

Green Pass and COVID-19 Vaccine Booster Shots in Israel – A More ‘Realistic’ Empirical Assessment Analyzing the National Airport Data

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Abstract

The paper describes an analysis based on data published on November 1, 2021, by the Israeli Ministry of Health (MOH) on its control dashboard about returning Israelis through the national airport. The data include the respective numbers of Vaccinated and Unvaccinated individuals and the number of positive COVID-19 cases identified in each group. These reflect the modified definitions of Vaccinated and Unvaccinated status after the Pfizer booster vaccination campaign in Israel (August-October). In particular, to maintain a Vaccinated status and specifically the “Green Pass”, individuals who received the initial 2 doses more than 6 months ago were required to receive the booster vaccine.

Israel national airport is a unique setting, where the Vaccinated and Unvaccinated individuals all have to test, which allows a more objective assessment of both the booster and Green Pass efficacy in preventing infections. The analysis suggests that the positivity rate (number of cases divided by number of tests) among the Vaccinated cohort throughout August-October is only 1.54-fold smaller than the one among the Unvaccinated cohort (about 35% relative protection). More specifically, compared to the Unvaccinated group, the Vaccinated group has a significantly higher positivity rate during the month of August, then in September it shows a 3.45-fold smaller positivity rate (71% relative protection), and this protection decreases to 2.66-fold (62% protection) during October. The analysis suggests that the relative protection of the booster shot against infection is likely to be significantly smaller than the initial estimates of 10-11-fold (over 90%) reported by the MOH, probably around 60% at best. This also implies that the absolute number of infected individuals in the Vaccinated group is likely to be at least as high as in the Unvaccinated, raising serious concerns that the new Green Pass is inefficient in preventing infection spread, and could expose high risk individuals to risk.

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Introduction

Starting the 3rd week of June 2021 Israel experienced another wave of COVID-19 infections. This wave emerged in spite the implementation of a strict “Green Pass” policy that required any unvaccinated individuals above the age of 3 to have a recent (last 72 hours) negative COVID-19 test in order to be able to enter restaurants, as well as culture, entertainment and sport events or other public settings. In fact, a similar policy has been implemented by many workplaces.

Due to the rapidly increasing number of confirmed cases, hospitalizations and deaths, and based on several studies⁴, the Israel Ministry of Health (MOH) has concluded⁵ that the Pfizer-BioNTech vaccine’s efficacy is waning over time to the extent that it is necessary to administer a booster shot (3rd dose of the Pfizer-BioNTech vaccine) to regain the efficacy against infections. On July 30, 2021, Israel launched an aggressive booster vaccination campaign that started with the over 60 population and rapidly expanded (by August 29, 2021) to all ages above 16. In spite of the aggressive campaign the infection rates continued to increase rapidly throughout the month of August. The decrease in infection rates were observed only 6 weeks after booster vaccination was launched in mid-September and throughout October. (See Graph A⁶ in the Supplementary Appendix)

Following the aggressive booster vaccination campaign, as of October 3, 2021 the Israel MOH has changed the eligibility criteria⁷ for Green Pass holders, requiring anyone above the age of 12 that received the 2nd dose of the Pfizer vaccine more than 6 months ago to receive a 3rd dose (booster) or otherwise lose their Green Pass. Additionally, individuals who recovered more than 6 months ago were also required to vaccinate. Consequently, the new definition of Vaccinated and Unvaccinated is as follows:

Vaccinated:

- Anyone who has received the 3rd dose (booster) more than 7 days ago.
- Anyone who has received 2 doses more than 7 days ago, but less than 6 months ago.
- Anyone who recovered after testing positive (PCR test), or shows recovery signals on a serological test within the last 6 months, and has received 1 dose more than 7 days ago.

⁴ Waning of BNT162b2 vaccine protection against SARS-CoV-2 infection in Qatar (<https://www.medrxiv.org/content/10.1101/2021.08.25.21262584v1>)

⁵ Waning immunity of the BNT162b2 vaccine: A nationwide study from Israel (<https://www.medrxiv.org/content/10.1101/2021.08.24.21262423v1.full-text>)

⁶ <https://ourworldindata.org/coronavirus/country/israel>

⁷ <https://www.gov.il/he/departments/news/29082021-01>

Unvaccinated:

- Anyone who did not receive 2 doses at least 7 days ago.
(note that this includes completely unvaccinated individuals).
- Anyone who has received their 2nd dose more than 6 months ago.

More recently, the Israel MOH published a study on the booster efficacy⁸ based on data collected by the MOH during the campaign. The study asserts that the booster achieves a 11.3-fold relative reduction in the risk of COVID-19 infection⁹ among the over 60 population, compared to the original 2 vaccine doses, thus, providing further support and justification to the current Green Pass policy in Israel.

