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Does the COVID Vaccine really help? A cross-sectional study to assess the positivity rate among Health Care Workers and staff members at Tertiary Care Hospitals

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A B S T R A C T

Background: The unprecedented COVID-19 pandemic has spurred a worldwide race for the development of effective vaccines to combat the SARS-CoV-2 virus. A prevailing strategy in numerous vaccine initiatives has been to target the virus's spike (S) protein, a critical component for viral entry into host cells. As trillions of doses of COVID-19 vaccines are being administered across the globe, the profound impact of these vaccines on mitigating the devastating effects of the disease is becoming increasingly evident.

Objective: To assess the impact of COVID-19 vaccination on healthcare workers in five tertiary care hospitals across different cities in Pakistan.

Methodology: The study included 372 participants aged 16 years and above, who were healthcare workers at selected tertiary care hospitals. A questionnaire with 15 standardized questions was circulated among the individuals, from September 2021 to March 2023. Data analysis was performed using SPSS V21.0, and chi-square test was applied.

Results: The mean age of the participants was 46.2 years, with 53.51% being female. COVID-19 infections were most common among Ward Staff (34.59%) and Nurses (30.08%) after vaccination. The nasal swab test was the primary method for detecting SARS-COVID-19 (97%). A majority of infected workers were female (64%). Most participants (93%) were vaccinated, with 53.27% receiving two doses, 24.27% one dose, and 15.83% a third booster dose.

Conclusion: The study revealed that breakthrough infections among healthcare workers were observed even after vaccination. Most infections occurred after the first dose. A significant proportion of infected workers reported persistent symptoms, including "long COVID-19." While a majority recommended vaccination to others, some believed that the vaccine did not prevent infection but resulted in milder symptoms.

Keywords: Booster Dose; Co-morbidities; COVID-19; Healthcare Impact; Symptoms; Vaccination

Introduction

The COVID-19 pandemic, declared a global public health crisis by the World Health Organization (WHO), has profoundly impacted global health, economies, and daily life. Coronaviruses, a diverse group of single-stranded large RNA viruses found in various mammals and birds, belong to the Coronaviridae family. COVID-19, caused by the novel coronavirus SARS-CoV-2, has demonstrated a remarkable ability to spread through both direct and indirect contact, leading to unprecedented challenges in public health management.[1,2]

Governments worldwide have adopted various strategies to mitigate the spread of COVID-19, including implementing lockdowns and enforcing "stay at home" policies. These measures, while necessary for public health, have had significant socio-economic repercussions, underscoring the urgent need for effective medical interventions, particularly vaccines. The first COVID-19 vaccine was administered in China on December 31, 2019, marking a significant milestone in the fight against the pandemic. Pakistan commenced its vaccination campaign in February 2020, joining the global effort to immunize populations against this devastating disease.[3,4]

Since its emergence in November 2019, COVID-19 has affected approximately 25 territories and 188 countries. Despite extensive containment efforts by governments and the WHO, the virus's highly contagious nature has posed a major challenge in controlling its spread. This situation has underscored the critical role of vaccine development in combating the pandemic. The S-Protein of the virus has been a focal point in many vaccine initiatives, given its key role in the virus's ability to infect human cells.[4]

As of July 2, 2020, there were 158 vaccine candidates for SARS-CoV-2 worldwide, with 135 in various stages of development. Notable among these are the vaccine candidates from the University of Oxford (ChAdOx1), CanSino Biologicals (Ad5-nCoV), Inovio, Inc (INO-4800), Shenzhen Geno-Immune Medical Institute (LV-SMENP-DC, Pathogen-specific aAPC), and Moderna (mRNA-1273). These candidates had entered into phase one or two clinical trials, demonstrating the rapid mobilization of scientific resources in response to the pandemic. The diverse approaches employed in these vaccine developments, including live attenuated viruses, inactivated viruses, protein subunits, virus-like particles (VLPs), viral vectors (both replicating and non-replicating), RNA, DNA, and nanoparticles, each present distinct advantages and challenges.[5]

The development and deployment of COVID-19 vaccines have been a testament to the extraordinary capabilities of modern science and medicine. Vaccination against COVID-19 has now reached billions of people worldwide, offering life-saving protection against a disease that has claimed millions of lives. The vaccines represent not only a technical achievement but also a beacon of hope for the eventual control of the pandemic. However, the journey from vaccine development to widespread immunization has been fraught with challenges, including logistical hurdles, vaccine hesitancy, and the emergence of new variants of the virus.

