https://doi.org/10.52763/PJSIR.PHYS.SCI.69.1.2026.8.13

Pak. j. sci. ind. res. Ser. A: phys. sci. 2026 **69A**(1) 8-13

# Infection, Reinfection and Post-Vaccination Infection of Sars-Cov-2 in Healthcare Workers at Alsader Teaching Hospital in Maysan Province, Southern Iraq

**Mukhallad Abdul Kareem Ramadhan[a], Mustafa Adnan Nama[b] and Qayssar Ali Kraidi[b]***
[a]Department of Pathology and Forensic Medicine, College of Medicine, University of Misan, Maysan, Iraq
[b]Department of Medical Sciences, College of Nursing, University of Misan, Maysan, Iraq

(received August 6, 2024; revised December 16, 2024; accepted December 18, 2024)

**Abstract.** A shortage in the number of healthcare workers in Iraq was seen during the Coronavirus pandemic. So the study aims to demonstrate the determinants of COVID-19 infection and reinfection in HCWs and to evaluate the incidence of post-vaccination infection and its contributing factors in healthcare workers at Alsader teaching hospital in Maysan province. The results revealed that the high prevalence of COVID-19 in the study sample was within age groups (41-45 years), they reached their percentage of 26 (26.0%) of HCWs. Also, adults aged 26 to 30 and 31 to 35 represented 19% and 18% of all infected HCWs, respectively. High incidence rates (36.0%) and (23%) were reported in doctors and nurses, respectively. Regarding gender, more than half of the participants were male 51(51.0%). Concerning the weight infected almost two third of the participants in the study sample were weight between 60-69 Kg and 80-89 Kg, the subject of chronic disease 31% of participants had chronic illnesses predominately hypertension and DM. A total of 86 healthcare workers were vaccinated for COVID-19 during the studied period (86% of them have received at least one shot of the vaccine) which was more than those who were not taking vaccines. However, the highest percentage of patients gave preference to the Pfizer vaccine followed by AstraZeneca and the last one was the Sinopharm vaccine, (56%), (16%) and (14. %), respectively. The results demonstrated that 51% and 27% of infected HCWs in partially and fully vaccinated, respectively. Predominant symptoms before and after the launch of the COVID-19 vaccination campaign in Iraq include fever (52.0%) followed by headache (50.0%), loss of smell (50.0%), muscle pain (46.0%) and cough (41.0%), The same results were stated in unvaccinated individuals after the launch of the COVID-19 vaccination campaign in Iraq. Surprisingly we noticed a decline in the percentage of symptoms in each reinfected and post-vaccinated patient.

**Keywords:** maysan, province, Iraq, Sars-CoV-2, infection, reinfection

## Introduction

Healthcare workers represent the first line of the nation's fight against the coronavirus disease (COVID-19). Iraq has suffered heavy losses in the lives of healthcare workers during the coronavirus pandemic, which has led to a shortage in the number of workers in this field. According to a previous study, 152,888 HCWs were infected with SARS-COV-2 globally in 2020 (Bandyopadhyay *et al*., 2020). According to the WHO, 14% to 35% of HCWs have been infected with COVID-19 in some regions of the world and in India, 11.1%-16.43% have been reported by different research (Dev *et al*., 2021; Goenka *et al*., 2020; Mahajan *et al*., 2020). Careful attention should give to healthcare workers, as emerge of new variants of COVID-19. The protection of SARS-CoV-2 reinfection after a primary infection is yet unresolved and the immunity against the virus is not well understood. However, many confirmed reinfected cases have been reported by PCR worldwide (Hall *et al*., 2021; Gogoi *et al*., 2021; Garduño-Orbe *et al*., 2021). Globally vaccination against COVID-19 is the primary road to controlling the COVID-19 pandemic (Dong *et al*., 2020). Indian vaccination national campaign of high-risk groups for COVID-19 was first performed on HCWs and another risk group on January 16, 2021. The effect of vaccination against COVID-19 incidence has been registered by several real-world observational research (Menni *et al*., 2021; Kaplan and Milstein, 2021). However, only a few studies have been done on the most vulnerable HCWs, who are at an increased risk of infection and are eligible for early vaccination conversely, the estimation of determinants, severity and outcome of post-vaccination infection was not focused on much in Indian settings

