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The breakthrough of covid19 infection after vaccination in healthcare workers in Al Diwanyiah governorate

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Abstract
A huge effort has been made to produce and deliver vaccinations at an unprecedented level as part of the global fight against the COVID-19 pandemic. the threat of breakthrough infections has persisted, casting doubt on the effectiveness of these shots and the persistent difficulties in controlling the pandemic. Aim of the study to find the prevalence of breakthrough covid19 infection and its associated risk factors. We conducted cross sectional study enrolled 200 healthcare workers from Al-Diwanyiah governorate. The participant was asked to answer a structured questionnaire who were either interviewed face-to-face by the authors or filled by the participant. The study involved 200 patients with Covid-19 vaccinations, with 47% aged 28-37, and 5% elderly. 55% were female, with 25% doctors, 22.5% pharmacists, 6% dentists; there were 77 cases with post-vaccination infections in overall. After immunization, the prevalence of COVID-19 infection was 39%, there is no statistically significant association (p=0.202) between the age category and infection severity. However, there is a statistically significant association (0.012) between severity and gender. Regarding to the worker's place of employment, there was a statistically significant association (p=0.004) between the severity of infection and all cases of severe illness among the pharmacies group. The findings underscore that while breakthrough infections can occur, particularly among healthcare workers, vaccination remains a vital tool in mitigating severe illness and preventing hospitalizations. This reinforces the critical role of continued vaccination efforts in controlling the spread and impact of COVID-19.

Keywords: Covid-19, vaccine, pandemic, outbreak, healthcare workers

Introduction

The global battle against the COVID-19 pandemic has witnessed a great effort to develop and distribute vaccines at an unprecedented pace [1]. In Iraq, as in many parts of the world, the rollout of COVID-19 vaccinations has been a critical strategy in curbing the spread of the virus and preventing severe illness and death. However, even as vaccination programs have expanded to include all adults, the specter of breakthrough infections has remained, raising questions about the efficacy of these vaccines and the ongoing challenges in managing the pandemic [2]. This study investigates a particular aspect of the immunization program in Iraq by concentrating on a healthcare facility that serves a particular patient population [3].

However, Severe acute respiratory syndrome coronavirus (SARS-Covid19)-2, a novel RNA coronavirus from the same family as SARS-Covid19 and Middle East respiratory syndrome coronavirus (MERS-Covid19), was identified in early January 2020 as the cause of a pneumonia epidemic affecting the city of Wuhan, the capital of Hubei province, from where it rapidly spread across China [3-5]. After infecting and causing the deaths of thousands of people in China, the presentation of COVID-19 varies considerably from asymptomatic individuals and those presenting with mild respiratory symptoms to the more severe spectrum of disease requiring hospitalization [6].

Furthermore, COVID-19 vaccinations began outside clinical trials on December 8, 2020 [7]. By December 8, 2021, 45.5% of the global population had received two doses, 4.3% had received a booster, and 55.9% had received at least one dose [8]. Despite the vaccines' high efficacy, breakthrough infections can still occur as no vaccine offers 100% protection [9]. Healthcare professionals in Baghdad showed low acceptance of the vaccines, potentially impacting disease control efforts [10]. In Iraq, three vaccines—Sino pharm, AstraZeneca-Oxford, and Pfizer-BioNTech—are available, with varying efficacy rates. The Pfizer vaccine (BNT162b2) uses mRNA technology, AstraZeneca (ChAdOx1 nCoV-19) uses an adenoviral vector, and Sino pharm's BBIBP-CoV is an inactivated virus vaccine [11]. Despite its lower T cell response, Sino pharm was the first administered in Iraq. Globally, vaccine efficacy (VE) against severe COVID-19, particularly with the mRNA vaccines, began declining by mid-2021, especially with the emergence of the Delta variant, though protection against severe disease remained substantial [12]. However, VE against the Omicron variant waned over time, even with booster doses, highlighting the need for ongoing monitoring and possibly updated vaccination strategies [13].

The central aim of this research is to shed light on the occurrence of breakthrough COVID-19 infections among the dedicated healthcare professionals of this institution.