As the pandemic continues, the role of vaccines in providing a defense against COVID-19 cannot be overstated. The rapid development of multiple vaccine candidates reflects a remarkable global scientific collaboration. However, the equitable distribution of these vaccines remains a significant challenge, particularly in low- and middle-income countries. The disparity in vaccine access underscores the need for international cooperation and resource allocation to ensure that all populations, regardless of geographic or economic status, can benefit from these life-saving interventions.

The COVID-19 pandemic has brought unprecedented challenges to global public health, economies, and societal structures. The rapid development and deployment of vaccines have been crucial in the fight against the pandemic, offering a path to eventual recovery. However, the journey is far from over, with ongoing efforts required to address the challenges of vaccine distribution, public hesitancy, and the evolving nature of the virus. The global response to COVID-19 will continue to shape the landscape of public health, scientific research, and international collaboration for years to come.

Objective

This quantitative cross-sectional study aimed to assess the impact of COVID-19 vaccination on healthcare workers in five tertiary care hospitals across different cities in Pakistan. The study focused on breakthrough infections, demographics, occupation, co-morbidities, vaccination records, and the perception of vaccine effectiveness among vaccinated individuals.

Methodology

This study presents a quantitative cross-sectional survey, focusing on Health Care Workers (HCWs) and staff members across five tertiary care hospitals in Pakistan. These hospitals include Fauji Foundation Hospital (FFH) in Rawalpindi, Margalla Institute of Health Sciences (MIHS) also in Rawalpindi, Islamic International Medical College (IIDC) in Islamabad, CMH Lahore Medical & Dental College, and Liaquat College of Medicine & Dentistry in Karachi.

The survey's target population comprised individuals who have received COVID-19 vaccination and are either working or studying in these tertiary care hospitals. The inclusion criterion was set for individuals aged 16 years and above. Conversely, individuals who had not received