*Author for correspondence; E-mail: caesar.ali@uomisan.edu.iq

(Patil *et al*., 2021). Completing the second year of the COVID-19 pandemic, there have been over 460 Million confirmed cases and 6.1 Million deaths reported worldwide, while the total cases of SARS-CoV-2 in Iraq reached 2,465,545 (coronastatic around the world). The COVID-19 vaccination program began in Iraq on January 16, 2021, with the priority group of healthcare workers (HCWs). The program utilized three main types of COVID-19 vaccines that are approved or authorized for use in Iraq (Pfizer-BioNTech, AstraZeneca and Sinopharm) and were available through the private sector through a limited supply. Vaccination programs include a two-dose schedule given for HCWs with 14 to 21 interval days between the first and second dose. So the study aims to demonstrate the determinants of COVID-19 infection and reinfection in HCWs and to evaluate the incidence of post-vaccination infection and its contributing factors in healthcare workers at Alsader teaching hospital in Maysan province between the period from December 25, 2021 to May 10, 2022.

## Materials and Methods

**Sample size.** A hundred HCWs at Al-Sadder teaching hospital (36 doctors, 23 nurses, 21 laboratory staff and 20 pharmacists) have participated in the present study.

**The study instrument.** A questionnaire is designed for the study based on a comprehensive review of relevant literature. The questionnaire included demographic information about HCWs and standardized data on chronic diseases, clinical symptoms and COVID-19 vaccination status (fully/partially vaccinated) was collected. Operational definitions of reinfection and the fully or partially vaccinated individual were used as described by (CDC, 2021). RT-PCR tests were used for confirmation of COVID-19-infected or reinfected cases after entry time. The HCW's information was collected by interview. Post-vaccination infection cases have been followed, since the launch of vaccination for HCWs started on January 20, 2021 in Iraq. This study was approved by the committee of the University of Misan, Alsider teaching hospital, Maysan, south of Iraq.

**Statistical data analysis.** The data were analyzed by using statistical package of social sciences (SPSS) version-21. The following statistical data analysis approaches have been used through.

## Results and Discussion

The result revealed that the high prevalence of COVID-19 in the study sample was within age groups (41-45 years), they reached their percentage of 26 (26.0%) of HCWs. Also, adults aged 26 to 30 and 31 to 35 represented 19% and 18% of all infected HCWs, respectively. High incidence rates (36.0%) and (23%) were reported in doctors and nurses, respectively. Regarding gender, more than half of the participants were male 51(51.0%). Concerning the weight infected almost two third of the participants in the study sample were weight between 70-79 Kg and 80-89 Kg, the subject of chronic disease 31% of participants had chronic illnesses predominately hypertension and DM as shown in (Table 1).

The results of the COVID-19 vaccination status and post-vaccination COVID-19 infection among healthcare

**Table 1.** Distribution of the socio-demographic characteristics

| Variables | Groups (n=30) | Frequency | Percent |
|---|---|---|---|
| Age (years) | 21-25 | 10 | 10.0 |
| | 26-30 | 19 | 19.0 |
| | 31-35 | 18 | 18.0 |
| | 36-40 | 14 | 14.0 |
| | 41-45 | 26 | 26.0 |
| | 46-50 | 6 | 6.0 |
| | 51-55 | 7 | 7.0 |
| | Total | 100 | 100.0 |
| Gender | Male | 51 | 51.0 |
| | Female | 49 | 49.0 |
| | Total | 100 | 100.0 |
| Weight at infected | 50-59 Kg | 9 | 9.0 |
| | 60-69 Kg | 22 | 22.0 |
| | 70-79 Kg | 31 | 31.0 |
| | 80-89 Kg | 32 | 32.0 |
| | 90-99 Kg | 6 | 6.0 |
| | Total | 100 | 100.0 |
| Provider health caregiver | Doctor | 36 | 36.0 |
| | Nurse | 23 | 23.0 |
| | Laboratory staff | 21 | 21.0 |
| | Pharmacists | 20 | 20.0 |
| | Total | 100 | 100.0 |
| Chronic disease | None | 69 | 69.0 |
| | DM | 9 | 9.0 |
| | Hypertension | 10 | 10.0 |
| | Cardiac disease | 4 | 4.0 |
| | Lung disease | 6 | 6.0 |
| | Renal disease | 2 | 2.0 |
| | Total | 100 | 100.0 |

