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Short Communication

Are we suffering from the Peltzman effect? Risk perception among recovered and vaccinated people during the COVID-19 pandemic in Israel

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ABSTRACT

Objectives: The challenge of waning immunity and reinfection has been an acknowledged concern since the beginning of the COVID-19 pandemic. In the ongoing outbreak, reinfection rates are increasing alongside breakthrough cases among vaccinated individuals. The objective of this study was to examine the demographic characteristics associated with vaccination uptake among individuals previously infected with COVID-19 and to evaluate the period elapsed between the last vaccine dose and infection. **Study design:** A retrospective-archive study was conducted.

Methods: Data were extracted from the Israeli Ministry of Health's open COVID-19 database.

Results: The study found that uptake of vaccination in previously infected individuals is relatively low. When examining gender, previously infected females were more likely to receive vaccination than previously infected males. Similarly, differences in vaccination uptake exist between age groups. When examining the interval between the last vaccine dose and infection, the most significant breakthrough infection rate was observed among individuals aged 20–59 years.

Conclusions: This study shows that there are specific populations subgroups that may serve as reservoirs of viral spread. Individuals in these groups may experience a false sense of security from a perceived sense of acquired long-term immunity, resulting in low levels of vaccine uptake and non-compliance with protective behaviours. Targeted messaging should be used to reemphasise the need for continued protective behaviours.

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Introduction

COVID-19 has shown the impact that a novel, infectious pathogen can have on all facets of life for the global community.¹ Despite the implementation of numerous measures, employed to varying degrees of stringency by different authorities, COVID-19 continues to spread. In December 2020, in addition to various other countermeasures, the emergence of effective vaccines and the subsequent inoculation campaigns were integrated into the fight against the pandemic. Although COVID-19 mitigation measures have been shown to be effective in reducing morbidity and

mortality rates, long-lasting flattening of the epidemic curve has not yet been achieved.³ Acquired immunity on an individual level is established either through vaccination or natural pathogen infection. COVID-19 immunity has been challenged by virologically confirmed reinfection of previously infected individuals and vaccine breakthrough cases.²

The challenge of fading immunity and reinfection has been an acknowledged concern since the beginning of the COVID-19 pandemic. Findings from epidemiological analyses have reported natural immunity protection from reinfection for 6–12 months. Reinfection can occur when immunity wanes over time or the pathogen's antigenicity evolves, resulting in immune evasion.³ Initially, it was uncertain whether individuals who had previously been infected would benefit from vaccination; however, subsequent findings have indicated that previously infected individuals would benefit from one vaccine dose.⁴

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The effectiveness of acquired immunity from the Pfizer BioNTech (BNT162b2) COVID-19 vaccine has demonstrated modest rates of breakthrough infection against the beta and delta COVID-19 variants, whereas other studies have reported higher rates.⁵ Moreover, Goldberg et al.⁶ indicated waning immunity a few months after receipt of a second inoculation dose. Thus, the present study aimed to (i) examine the demographic characteristics associated with vaccination uptake during the first year of an available vaccine in Israel among individuals who were previously infected with COVID-19 and (ii) evaluate the period elapsed between the last vaccine dose received (before infection) and infection. Given that reinfection and the emergence of novel variants have challenged the management of the ongoing COVID-19 pandemic, it is essential to determine which subgroups of the population have inadequate immunity.

Methods

A retrospective-archive study was conducted in Israel from 1 March 2020 to 31 December 2021. Data were obtained from the Israeli Ministry of Health's (MOH) open COVID-19 database. Data were also collected regarding the time elapsed between the last vaccine dose (adjusted to MOH guidelines) and infection.

First, an examination of the vaccination rates for the Pfizer BioNTech (BNT162b2) COVID-19 vaccine among previously infected and now recovered individuals, by the month of recovery, was conducted. For each confirmed patient, the vaccination status (yes or no) was examined from March 2020 to December 2021 (dynamic cohort).

Vaccination rates were compared by gender and by the following age groups: 0–19 years ($n = 3,333,889$); 20–59 years ($n = 4,446,308$); and ≥ 60 years ($n = 1,509,562$).

Non-vaccinated individuals are defined as those who did not receive any vaccine (or time of assessment was < 1 week after their first dose). Patients with reinfection after vaccination were excluded from this part of the investigation ($n = 182,611$ [17%]).