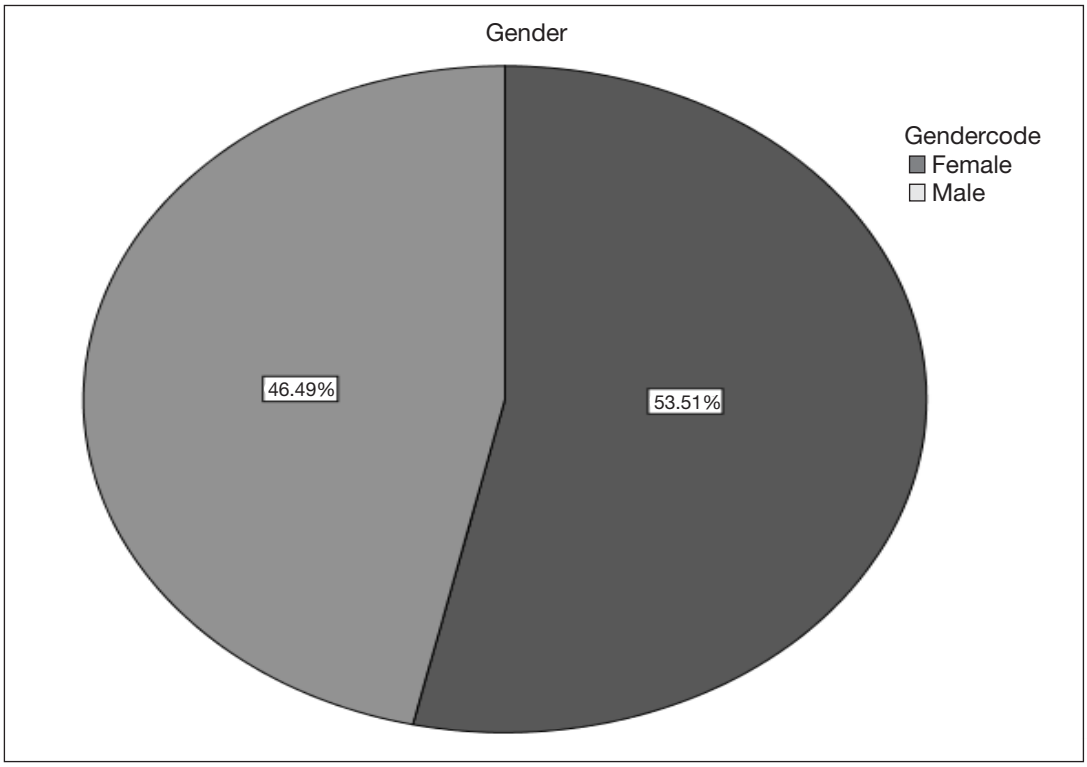

Figure 1. Gender base distribution of study cases

the COVID-19 vaccine were excluded from the study.

The methodological framework of this study involved the use of a specifically designed questionnaire, consisting of 15 standardized questions. These questions encompassed various domains such as demographics, occupational details, co-morbidities, vaccination records, instances of COVID-19 positivity post-vaccination, and individual perceptions regarding the vaccine's effectiveness.

In terms of data collection, the survey was conducted online, leveraging social media platforms for widespread dissemination. The timeline for this survey spanned from September 2021 to March 2023. The estimated sample size was determined to be 350, calculated in accordance with the World Health Organization (WHO) sample size calculator, ensuring a confidence interval of 95%.

Data analysis constituted a critical component of this research. The collected data was analyzed using the Statistical Package for the Social Sciences (SPSS) software, version 21.0. The chi-square test was employed as the primary statistical tool for analysis. This analytical approach was geared towards identifying the prevalence and characteristics of COVID-19 infections among the healthcare workers during the study period. This included the detection of asymptomatic infections.

A notable aspect of this study was the definition and

Table 1. Frequency of type of vaccine administered

Vaccine Brand	Frequency	Percent
Sinopharm	246	66.16
Sinovac	82	22.04
Pfizer	34	9.14
Other Brands	10	2.96
Total	372	100

Table 2. Frequency of the symptoms of patients with COVID-19

Symptom	Frequency	Percent
Upper Respiratory Congestion	134	36.02
Myalgia	104	27.96
Loss of Smell or Taste	104	27.96
Fever or Rigours	78	20.97
Symptoms (>14 days)	116	31.18
Long COVID-19 Symptoms (more than 2 weeks)	71	19.09
Total	372	100

identification of breakthrough infections. A breakthrough infection was defined as the detection of the SARS-CoV-2 virus through a PCR assay. The overarching goal of the study was to meticulously record and analyze every instance of infection among the healthcare personnel within the study's scope, providing valuable insights into the efficacy of COVID-19 vaccination among this critical demographic.

Results

The present study enrolled a total of 372 participants who met the stringent inclusion criteria, and their characteristics were meticulously analyzed. The mean age of the cohort stood at 46.2 years, with a noteworthy age range spanning from 36 to 54.1 years. Notably, 53.51% of the participants were of the female gender (Figure 1).

Within the spectrum of healthcare workers, the most prominently affected category was the Ward Staff, constituting 34.59% of the study population. Subsequently, Nurses accounted for 30.08%, PG trainees constituted 21.05%, House Officers comprised 6.02%, and Undergraduate Students and Demonstrators stood at 3.76% and 2.26%, respectively. Assistant/Associate Professors were the least affected at 1.50%. Interestingly, Janitor Staff who had received vaccinations and consultants/Professors were found to be the least affected categories (Figure 2).

