-33] Recent reports on mRNA BNT162b or CoronaVac post vaccination also reported lower antibody titers in males in comparison to females with statistically non-significant results.[25,27,34] Our findings were quite different from Kutsuna et al, 2021 results that showed that men have a higher antibody titers than women.[35] On the contrary Caglayan et al, found no association between sex and low antibody titers.[22] Therefore, effect of Sex on IgG antibodies titers still requires more investigation.

Older adults generally exhibit a weaker immune reaction to vaccinations compared to their younger counterparts. In the present study, HCWs in the age group III (50 years and older) have lower level of IgG anti-SARS-CoV-2 than age group II (30–50 years) and age group (18–30 years) and difference in SARS-CoV-2 IgG spike antibody titer was found to be statistically significant ($p<0.001$) among all the three age groups. Kusunoki et al also observed negative correlation between age and antibody titer in their study but the association was not statistically significant.[36] Bay et al reported relatively high frequency of IgG antibodies in Health care workers (HCW) aged 18-59 than participants having age more than 60 years after two doses of CoronaVac.[20] Generally, most of the researchers have reported negative correlation of IgG levels with age with few statistically significant as well. Older individuals, mostly more than 60 years old, experienced higher sero negativity after taking two doses of almost any type of COVID-19 vaccines, including CoronaVac, AstraZeneca and Moderna.[37-39] Our results are in concordance with reports of Soeorg et al and Hirmoto et al who have found lower SARS-CoV-2 IgG spike levels in older individuals' comparison to younger individuals.[40,41]

In current study, HCWs having positive history of the COVID-19 have higher titers of IgG anti-SARS-CoV-2 antibody in comparison to HCWs negative history of the COVID-19. Difference in titers of IgG anti-SARS-CoV-2 antibody among HCWs having positive history and negative history of COVID-19 was found to be significantly significant as well. Various researchers have also reported statistically significant higher antibody titers in participants having previous history SARS- Cov-2 Infection than SARS-CoV-2 naïve participants.[20-29] Recent reports also elucidated higher levels of anti-spike antibodies in previously SARS- Cov-2 infected individuals compared to SARS- Cov-2naive individuals.[42-44] Roberstson et al also asserted that previously SARS- Cov-2 infected participants had higher antibody titers than SARS- Cov-2 naïve participants.[45] Our findings are in correlation with other reports showing

high titers of SARS- Cov-2 spike antibody in SARS-Cov-2 infected individuals compared to SARS- Cov-2 naive individuals. Current research has demonstrated that HCWs having Co-morbidity, High BMI and Smoking have lower median titers of SARS-CoV-2 IgG spike-antibody comparison to HCWs not associated with any risk factors. Individuals with older age, smoking behavior and pre-existing health conditions such as co morbidities, High BMI showed low vaccine immunogenicity and antibody response.[46] Pellini et al also reported higher antibodies titers in low-weight and normal-weight individuals in comparison to pre-obese individuals after vaccination.[33] Researchers have reported lower rates of antibody production and lower median antibody titers in participants with co morbidities.[20,34] Individuals with co morbidities were more likely to not have an antibody response after receiving any type of COVID-19 vaccine.[47] Our findings align with other studies that have reported low median levels of SARS-CoV-2 antibodies among HCWs having old age, Co morbidities, High BMI and smoking behavior.

Strengths

Current study is multi-centre with a large number of participants as well. Apart from that majority of the past similar studies have studied prevalence of SARS-CoV-2 Infection and their associated risk factors among healthcare workers only. In the present study, we have analyzed seroprevalence of SARS-CoV-2IgG spike antibody post vaccination and associated risk factors among HCWs of Government Medical College (GMC) and its Associated Hospitals, Jammu (J&K) catering most of HCWs associated with emergency health services of the Jammu region of union territory of Jammu and Kashmir.

Limitations

The present study has several limitations as well. There is lack of differentiation between post-vaccination and post-infection IgG antibodies. Cell-mediated immune responses and neutralizing anti bodies that also has protective role against SARS-CoV-2 infection were not studied in current study.