Material and methods

Sample collection

A cross-sectional study was conducted involving 200 healthcare workers (HCWs) from Al-Diwaniyah governorate. Data were collected between March 2023 and October 2023 from HCWs at Al-Diwaniyah Teaching Hospital, Al-Taliaa Healthcare Center, and the Public Health Department. Participants were selected using a convenience sampling method. The study included HCWs aged 18 to 60 who had received at least one dose of a COVID-19 vaccine available in Iraq (Sino pharm, AstraZeneca, or Pfizer) [14]. Those with immune-suppressive conditions, on immune-suppressive medication, or vaccinated outside of Iraq with vaccines not available in the country were excluded. Participants, including physicians, nurses, pharmacists, dentists, paramedics, and laboratory technicians, completed a structured questionnaire either through face-to-face interviews or by self-completion. Informed consent was obtained from all participants [15].

The questionnaire used to estimate study

The questionnaire consisted of 17 questions. The first section covered questions about workplace, age, gender, occupation, and concomitant conditions, among other demographic details. The second section contained information on COVID infection and vaccination, including a pre-vaccination history of COVID infection, the type of vaccine, and the number of doses. The final section included information the time and severity of their COVID-19 infection, and if they contracted BT after vaccination. The questionnaire asked about social distancing, hand washing, mask wearing, and other COVID-19 preventive measures, as well as potential confounders related to workplace and community attitudes. For instance, it asked if the participant had had any close contact with an infected person during the post vaccination period.

Diagnosis of breakthrough infection

Breakthrough COVID-19 infection following vaccination (BCV): tested positive for SARS CoV-2 RNA or antigen in respiratory sample or diagnosed to have COVID-19 using imaging methods after 14th day following receipt of vaccine. BCV based on signs and symptoms suggestive of COVID-19: individual who have developed signs & symptoms strongly suggestive of COVID-19 after 14th day following receipt of vaccine. Severe COVID-19 was defined as any case that required oxygen therapy or hospitalization [16-18].

Statistics

Version 26 of the Statistical Package for the Social Sciences was used for analyzing all the data. For the medical anamnesis and demographic data, descriptive statistics were used. The related risk variables for post-vaccination SARS-CoV-2 infection were identified using chi_ square test. A statistically significant p-value was defined as ≤0.05.

Results

The study sample included 200 patients with various Covid-19 vaccinations, and the majority of study participants were from the age group of 28-37 years (47%), and only (5%) were elderly people (58-60 years). The percentage of participants was more female than male (54.5% and 45.5%, respectively), and the professions included in the study were 25% doctors, 22.5% pharmacists, 6% dentists, and 14% nurses. In addition, the results found that 74% of the total sample were working in non-Covid19 areas and 26% were working in Covid centers. Regarding comorbidities, the results showed that 84.5% of the study sample did not suffer from any comorbidities, while 15.5% suffered from asthma, diabetes, and hypertension. As shown in Table 1.

Table 1: Distribution of study sample according to demographic characteristic. N=200

Variables		Frequency	Percent
Age/years	18-27	31	15.5
	28-37	94	47
	38-27	40	20
	48-57	25	12.5
	58-60	10	5
	Total	200	100
Gender	Female	109	54.5
	Male	91	45.5
	Total	200	100
Occupation	Dentist	12	6
	doctor	51	25.5
	nurse	28	14
	Other *	64	32
	pharmacist	45	22.5
	Total	200	100
Place of worker	Covid center	52	26
	Non Covid center	148	74
	Total	200	100
Co morbidities	No	169	84.5
	Yes	31	15.5
	Total	200	100

In respect to the correlation between co-morbidity and infection after vaccination, the findings revealed that 15.6% of participants with co-morbidity had infection, although there was no statistically significant correlation between the types of comorbidity and infection after vaccination (p = 0.067) as displayed in Table 2.