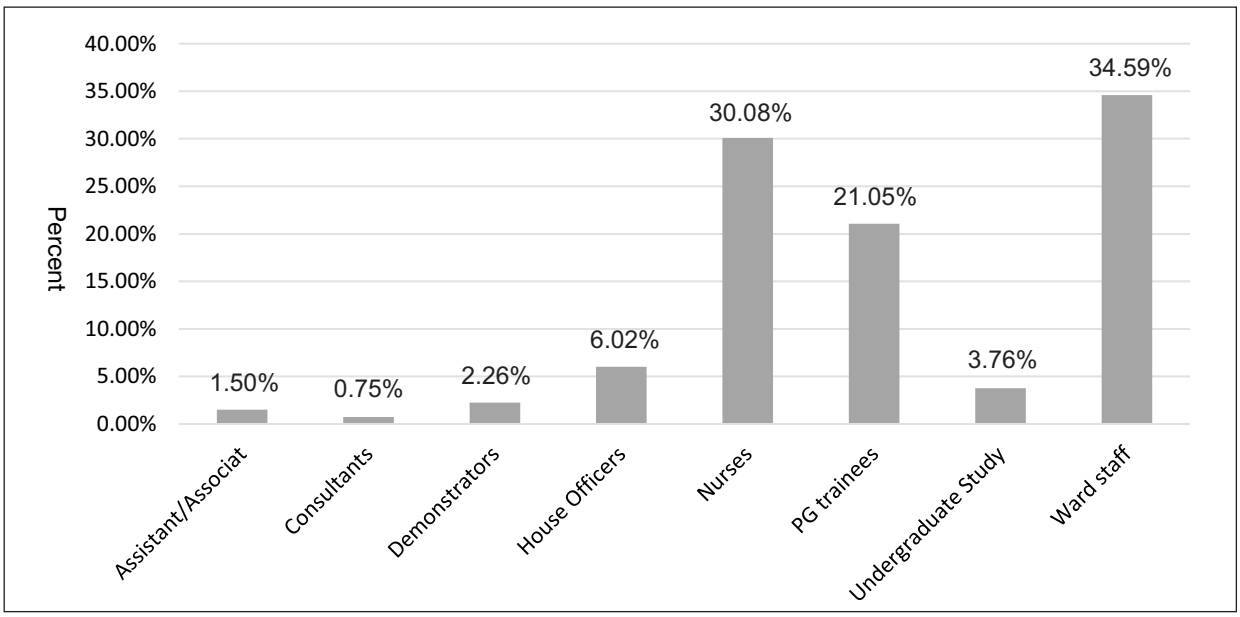

Figure 2. Rate of infection among study cases

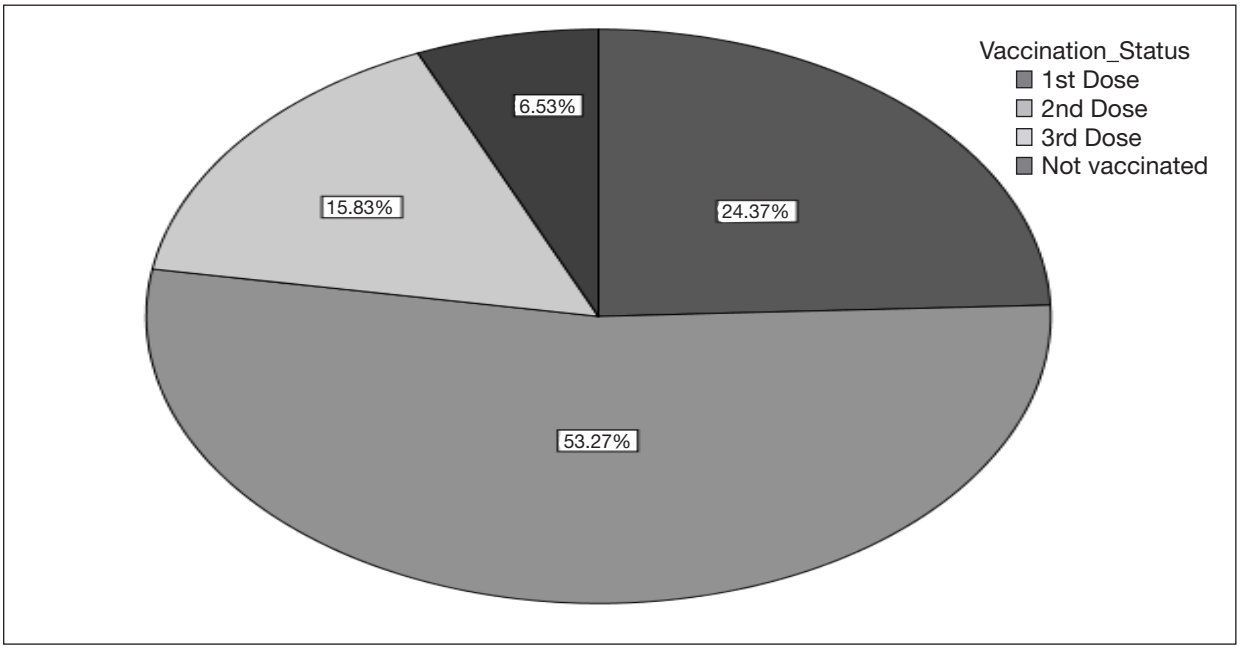

Figure 3. Frequencies of different vaccines administered to study cases.

Regarding diagnostic methodologies employed, the nasal swab test was overwhelmingly prevalent, utilized in 97% of cases, while the remaining 3% relied on throat swabs for diagnosis. Remarkably, despite the diversity in healthcare specialties, there were no discernible disparities between male and female healthcare workers concerning their susceptibility to the virus. An intriguing observation was that 93.47% of the participants had been vaccinated, in accordance with the hospital's policy, while only 6.53% remained unvaccinated. Among the vaccinated individuals, 53.27% had received both doses of the vaccine, 24.27% had only received a single dose, 15.83% had been administered a third booster dose, and the remaining 6.53% had chosen not to be vaccinated (Figure 3).

Examining the specifics of vaccine administration, it was found that Sinopharm was the most prevalent vaccine, administered to 66.16% of the study participants, followed by Sinovac at 22.04%, and Pfizer at 9.04%. A small fraction of individuals, approximately 3%, received vaccines of other brands (Table 1).

A significant observation emerged from the data, as 78.76% of participants tested positive for COVID-19 even after receiving vaccinations (Figure 4). Among these cases, 86% tested positive after the first vaccine dose, while 23% did so after the second dose. It is noteworthy that a majority of the participants adhered to Standard Operating Procedures (SOPs), although a lower percentage was observed among the lower staff. Among the afflicted individuals, 46% had underlying medical conditions, with the majority (56%) being known hypertensives, followed by 24% being Diabetic, 7% suffering from asthma, and 13% having other medical conditions.

The most prevalent reported symptom among the affected individuals was upper respiratory tract congestion, accounting for 36.02% of all cases, followed closely by myalgia (27.96%) and loss of taste or anosmia (27.96%). Notably, 20.97% of those afflicted experienced fever and rigors. Furthermore, 31.18% of those who contracted COVID-19 reported experiencing lingering symptoms even after 14 days from their initial diagnosis. In-depth inquiry revealed that 19.09% of participants endured "long COVID-19" symptoms, characterized by persistent issues such as prolonged loss of smell, a persistent cough, fatigue, weakness, dyspnea, or myalgia, persisting for up to 6 weeks post-diagnosis (Table 2).