CONCLUSION

This study demonstrates that SARS-CoV-2 IgG spike antibodies remain detectable in the majority of vaccinated individuals even after a period of six months, indicating sustained humoral immune response following vaccination. The high rate of seropositivity reflects highlights the effectiveness of vaccination in maintaining a baseline level of immune protection over time.Current study also highlights that the magnitude of the antibody response is not uniform across all individuals. Certain host-related risk factors, including smoking, elevated body mass index (BMI), and the presence of comorbid conditions, were found to adversely affect IgG spike antibody titers. Individuals with these risk factors exhibited comparatively lower antibody levels, suggesting a potentially weakened immune response despite being seropositive. The results underscore the need for targeted public health strategies, including closer monitoring, prioritization for booster doses, and lifestyle modifications, particularly among individuals with identified risk factors. Further longitudinal studies are recommended to assess the long-term durability of antibody responses and their correlation with clinical protection against infection and severe disease.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. COVID-19 Vaccine Breakthrough Infections Reported to CDC- United States, January 1–April 30, 2021. MMWR Morb Mortal Wkly Rep. 2021;70.
2. World Health Organization. Weekly Epidemiological Update on COVID-19-1 June. Available at: https://www.who.int/publications/m/item/weekly-epidemiological-update. Accessed on 21 August 2025.
3. John Hopkins Coronavirus Resource Tracker. Available at https://coronavirus.jhu.edu/map.html. Accessed on 6th June, 2021.
4. World Health Organization. Statement for Healthcare Professionals: How COVID-19 Vaccines Are Regulated for Safety and Effectiveness (Revised March 2022). Available at: https://www.who.int/news/item/17-05-2022-statement-for-healthcareprofessionals-how-covid-19-vaccines-are-regulated-for-safety-and-effectiveness. Accessed on 9 June 2022.
5. PM Launches pan India rollout of COVID-19 vaccination drive. Available at: https://pib.gov.in/Pressreleaseshare.aspx?PRID=1689021. Ministry of Health and Family Welfare. Last Accessed on 6th June, 2021.
6. Serum Institute of India Pvt. Ltd Fact sheet for vaccine recipient approved for restricted use in an emergency situation of ChAdOx1 nCoV 19 Corona Virus Vaccine (Recombinant). Available at https://www.seruminstitute.com/pdf/Covishield_fact_sheet.pdf.
7. World Health Organization. COVID-19 Vaccines. Available from: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/covid-19-vaccines. Accessed on 6th June, 2021.
8. Milne G, Hames T, Scotton C, Gent N, Johnsen A, Anderson RM, et al. Does infection with or vaccination against SARS-CoV-2 lead to lasting immunity. Lancet Resp Med. 2021;9(12):1450-66.