Table 2: Relationship between infection post vaccination and co-morbidity characteristic. N=200

	Infection Post-Vaccination		**Total**	**P value**
	No	**Yes**		
No	104	65	169	0.979
	84.60%	84.40%	84.50%	
Yes	19	12	31	Df=1
	15.40%	15.60%	15.50%	
Total	123	77	200	Chi Square test=0.001a
	100.00%	100.00%	100.00%	
Diseases	Infection post-vaccination		Total	P value
	No	Yes		
No	104	65	169	0.067
	84.60%	84.40%	84.50%	
Asthma	1	3	4	
	0.80%	3.90%	2.00%	
DM	10	1	11	Df=3
	8.10%	1.30%	5.50%	
HT	8	8	16	Chi Square test=7.163
	6.50%	10.40%	8.00%	
Total	123	77	200	
	100.00%	100.00%	100.00%	

In the current study, 75.30% of infection post-vaccination had a history of COVID-19 infection pre-vaccination and without statistical association (p = 0.149). The correlation between infection post-vaccination and types of vaccine, the results showed more infection among participants that were vaccinated by Pfizer type but without statistical association (p = 0.213). Also, there is no statistically significant association between the number of vaccine doses and infection post-vaccination (p = 0.517) as shown in Table 3.

Table 3: Relationship between infection post vaccination and vaccination characteristic. N=200

History of covid19 infection pre-vaccination	**Infection post-vaccination**		**Total**	
	No	**Yes**		**P value**
No	41	19	60	0.194
	33.30%	24.70%	30.00%	
Yes	82	58	140	Df=1
	66.70%	75.30%	70.00%	
Total	123	77	200	chi square test=1.690
	100.00%	100.00%	100.00%	
Vaccine manufacturer	Infection post vaccination		Total	P value
	No	Yes		
AstraZeneca	16	17	33	
	13.00%	22.10%	16.50%	
Mix vaccine	2	2	4	0.213
	1.60%	2.60%	2.00%	
Pfizer	86	43	129	Df=3
	69.90%	55.80%	64.50%	
Sino pharm	19	15	34	
	15.40%	19.50%	17.00%	chi square test=4.492
Total	123	77	200	
	100.00%	100.00%	100.00%	
Doses	Infection post vaccination		Total	P value
	no	yes		
One	3	4	7	
	2.40%	5.20%	3.50%	
Two	118	71	189	0.517
	95.90%	92.20%	94.50%	
Three	2	2	4	Df=2
	1.60%	2.60%	2.00%	
Total	123	77	200	chi square test=1.321
	100.00%	100.00%	100.00%	

In the current study found 100% of severe infection were among patient who vaccinated by Pfizer but without statistical association (p = 0.129). Also, there is no statistically significant association between the number of vaccine doses and severity of infection post-vaccination (p = 0.116) as shown in Table 4.

Table 4: Relationship between severity of infection post vaccination and vaccination characteristic=77

Vaccine manufacturer	Severity of infection post-vaccination			Total	P value
	Mild	Moderate	Sever		
AstraZeneca	10	7	0	17	0.129
	28.60%	19.40%	0.00%	22.10%	
Mix vaccine	0	2	0	2	
	0.00%	5.60%	0.00%	2.60%	Df=6
Pfizer	20	17	6	43	
	57.10%	47.20%	100.00%	55.80%	
Sinopharm	5	10	0	15	
	14.30%	27.80%	0.00%	19.50%	chi square test=9.895
Total	35	36	6	77	
	100.00%	100.00%	100.00%	100.00%	
Doses	Severity of infection postvaccination			Total	P value
	Mild	Moderate	Sever		
One	0	4	0	4	0.116
	0.00%	11.10%	0.00%	5.20%	
Two	35	30	6	71	Df=4
	100.00%	83.30%	100.00%	92.20%	
Three	0	2	0	2	
	0.00%	5.60%	0.00%	2.60%	chi square test=7.411
Total	35	36	6	77	
	100.00%	100.00%	100.00%	100.00%	

Discussion

This study offers important new information about how well a sample of 200 participant responded to COVID-19 vaccines. A few important topics to talk about: First Patients in the 28–37 age range made up the bulk of the participant, with a slightly higher percentage of females. A sizable fraction of the sample is made up of physicians and pharmacists. 84.5% had no comorbidities. The manufacturer that gave immunizations the most frequently was Pfizer. This could be a reflection of the vaccination preferences of the study population this finding similar to the finding for other study that carry out in Karbala, Iraq [19] Despite this, a sizable proportion of infection happened in those who received the Pfizer vaccination, suggesting breakthrough infections.