workers exhibited that a total of 86 healthcare workers were vaccinated for COVID-19 during the period of study (86% of them have received at least one shot of the vaccine) which was more than those who were not taking vaccines. However, the highest percentage of patients gave preference to the Pfizer vaccine followed by AstraZeneca and the last one was the Sinopharm vaccine, (56%), (16%) and (14%), respectively. The results demonstrated that 51% and 27% of infected HCWs in partially and fully vaccinated, respectively as indicated in (Table 2).

Predominant symptoms before and after the launch of the COVID-19 vaccination campaign in Iraq include fever (52.0%) followed by headache (50.0%), loss of smell (50.0%), muscle pain (46.0%) and cough (41.0%). The same results were stated in unvaccinated individuals after the launch of the COVID-19 vaccination campaign in Iraq. Surprisingly it is noticed a decline in the percentage of symptoms in reinfected and post-vaccinated patients as clearly shown in (Table 3).

**Table 2.** Distribution of the COVID-19 vaccination status

| Variables | Groups (n=100) | Frequency | Percent |
|---|---|---|---|
| Vaccination status | None | 14 | 14.0 |
| | Partial vaccine (one dose) | 20 | 20.0 |
| | Complete vaccine (two dose) | 66 | 66.0 |
| | Total | 100 | 100.0 |
| Vaccination types | None | 14 | 14.0 |
| | Pfizer | 56 | 56.0 |
| | Astrazeneca | 16 | 16.0 |
| | Sinopharm | 14 | 14.0 |
| | Total | 100 | 100.0 |
| Infection dose1 | None | 49 | 49.0 |
| | 1-7 days | 9 | 9.0 |
| | 8-14 days | 20 | 20.0 |
| | 15-21 days | 8 | 8.0 |
| | 22-28 days | 7 | 7.0 |
| | = 30 days | 7 | 7.0 |
| | Total | 100 | 100.0 |
| Infection dose2 | None | 73 | 73.0 |
| | 1-7 days | 7 | 7.0 |
| | 8-14 days | 3 | 3.0 |
| | 15-21 days | 7 | 7.0 |
| | 22-28 days | 3 | 3.0 |
| | = 30 days | 7 | 7.0 |
| | Total | 100 | 100.0 |

n = sample size

The high prevalence of COVID-19 in the study sample of current research was within age groups (41-45 years), they reached their percentage of 26 (26.0%) of HCWs. Also, adults aged 26 to 30 and 31 to 35 represented 19% and 18% of all infected HCWs, respectively. These results are in accordance with a previous study which mentioned that a high percentage of 75% of infections occur in adults aged 20 to 49 and linked that to an elevation of transmission risks before school reopening, while after school reopening, the rate of infection relatively increased toward younger ages, despite the adults aged 20 to 49 continuing to be the only age group that plays a major role in COVID-19 spreading (Monod *et al*., 2021).

High incidence rates (36.0%) and (23%) were reported in doctors and nurses, respectively. Regarding gender represented more than half of the participants were male 51(51.0%). The same results have been reported in India the majority of incidences (49.7%) and (26%) were reported in doctors and nurses while (24.3%) in others (Nisha *et al*., 2022). The age of infected patients was 20 to 61, forty-three (60.6%) and 28 (39.4%) of them were males and females, respectively (Ullah *et al*., 2022). Concerning the weight infected almost two third of the participants in the study sample were weight between 70-79 Kg and 80-89 Kg. The results of Jung (2024) revealed significant associations between COVID-19 infection incidence and weight status and individuals classified as overweight exhibited a significantly higher likelihood of COVID-19 infection. Healthy weight management may be beneficial against the risk of COVID-19 (Yoon *et al*., 2023). The subject of chronic disease 31% of participants had chronic illnesses predominately hypertension and DM. It's well known that several chronic diseases and obesity are all reasons that increase COVID-19 severity and lead to death (CDC, 2021). In healthcare workers in Tamil Nadu, India. Chronic conditions were significantly linked with all infections (Nisha *et al*., 2022).