Separately, for all recovered patients who were infected after vaccination, we measured the period elapsed between the patient's most recent vaccine dose (before infection) and the infection itself.

The examined periods defined for each dose were: 1st dose ≥ 20 days; 2nd and 3rd doses: 31–90 days and ≥ 3 months.

The rate of infected patients after receiving a specific dose in the specific periods were computed and stratified by age groups. The reinfection percentage from the beginning of the pandemic to the end of the study period was examined for vaccinated and unvaccinated individuals.

Results

From the onset of the pandemic until the end of December 2021, 1,392,144 people in Israel tested positive for COVID-19. Approximately 30% of the patients who were diagnosed with COVID-19 in March 2020 did not take up the offer of vaccination by the end of the study period (December 2021). This percentage of individuals receiving vaccination increased over the following months (i.e. for patients infected in April, May, June 2020 etc), where the percentage of receiving the first dose of vaccination among those previously infected during the first year of the pandemic was fairly stable and remained at approximately 40%. In a sub-analysis, when examining gender, the rate of immunisation among recovering females was higher than among males by 3–4% in the majority of months (see Fig. 1). In addition, immunisation rates were relatively low in young people (aged 0–19 years) compared with older age groups (aged 20–59 years and ≥ 60 years [data not shown]).

When examining the interval between vaccination and infection according to age group, relative to the population, the rate of infection was highest among the young population during the period of 20 days after the first dose of vaccination. Similarly, when examining the second dose of vaccination, the youngest population (aged 0–19 years) had the highest rate of infection between 1 month and 3 months following vaccination. Despite these results, the general population experiences a higher rate of infection 3 months following the second dose of vaccine. The most significant infection rate was observed among the age group 20–59 years, where 3.6% of all those vaccinated with the second vaccine dose were infected ≥ 3 months after vaccination. Among the age groups 0–19 years and ≥ 60 years, infection rates of 1.53% and 1.33%, respectively, were recorded for individuals who were infected ≥ 3 months following a second vaccine dose.

When investigating infection rates after the third booster dose, a similar but more moderate trend was found in the long-term follow-up (90 days after vaccination) when a higher incidence of infection was found in the 20–59 years and ≥ 60 years age groups. Three months after receiving the third vaccine dose, infection rates increase significantly among all age groups compared with the shorter periods examined; in particular, the 20–59 years age group has an infection rate of 0.29%, followed by 0.21% among individuals aged ≥ 60 years and 0.08% in the 0–19 years age group. It is important to note that infection rates 3 months after receiving the third vaccine dose are significantly lower than infection rates 3 months after receiving the second vaccine dose.

Discussion

The present study identified that uptake of vaccination following infection is relatively low among Israeli residents. While scientific understanding about natural infection-derived immunity is continuously emerging, findings have shown that vaccination can provide improved protection for previously infected individuals.⁷ Furthermore, Kaim et al.⁸ indicated that previously infected individuals were also less compliant with additional protective health behaviours (e.g. mask wearing and social distancing), rendering this population group a significant potential reservoir of viral spread. Previously infected individuals who successfully recover may have a diminished perceived health risk and perceived severity of the virus. As risk perception and perceived severity have been shown to play an important role in adherence to protective behaviours, these individuals may be less likely to comply.⁹ Current literature shows that novel risks, such as the COVID-19 pandemic, often induce fear; however, repeated exposure to the risk may result in risk underestimation and reduced compliance with protective health behaviours.¹⁰ Consistent with studies on vaccine hesitancy, younger age was observed to be a predictor for lower vaccine uptake; however, the current findings relating to gender were inconsistent with previous results, where lower vaccine uptake was often observed among women.

The trends of infection suggest that individuals in the 20–59 years age group may serve as a critical potential source of viral spread, despite data concentrating on individuals who have been vaccinated. The results indicate the possibility that this population group may also become less vigilant about protective behaviours and engage in more risky behaviours, as described by the Peltzman effect.¹¹

The present study reveals insights from the COVID-19 global pandemic. Specifically, this study emphasises the importance of improved public communication strategies for promoting uptake of protective health behaviours and emphasising the necessity of continued vigilance in behaviour during times of crises. The current