9. Van Elslande J, Decru B, Jonckheere S, Van Wijngaerden E, Houben E, Vandecandelaere P, et al. Antibody response against SARS-CoV-2 spike protein and nucleoprotein evaluated by four automated immunoassays and three ELISAs. Clin Microb Infect. 2020;26(11):1557.
10. Rezaei M, Sadeghi M, Korourian A, Tabarsi P, Porabdollah M, Askari E, et al. Comparative evaluation of SARS-CoV-2 IgG assays against nucleocapsid and spike antigens. Human Antibodies. 2021;29(2):109-13.
11. Awandu SS, Ochieng Ochieng A, Onyango B, Magwanga RO, Were P, Atieno Ochung' A, et al. High seroprevalence of Immunoglobulin G (IgG) and IgM antibodies to SARS-CoV-2 in asymptomatic and symptomatic individuals amidst vaccination roll-out in western Kenya. PLOS ONE 2022L17(12):72751.
12. Onifade AA, Fowotade A, Rahamon SK, Edem VF, Yaqub SA, Akande OK, et al. Seroprevalence of anti-SARS-CoV-2 specific antibodies in vaccinated and vaccine naïve adult Nigerians. PLOS ONE. 2023;18(1):80276.
13. Aguilera X, González C, Apablaza M, Rubilar P, Icaza G, Ramírez-Santana M, et al. 2022. Immunization and SARS-CoV-2 antibody seroprevalence in a country with high vaccination coverage: lessons from chile. Vaccines. 2022;10(7):1002.
14. Kajanova I, Lukacikova L, Jelenska L, Grossmannova K, Radikova Z, Vlcek M, Klempa B, et al. Seroprevalence of SARS-CoV-2 IgG antibodies in the staff of the Slovak Academy of Sciences in response to COVID-19 and/or vaccination: situation in August 2021. Acta Virologica. 2022;65(4):420–32.
15. Ben Houmich T, Tali A, Debbagh F, Lamrani Hanchi A, Soraa N. Seroprevalence of SARS-CoV-2 antibodies in vaccinated healthcare workers in Marrakech (Morocco). International J Immunopathol Pharmacol. 2022;5;36:3997.
16. Decarreaux D, Pouquet M, Souty C, Vilcu A-M, Prévot-Monsacre P, Fourié T, et al. 2022. Seroprevalence of SARS-CoV-2 IgG antibodies and factors associated with SARS-CoV-2 IgG neutralizing activity among primary health care workers 6 months after vaccination rollout in France. Viruses. 2022;14(5):957.
17. Elangovan D, Hussain SMS, Virudhunagar Muthuprakash S. Impact of COVID-19 vaccination on seroprevalence of SARS-CoV-2 among the health care workers in a tertiary care centre, South India. Vaccines 10(11):1967.
18. Bielicki JA, Duval X, Gobat N, Goossens H, Koopmans M, Tacconelli E, et al. Monitoring approaches for health-care workers during the COVID-19 pandemic. Lancet. 2020;20(10):261-7.
19. Kajanova I, Jelenska L, Lukacikova L, Grossmannova K, Belisova M, Istvanova N, et al. Influence of the SARS-CoV-2 Omicron (B. 1.1. 529) variant and booster vaccine doses on the seroprevalence of specific IgG antibodies in the staff of the Slovak Academy of Sciences. Acta Virologica. 2023;28;67:11637.
20. Bayram A, Demirbakan H, Günel Karadeniz P, Erdoğan M, Koçer I. Quantitation of antibodies against SARS-CoV-2 spike protein after two doses of CoronaVac in healthcare workers. J Med Virol. 2021;93:5560-7.
21. Hossain A, Nasrullah SM, Tasnim Z, Hasan MK, Hasan MM. Seroprevalence of SARS-CoV-2 IgG antibodies among health care workers prior to vaccine administration in Europe, the USA and East Asia: A systematic review and meta-analysis. EClinicalMedicine. 2021;1:33.
22. Çağlayan D, Süner AF, Şiyve N, Güzel I, Irmak Ç, Işik E, et al. An analysis of antibody response following the second dose of CoronaVac and humoral response after booster dose with BNT162b2 or CoronaVac among healthcare workers in Turkey. J Med Virol. 2022;94(5):2212-21.
23. Costa C, Migliore E, Galassi C, Scozzari G, Ciccone G, Coggiola M, et al. Factors influencing level and persistence of anti-SARS-CoV-2 IgG after BNT162b2 vaccine: evidence from a large cohort of healthcare workers. Vaccines. 2022;10(3):474.
24. Nomura Y, Sawahata M, Nakamura Y, Kurihara M, Koike R, Katsube O, et al. Age and smoking predict antibody titers at 3 months after the second dose of the BNT162b2 COVID-19 vaccine. Vaccines. 2021;9(9):1042.
25. Salvagno GL, Henry BM, Di Piazza G, Pighi L, De Nitto S, Bragantini D, et al. Anti-SARS-CoV-2 receptor-binding domain total antibodies response in seropositive and seronegative healthcare workers undergoing COVID-19 mRNA BNT162b2 vaccination. Diagnostics. 2021;11(5):832.
26. Damerau L, Mühlenbruch G, Evenschor-Ascheid A, Fussen C, Nienhaus A, Terschüren C, et al. Coronavirus vaccination: spike antibody levels in health workers after six months a cross-sectional study. International J Environ Res Public Health. 2022;9(18):11422.
27. Vassilaki N, Gargalionis AN, Bletsa A, Papamichalopoulos N, Kontou E, Gkika M, et al. Impact of age and sex on antibody response following the second dose of COVID-19 BNT162b2 mRNA vaccine in Greek healthcare workers. Microorganisms. 2021;9(8):1725.
28. Robbiani DF, Gaebler C, Muecksch F, Lorenzi JC, Wang Z, Cho A, et al. Convergent antibody responses to SARS-CoV-2 in convalescent individuals. Nature. 2020;584(7821):437-42.
29. Ishaq SE, Abdulqadir SZ, Omar SA, Qadir MK, khdir Awla H, Rasul MF, et al. Comparative study of SARS-CoV-2 antibody titers between male and female COVID-19 patients living in Kurdistan region of Iraq. Gene Reports. 2021;25:101409.