Eighty healthcare workers were vaccinated for COVID-19 during the studied period (86% of them have received at least one shot of the vaccine) which was more than those who were not taking vaccines. However, the highest percentage of patients gave preference to the Pfizer vaccine followed by AstraZeneca and the last one was the Sinopharm vaccine, (56%), (16%) and

**Table 3.** Distribution of the infection, reinfection and post vaccination infection rates of SARS-COVID-19 in healthcare workers

| Signs and symptoms | Infection before the launch of COVID-19 vaccination campaign in Iraq | | | | Infection after the launch of the COVID-19 vaccination campaign in Iraq | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Infection | | Reinfection | | Unvaccinated | | Partial vaccination | | Complete vaccination | |
| | F | % | F | % | F | % | F | % | F | % |
| Fever | 52 | 52.0 | 18 | 18.0 | 10 | 10.0 | 17 | 17.0 | 10 | 10.0 |
| Runny nose | 40 | 40.0 | 14 | 14.0 | 12 | 12.0 | 7 | 7.0 | 9 | 9.0 |
| Sore throat | 38 | 38.0 | 18 | 18.0 | 11 | 11.0 | 7 | 7.0 | 11 | 11.0 |
| Cough | 41 | 41.0 | 10 | 10.0 | 13 | 13.0 | 7 | 7.0 | 6 | 6.0 |
| Whistling | 14 | 14.0 | 6 | 6.0 | 6 | 6.0 | 2 | 2.0 | | |
| SOB | 37 | 37.0 | 24 | 24.0 | 11 | 11.0 | 11 | 11.0 | 10 | 10.0 |
| Chest pain | 29 | 29.0 | 12 | 12.0 | 10 | 10.0 | 4 | 4.0 | 3 | 3.0 |
| Loss of taste | 44 | 44.0 | 20 | 20.0 | 15 | 15.0 | 12 | 12.0 | 12 | 12.0 |
| Loss of smell | 50 | 50.0 | 17 | 17.0 | 13 | 13.0 | 8 | 8.0 | 12 | 12.0 |
| Nausea & vomiting | 27 | 27.0 | 7 | 7.0 | 9 | 9.0 | 8 | 8.0 | 3 | 3.0 |
| Abdominal pain | 24 | 24.0 | 2 | 2.0 | 9 | 9.0 | 7 | 7.0 | 1 | 1.0 |
| Diarrhea | 27 | 27.0 | 11 | 11.0 | 6 | 6.0 | 3 | 3.0 | 3 | 3.0 |
| Headache | 50 | 50.0 | 11 | 11.0 | 13 | 13.0 | 13 | 13.0 | 10 | 10.0 |
| Muscle pain | 46 | 46.0 | 19 | 19.0 | 11 | 11.0 | 18 | 18.0 | 12 | 12.0 |

(14.%), respectively. These results agreed with those reported by Jawad *et al*. (2022) who demonstrated that the highest percentage of Iraqi people recommended the Pfizer vaccine.

Predominant symptoms before and after the launch of the COVID-19 vaccination campaign in Iraq include fever (52.0%) followed by headache (50.0%), loss of smell (50.0%), Muscle Pain (46.0%) and cough (41.0%). The same results were stated in unvaccinated individuals after the launch of the COVID-19 vaccination campaign in Iraq. Surprisingly we noticed a decline in the percentage of symptoms in reinfected and post-vaccinated patients. In India, the majority of healthcare workers had a symptomatic infection (318[90.6%]), predominantly with fever (75.1%) followed by myalgia (52.2%), cough (37.4%) and loss of smell 32.7% (Nisha *et al*., 2022). The current study demonstrated that 51% and 27% of infected HCWs in partially and fully vaccinated, respectively. The findings of the previous study showed a well-protection rate in persons with dual immunity (derived from natural infection and vaccination) from admission to hospital or exposure to severe disease for the year with little decline but still high protection against reinfection and reported 97.4% and 41.8% protection rate against infection and reinfection, respectively after one year in patients with hybrid immunity. In contrast, 74.6% and 24.7% protection rates against infection and reinfection, respectively in patients who a previously exposed to infection but had not been vaccinated (Torjesen, 2023).