Additionally, it was observed that 23% of individuals necessitated medical leave from work exceeding the prescribed quarantine period of 10 days. While the majority of employees in this category did return to work after two weeks, one worker was notably absent for a prolonged period, returning to work after six weeks. Importantly, 52% of respondents expressed their willingness to recommend COVID-19 vaccinations to others. On the contrary, some participants held the belief that the vaccine did not significantly impact their susceptibility to the virus; however, they did report experiencing milder symptoms following vaccination.

Discussion

The results provided in this study provide valuable insight

into impact of COVID 19 vaccination among healthcare workers in Pakistan, specifically those working in tertiary care hospitals. Notably, the occurrence of breakthrough infections among vaccinated healthcare workers has raised concerns. The fact that a significant proportion of these infections occurred after the first vaccine dose raises questions regarding the early efficacy of certain vaccines. It is crucial to conduct further investigations to determine whether these breakthrough infections are associated with new variants or other factors influencing vaccine effectiveness.

Research suggests that in general, women tend to adopt a more accountable attitude towards COVID 19 precautions compared to most men. Careless approach observed in some men, particularly regarding wearing of the mask, social distancing, hand hygiene, and obedience to home quarantine, may contribute to a higher infection rate among men.[7]

The variation in vaccination coverage among different categories of healthcare workers is an interesting finding. Ward staff and nurses appear to be more affected, likely due to their increased patient interactions. This underscores the importance of prioritizing these groups for booster doses and reinforcing strict adherence to safety measures. On the other hand, the lower infection rates among vaccinated janitorial staff and consultants/ professors may be attributed to reduced patient interaction or strict adherence to safety protocols.

Considering the prevalence of co-morbidities among infected participants, it is essential to acknowledge the vulnerability of healthcare workers with underlying medical conditions. This information can inform tailored vaccination strategies to effectively protect individuals with co-morbidities. Furthermore, the persistence of symptoms among infected healthcare workers, including "long COVID-19," highlights the necessity of comprehensive post-infection care and support within the healthcare community. Monitoring and addressing prolonged health issues among those affected is crucial, as it may impact their ability to provide continued patient care.

The varied perceptions of vaccine effectiveness among healthcare workers are noteworthy. While a majority recommended vaccination to others, a significant minority believed that the vaccine did not prevent infection but resulted in milder symptoms. This discrepancy emphasizes the need for clear and consistent communication regarding vaccine efficacy and the continued importance of adhering to safety measures even after vaccination.

Furthermore, our findings are consistent with research from the United Kingdom, which shows that, while age is the most significant risk factor for severe outcomes after COVID-19 infection, the presence of clinical comorbidities can also increase the risk of severe disease. Individuals with diabetes, severe asthma, chronic heart disease, chronic kidney disease (CKD), chronic liver disease, neurological conditions, or those receiving immunosuppressive therapy are more likely to be hospitalized or die as a result of COVID-19.[8] Many national vaccination programs have prioritized vaccination for people with these comorbidities as a result of these findings. Those at greatest risk of severe disease in the UK have been advised to'shield' by remaining isolated at home for extended periods of time. Along with older persons, this group was provided immunization beginning in January 2021. Individuals under the age of 65 in