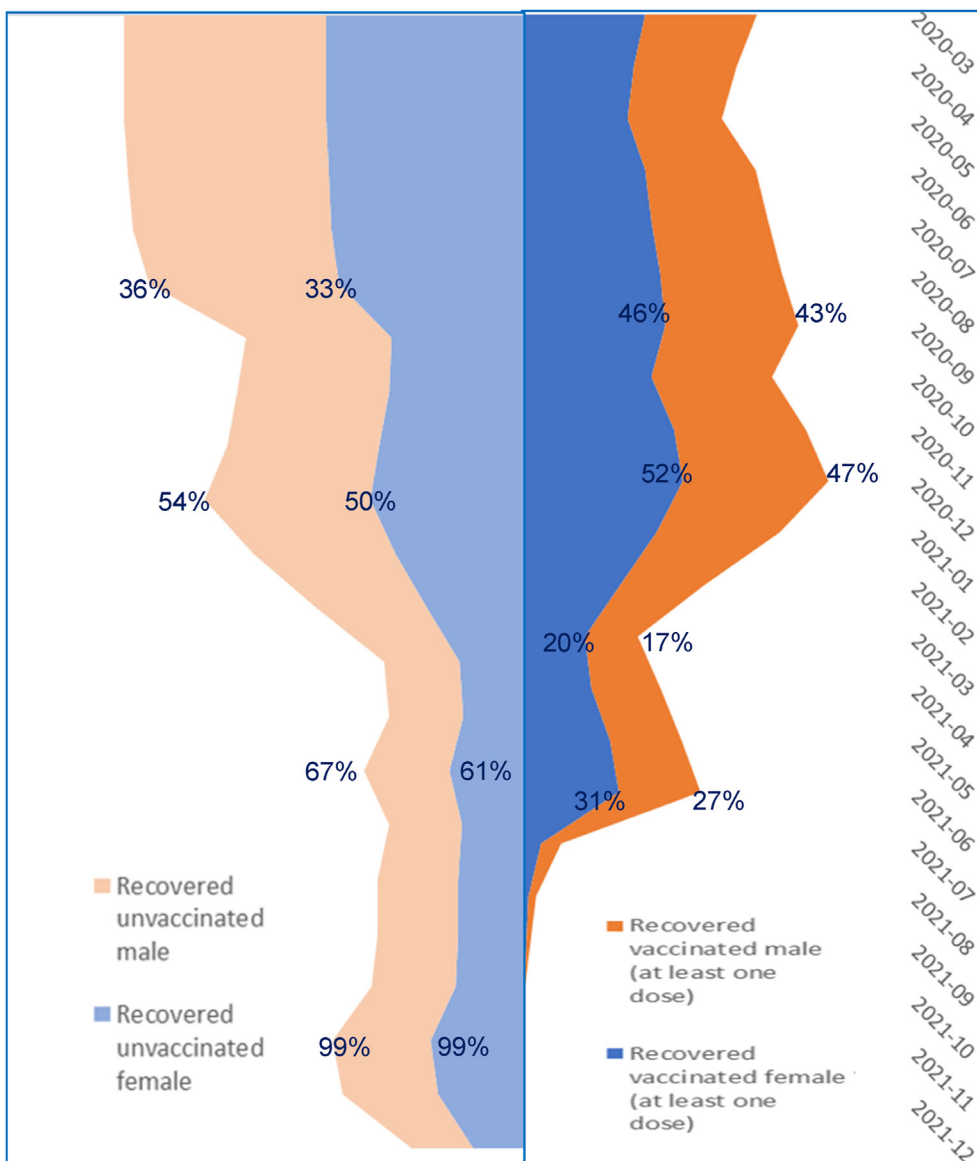


Fig. 1. Per month of infection (year-month), percentage of recovered patients according to number of vaccine doses received. Notes: Gender percentages for each are denoted in blue (male) and orange (female). In addition, patients with reinfection after vaccination are excluded in this figure. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article).

findings highlight the importance of targeting risk communication and information messaging to specific population subgroups. Specifically, the current results indicate that those of younger age, unvaccinated and non-booster vaccinated individuals should be targeted with different risk communication strategies that take into consideration the unique beliefs and features of each group.¹² Messages need to be adapted to accommodate specific concerns and hesitations demonstrated by these distinct population subgroups.

Author statements

Ethical approval

Ethical approval was not required since all data used in this study were obtained from the publicly available open COVID database website, <https://datadashboard.health.gov.il/COVID-19/general>. No individual data were included in the study.

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Competing interests

None declared.

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