## Conclusion

The high prevalence of COVID-19 in the present study was within age groups (41-45 years) of infected HCWs. Incidence was higher among doctors (36.0%) and most of the participants had chronic illnesses predominately hypertension and DM. Distribution of the COVID-19 vaccination status and post-vaccination COVID-19 infection among HCWs show that most participants were vaccinated with at least one dose which was more than those not taking vaccines. Predominant symptoms before and after the launch of the COVID-19 vaccination campaign in Iraq include fever, headache and loss of smell, Muscle Pain and cough. The same results were stated in unvaccinated individuals after the beginning of the COVID-19 vaccination campaign in Iraq. Interestingly it is noticed a decline in the percentage of symptoms in reinfected and post-vaccinated patients.

## Acknowledgment

We appreciate and thank the staff of Surveillance Section, Al-Sader Teaching Hospital.

**Conflict of Interest.** The authors declare that they have no conflict of interest.

## References


Bandyopadhyay, S., Baticulon, R.E., Kadhum, M., Alser, M., Ojuka, D.K., Badereddin, Y., Kamath, A., Parepalli, S.A., Brown, G., Iharchane, S., Gandino, S. Markovic-Obiago, Z., Scott, S., Manirambona, M., Machhada, A., Aggarwal, A., Benazaize, L., Ibrahim, M., Kim, D., Tol, I., Taylor, E.H., Knighton, A., Bbaale, D., Jasim, D., Alghoul, H., Reddy, H., Abuelgasim, H.,Sigler, A., Saini, K., Abuelgasim, L., Romero, M.M., Kumarendran, M., Abu Jamie, N., Ali, Q., Sudarshan, R., Dean, R., Kisyova, R., Kelzan, S., Roche, S., Ahsan, T., Mohamed, Y., Dube, A.M., Gwini, G.P., Gwokyalya, R., Brown, R., Papon, M.R.K.K., Li, Z., Ruzats, S.S., Charuvila, S., Peter, N., Khalidy, K., Moyo, N., Alser, O., Solano, A., Perez, E.R., Tariq, A., Gaddah, M., Kolovos, S., Muchemwa, F.C., Saleh, A., Gosman, A., Villanueva, R.P., Jani, A., Khundkar, P. 2020. Infection and mortality of healthcare workers worldwide from COVID-19: a systematic review. *British Medical Journal Global Health*, **5:** e003097.

Centers for Disease Control and Prevention. 2021. People with certain medical conditions. National public health agency. Retrived April 8, 2021 from https://www.cdc.gov/covid/risk-factors/index.html

Dev, N., Meena, R.C., Gupta, D.K., Gupta, N., Sankar, J. 2021. Risk factors and frequency of COVID-19 among healthcare workers at a tertiary care centre in India: a case–control study. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **115:** 551-556.

Dong, E., Du, H., Gardner, L. 2020. An interactive web-based dashboard to track COVID-19 in real time. *The Lancet Infectious Diseases*, **20:** 533-534.

Garduño-Orbe, B., Sánchez-Rebolledo, J.M., Cortés-Rafael, M., García-Jiménez, Y., Perez-Ortiz, M., Mendiola-Pastrana, I.R., López-Ortiz, E., López-Ortiz, G. 2021. SARS-CoV-2 reinfection among healthcare workers in Mexico: case report and literature review. *Medicina*, **57:** 442.

Goenka, M.K., Afzalpurkar, S., Goenka, U., Das, S.S., Mukherjee, M., Jajodia, S., Shah, B.B., Patil, V.U., Rodge, G., Khan, U., Bandyopadhyay, S. 2020. Seroprevalence of COVID-19 amongst health care workers in a tertiary care hospital of a metropolitan city from India. *Journal of the Association of Physicians of India*, **68:** 14-19.

Gogoi, G., Das, M., Borkakoty, B., Borgohain, M., Das, A.K. 2021. Suspected SARS-Cov-2 reinfections in health care workers from Assam, India: are they true reinfections. *Indian Journal of Pathology and Oncology*, **8:**10-16.