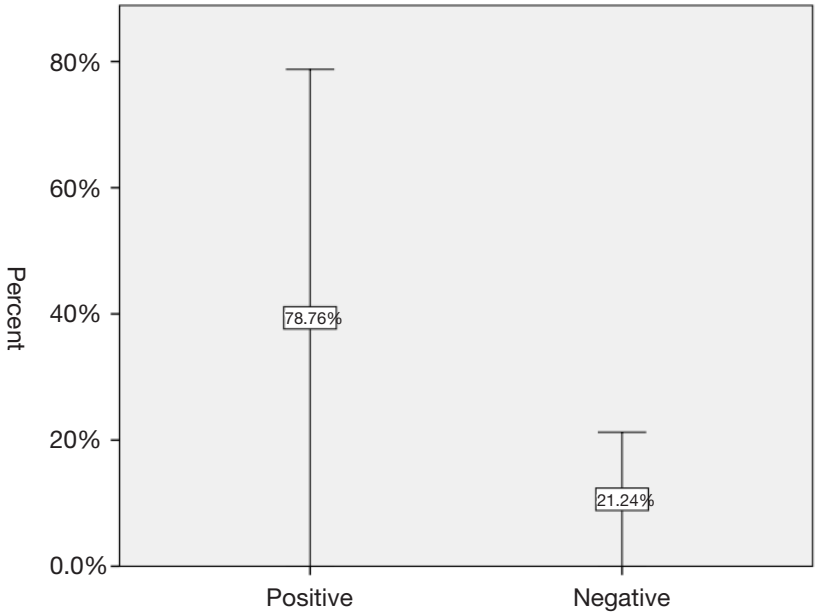

Figure 4. Rate of occurring of infection after vaccination

additional clinical risk groups will be offered immunization beginning in February 2021.[9]

The Middle East had one of the lowest rates of COVID-19 vaccination adoption rates in the world. Kuwait had the lowest acceptance rate (23.6%), followed by Jordan (28.4%), Saudi Arabia (64.7%), and Turkey (66.0%) (). COVID-19 vaccines have demonstrated significant levels of efficacy in clinical trials and real-world effectiveness studies in older persons, healthcare professionals, and the general public, however in our study, infectivity among patients remained but symptoms were reduced.[11,12] The data on the efficacy of these vaccines amongst people in clinical risk groups are limited.

Identifying immunological correlates of SARS-CoV-2 protection (or lack thereof) is crucial for forecasting how predicted antibody degradation would impact clinical outcomes, if and when a booster dose will be required, and if vaccinated people are protected. Predictive capability is very crucial in the creation of novel vaccines. Studies comparing the incidence of infection between seropositive and seronegative people have confirmed the hypothesis that the existence of neutralizing antibodies correlates with protection from reinfection.[9,12] Khoury et al.[13] and Earle et al.[14] have discovered that the neutralization level is significantly predictive of immune protection when population values from vaccination effectiveness and immunogenicity studies are compared. We present statistics from a vaccinated group that corroborate this association of protection.

Another study discovered that women have a somewhat stronger humoral immune response to the BNT162b2 vaccine (Pfizer-BioNTech).[8,15] As a result, women with breakthrough infections may exhibit reduced viral shedding.

Healthcare, notably dentistry, has the greatest risk jobs, although many nonhealthcare occupations are as vulnerable.[16] Life expectancy discrepancies across social and ethnic groups are likely to have grown in many nations, suggesting that COVID-19 has affected various groups differently. Although COVID-19-related deaths primarily affect the elderly, many of whom have underlying health concerns, there is some indication that an individual's occupation may contribute to the chance of getting infected and, hence, to the mortality pattern in society.[17]

In the face of evolving challenges posed by the pandemic, continued research, clear communication, and diligent adherence to safety measures remain vital components of our collective effort to combat COVID-19 and protect the health and well-being of our communities.

Conclusion

In conclusion, the COVID-19 vaccine, while facing significant challenges, has proven effective in reducing the severity of symptoms in vaccinated individuals compared to the unvaccinated, contributing to the global effort to reduce infection incidence. However, the successful deployment of immunization campaigns encounters hurdles such as mass manufacturing, equitable distribution, and concerns about long-term efficacy. The most formidable obstacle, often localized, is vaccine hesitancy. To address this, collaborative efforts between governments, health authorities, and media sources, especially on social media platforms, are crucial to build public trust in COVID-19 vaccination. Clear and timely communication through trusted channels advocating for vaccine safety and efficacy is paramount. This study on Pakistani healthcare workers highlights the importance of ongoing surveillance, customized immunization strategies, post-infection care, and effective communication in safeguarding healthcare personnel and their patients. Its findings hold potential for informing policies and healthcare procedures to better protect this vulnerable population amid the ongoing pandemic.

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