The study found 77 cases of post-vaccination COVID-19 infections, indicating a breakthrough infection rate of 39% among the vaccinated population, This finding parallels the findings of a study carried out in Baghdad which reported that Despite the aforementioned three vaccines minimizing the severity of infection but not preventing the occurrence of infection, this is evidenced and indicated by the high prevalence of COVID-19 IgG and IgM in vaccinated patients, which is released to support the immune system [20].

This percentage is higher as compared to another local study that have been done in Duhok showed that breakthrough infection is 25.5% [21], unlike our study, lower incidence of BT infection reported from united state [22] and united Kingdom [23], Different variants influenced the infection rate over time, therefore exposure to different variants at different times may have confused the waning of protection. [24] also, the waning of vaccine immune response after a 28 few months of the second dose cause reduction in vaccine protection, as reported in study from Qatar that reveal waning in vaccine effectiveness after 6 months from the second dose [25] Presumably, individuals who have received the vaccination possess an elevated level of social interaction in comparison to those who have not been vaccinated. Additionally, it is possible that these vaccinated individuals exhibit reduced compliance with safety protocols, as evidenced by the finding that 36.4 percent of vaccinated healthcare workers do not adhere to social distancing or preventive measures [26].

The research divided COVID-19 instances that occurred after vaccination into three groups: mild, moderate, and severe. Notably, only a small proportion of cases required hospitalization; the majority were mild or moderate. This implies that immunization continues to provide an effective protection against severe illnesses and hospitalizations [27]. Data from various nations indicates that approximately 14-19% of individuals who contract COVID-19 require hospitalization, while a further 3-5% experience a more severe manifestation of the disease necessitating intensive care [28] After vaccination, the study observed no significant relationship between age group and infection rates, gender or occupation. In the current investigation, while considering the risk factors linked to vaccine BT among fully vaccinated HCWs, no meaningful association between BT infection and gender, age, comorbidities, workplace, or occupation was discovered. Nevertheless, doctors exhibited an increased association with BT infection Based on research conducted in India, it has been observed that doctors are more likely to experience breakthrough infections, possibly due to their increased exposure to viral agents in clinical settings [29]. Additionally, it was observed that females have a slightly higher rate of BT infection. Moreover, non-COVID facilities exhibited a higher rate of BT infection compared to COVID centers. There was no statistically relation between co-morbidity and infection after vaccination ($p = 0.067$) unlike many other study [30, 31] that found associations between comorbidities and BT infection that may be related to the convenience sample of our research that contain only 15.5 percent that have chronic disease, In our study we found that higher post-vaccination COVID-19 infections in individual that have pre vaccination history of infection, unlike study conducted in Belgium that found higher BT in those who have infection before vaccination [31] In our investigation, there's no significant associations between age and infection severity, But we have identified a notable association between the intensity of BT and gender, with a higher prevalence observed among the female population as

opposed to their male correspondents, which diverges from the findings of a distinct inquiry conducted in the northern region of India [32] that found the severity of BT infection more in male than female In our investigation, it was determined that a significant association exists between specific professions and the degree of breakthrough Covid-19 infection. It was found that physicians and pharmacists have a higher propensity for experiencing moderate to severe infections [33-35].

Conclusion

The study found that most vaccinated individuals were between 28-37 years old, with a slight majority being female. A significant portion of the participants were healthcare professionals, especially doctors and pharmacists. Pfizer was the most common vaccine, but many still experienced breakthrough infections, including those who received Pfizer. This highlights the need for continued safety measures and monitoring, as immunity can decrease over time, and new variants may reduce vaccine effectiveness. While age, gender, and existing health conditions weren't linked to breakthrough infections, healthcare workers, particularly doctors, faced a higher risk due to their job exposure. Interestingly, more females experienced breakthrough infections, suggesting gender-specific factors might influence vaccine effectiveness. Additionally, doctors and pharmacists were more likely to have moderate to severe breakthrough infections, likely due to their occupational exposure.

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