Hall, V.J., Foulkes, S., Charlett, A., Atti, A., Monk, E.J., Simmons, R., Wellington, E., Cole, M.J., Saei, A., Oguti, B., Munro, K., Wallace, S., Kirwan, P.D., Shrotri, M., Vusirikala, A., Rokadiya, S., Kall, M., Zambon, M., Ramsay, M., Brooks, T., Brown, C.S, Chand, M.A., Hopkins, S., IREN Study Group†. 2021. SARS-CoV-2 infection rates of antibody-positive compared with antibody-negative health-care workers in England: a large, multicentre, prospective cohort study (SIREN). *The Lancet*, **397:** 1459-1469.

Jawad, M.J., Hasan, I.S., Hassan, S.M., Fatima, G., Hadi, N.R. 2022. Evaluation of COVID-19 vaccines efficacy in Iraqi peoples. *Wiadomosci Lekarskie*, **75:** 929-937.

Jung, S. 2024. Associations between COVID-19 incidence, weight status and social participation restrictions in the US: evidence from the national population, cross-sectional study. *BMC Public Health*, **24:** 1066.

Kaplan, R.M., Milstein, A. 2021. Influence of a COVID-19 vaccine's effectiveness and safety profile on vaccination acceptance. In: *Proceedings of The National Academy of Sciences*, **118:** e2021726118, USA.

Mahajan, N.N., Mathe, A., Patokar, G.A., Bahirat, S., Lokhande, P.D., Rakh, V., Gajbhiye, R., Rathi, S., Tilve, A., Mahajan, K., Mohite, S.C.C. 2020. Prevalence and clinical presentation of COVID-19 among healthcare workers at a dedicated hospital in India. *Journal of the Association of Physicians of India*, **68:** 16-21.

Menni, C., Klaser, K., May, A., Polidori, L., Capdevila, J., Louca, P., Sudre, C.H., Nguyen, L.H., Drew, D.A., Merino, J., Hu, C., Selvachandran, S., Antonelli, M., Murray, B., Canas, L.S., Molteni, E., Graham, M.S., Modat, M., Joshi, A.D., Mangino, M., Hammers, A., Goodman, A.L., Chan, A.D., Wolf, J., Steves, C.J., Valdes, A.M., Ourselin, S., Spector, T.D. 2021. Vaccine side-effects and SARS-CoV-2 infection after vaccination in users of the COVID Symptom Study app in the UK: a prospective observational study. *The Lancet Infectious Diseases*, **21:** 939-949.

Monod, M., Blenkinsop, A., Xi, X., Hebert, D., Bershan,

S., Tietze, S., Baguelin, M., Bradley, V.C., Chen, Y., Coupland, H., Filippi, S., Ish-Horowicz, J., McManus, M., Mellan, T., Gandy, A., Hutchinson, M., Vollmer, A.M., Weber, S., Zhu, H., Bezancon, A., Ferguson, N.M., Mishra, S., Flaxman, S., Bhatt, S., Ratmann, O.2021. Age groups that sustain resurging COVID-19 epidemics in the United States. *Science*, **371:** eabe8372.

Nisha, B., Dakshinamoorthy, K., Padmanaban, P., Jain, T., Neelavarnan, M. 2022. Infection, reinfection, and postvaccination incidence of SARS-CoV-2 and associated risks in healthcare workers in Tamil Nadu: a retrospective cohort study. *Journal of Family and Community Medicine*, **29:** 49-55.

Patil, Y., Kesari, M., Agrawal, S., Dholpure, M., Reheman, H. 2021. Post vaccination COVID infection in health care workers at a tertiary care centre: a retrospective cohort study. *International Journal of Contemporary Medical Research*, **8:** 1-5.

Torjesen, I. 2023. Covid-19: vaccination plus infection offers best protection, finds study led by WHO. *British Medical Journal*, **380:** 171.

Ullah, M., Mubashir, M., Atique, H., Aslam, F., Tahir, M., Naqvi, M. 2022. COVID-19 infection in vaccinated healthcare professionals. *Cureus*, **14:** e23386.

Yoon, S.S., Lim, Y., Jeong, S., Han, H.W. 2023. Association of weight changes with SARS-CoV-2 infection and severe COVID-19 outcomes: a nationwide retrospective cohort study. *Journal of Infection and Public Health*, **16:** 1918-1924.