30. Pani A, Cento V, Vismara C. Antibody response to BNT162b vaccine is almost universal in health care workers. Results from the RENAISSANCE study: REsponse to BNT162b2 COVID-19 vaccine-short- and long-term immune response evaluation in healthcare workers. In Mayo Clin Proc. 2021;96(12):2966-79.
31. Demonbreun AR, Sancilio A, Velez ME. COVID-19 mRNA Vaccination Generates Greater Immunoglobulin G Levels in Women Compared to Men. J Infect Dis. 2021;224(5):793–7.
32. Pang NYL, Pang ASR, Chow VT, Wang DY. Understanding neutralising antibodies against SARS-CoV-2 and their implications in clinical practice. Military Med Res. 2021;8(1):47.
33. Pellini R, Venuti A, Pimpinelli F. Initial observations on age, gender, BMI and hypertension in antibody responses to SARS-CoV-2 BNT162b2 vaccine. E Clin Med. 2021;36:100928.
34. Yalcin D, Bennett SJ, Sheehan J, Trauth AJ, Tso FY, West JT, et al. Longitudinal variations in antibody responses against SARS-CoV-2 spike epitopes upon serial vaccinations. International journal of molecular sciences. 2023;24(8):7292.
35. Kutsuna S, Asai Y, Matsunaga A, Kinoshita N, Terada M, Miyazato Y, et al. Factors associated with anti-SARS-CoV-2 IgG antibody production in patients convalescing from COVID-19. Journal of Infection and Chemotherapy. 2021;27(6):808-13.
36. Kusunoki H, Ohkusa M, Iida R, Saito A, Kawahara M, Ekawa K, et al. Longitudinal changes in IgG-type SARS-CoV-2 antibody titers after COVID-19 vaccination and a prominent increase in antibody titers when infected after vaccination. Vaccines. 2023;11(4):860.
37. Fonseca MH, de Souza TD, de Carvalho Araújo FM, de Andrade LO. Dynamics of antibody response to CoronaVac vaccine. Journal of Medical Virology. 2022;94(5):2139-48.
38. Chiarella SE, Jenkins SM, Smith CY, Prasad V, Shakuntulla F, Ahluwalia V, et al. Predictors of seroconversion after coronavirus disease 2019 vaccination. Ann Allergy Asthma Immunol. 2022;129(2):189-93.
39. Malagón-Rojas J, Mercado-Reyes M, Toloza-Pérez YG, Galindo M, Palma RM, Catama J, et al. Comparison of anti-SARS-CoV-2 IgG antibody responses generated by the administration of Ad26. COV2. S, AZD1222, BNT162b2 or CoronaVac: longitudinal prospective cohort study in the Colombian population, 2021/2022. Vaccines. 2022;10(10):1609.
40. Soeorg H, Jogi P, Naaber P, Ottas A, Toompere K, Lutsar I. Seroprevalence and levels of IgG antibodies after COVID-19 infection or vaccination. Infect Diseases. 2022;54(1):63-71.
41. Hiramoto S, Miyashita D, Kimura T. Serological Screening of Immunoglobulin G against SARS-CoV-2 Nucleocapsid and Spike Protein before and after Two Vaccine Doses among Healthcare Workers in Japan. Tohoku J Exp Med. 2022;257(1):57-64.
42. Ebinger JE, Fert-Bober J, Printsev I, Wu M, Sun N, Prostko JC, et al. Antibody responses to the BNT162b2 mRNA vaccine in individuals previously infected with SARS-CoV-2. Nature Med. 2021;27(6):981-4.
43. Favresse J, Eucher C, Elsen M, Gillot C, Van Eeckhoudt S, Dogné JM, et al. Persistence of anti-SARS-CoV-2 antibodies depends on the analytical kit: a report for up to 10 months after infection. Microorganisms. 2021;9(3):556.
44. Van Elslande J, Weemaes M, Godderis L, Van Pottelbergh G, Bossuyt X, Vermeersch P. IgG anti-spike antibody levels in healthcare workers with and without prior COVID-19 up to 3 months after BNT162b2 vaccination. Diagnostic Microbiology and Infectious Disease. 2022;102(4):115638.
45. Robertson LJ, Price R, Moore JS. IgG antibody production and persistence to 6 months following SARS-CoV-2 vaccination: A Northern Ireland observational study. Vaccine. 2022;40(18):2535-9.
46. Kwetkat A, Heppner HJ. Comorbidities in the elderly and their possible influence on vaccine response. Interdis Gerontol Geriat. 2020;43:73-85.
47. Huang CF, Jang TY, Wu PH, Kuo MC, Yeh ML, Wang CW, et al. Impact of comorbidities on the serological response to COVID-19 vaccination in a Taiwanese cohort. Virol J. 2023;20(1):112.
48. Robinson AV, Weaving G, Philips BJ, Eziefula AC, Shipman KE, Chevassut T. Real-world experience of SARS-CoV-2 antibody assays in UK healthcare workers. Clin Med. 2021;21(3):30.

Cite this article as: Gupta P, Singh M, Dogra S. Post-vaccination SARS-CoV-2 IgG spike antibody responses and risk factors among healthcare workers: a cross-sectional serological study. Int J Community Med Public Health 2026;13:1922-9.