The MOH study follows a cohort of 1,137,804 individuals ages 60 or older, who received their second dose before March 1, 2021, and were therefore eligible for a booster dose, between July 30 (when the booster campaign was launched) and August 31, 2021. The study follows two primary outcomes, specifically, rates of COVID-19 infections and severe cases per person-days at risk. These outcomes are then compared between two groups within the cohort, the Booster Group including those, who received the booster, and the Non-booster Group including those, who did not. Finally, using Poisson regression that controls for potential covariates, the study estimates the relative booster efficacy (11.3-fold).

Unfortunately, there are multiple methodological problems with this study, the most significant of which is the fact that there is no appropriate control for the number of respective tests conducted among the members of each group. Moreover, the resulting respective positivity rates not reported. Inadequate control of the number of tests is a major potential source of upward bias of the booster efficacy against infections, since there are all reasons to believe that the booster cohort was tested in significantly lower intensity. In fact, there are data in the MOH study itself to support this assumption. The different intensity is likely the result of both individual behavior (i.e., individuals who are vaccinated with the booster will be less concerned about infections and will test less frequently), as well as the MOH testing policy, including in particular the Green Pass policy that requires unvaccinated individuals to test, each time they enter a public or workplace setting operated under the Green Pass policy.

The goal of this study is to provide a more realistic assessment of the relative efficacy of the booster against COVID-19 infections and more generally evaluate the effectiveness of the

⁸ Protection of BNT162b2 Vaccine Booster against Covid-19 in Israel
<https://www.nejm.org/doi/full/10.1056/NEJMoa2114255>

⁹ The study also reports the rate of severe illness was lower by a factor of 19.5 (95% CI, 12.9 to 29.5).

current Green Pass policy in preventing infections. Specifically, the paper describes analysis of data posted publicly by the Israel MOH regarding individuals entering Israel through its national airport.

Methods

Note that the entrance to Israel through the airport is perhaps the only setting, in which Vaccinated and Unvaccinated individuals (based on the current eligibility definition of the Green Pass policy outlined above), all have to take a PCR test, independent of their vaccination status. That said, following the test upon entrance, Unvaccinated individuals, regardless of their test outcome, are required to self-quarantine for 14 days (or only 7 days, if they show another negative PCR test, 7 days after arrival). This self-quarantine requirement does not apply to Vaccinated individuals, who tested negative. Thus, even in this setting Unvaccinated individuals are likely tested almost twice as much as Vaccinated.

In the middle of September, the MOH introduced a new “widget” to the public online Control Dashboard¹⁰ that presents detailed data on individuals entering into Israel. The data include aggregated information on the vaccination status, as well as the number of positive cases per vaccination status, detected throughout the 10 days following the entrance to Israel.

These data allow the calculation of the positivity rate among Vaccinated and Unvaccinated individuals, respectively, i.e., the ratio between the number of COVID-19 cases detected and the number of individuals entering Israel, in each group. These ratios are calculated both for the entire period starting on August 1, 2021, just after the booster vaccination campaign was launched, and throughout October 31, 2021, as well as for each month (August, September, and October) separately.

To provide general context, the monthly infection and positivity rates detected in Israel, in each of the respective months August-October’ are also reported. Additionally, note that the make-up of the Vaccinated and Unvaccinated groups, as per the new Green Pass definition outlined above, are evolving over time as more individuals receive the booster. The approximate make-up of the respective groups is reported, for each of the months August-October. The calculations of the approximated make-up of the two groups are done based on data posted publicly by the Israel MOH that include the daily number of individuals, who received the 1st, 2nd and 3rd doses, respectively¹¹. The number of recovered individuals is also reported daily on the MOH telegram channel¹².

¹⁰ <https://datadashboard.health.gov.il/COVID-19/general>

¹¹ <https://datadashboard.health.gov.il/COVID-19/general>

¹² <https://t.me/MOHreport>

Results

Table 1¹³ below shows the respective data of the above-mentioned airport widget from August 1, 2021 and throughout October 31, 2021 (for complete daily information, see Table 3 in the Supplementary Appendix). Overall, there were 5,074 confirmed cases among 799,633 Vaccinated individuals, which is 0.63% positivity rate. Additionally, there were 6415 confirmed cases among 654,952 Unvaccinated which is 0.98% positivity rate.

During August 1-31, 2021, there were 182,696 Vaccinated individuals who entered Israel with 2,912 COVID-19 cases detected, resulting in a positivity rate of 1.59%. Over the same period of time there were 290,383 Unvaccinated individuals with 1,878 cases and respective positivity rate of 0.65%. The numbers for the month of September were 270,569 (entering individuals), 1,595 (cases) and 0.59% (positivity rate) for the Vaccinated compared to 184,416 (entering individuals), 3,752 (cases) and 2.03% (positivity rate) for the Unvaccinated. Finally, during the month of October the numbers were 346,368 (entering individuals), 567 (cases) and 0.164% (positivity rate), compared to 180,153 (entering individuals), 785 (cases) and 0.436% (positivity rate), respectively for Vaccinated and Unvaccinated.

Month	Vaccinated	Vaccinated Confirmed Cases	Unvaccinated	Unvaccinated Confirmed Cases	Relative Efficacy
August	182696	2912	290383	1878	
	% Positive:	1.59%	% Positive:	0.65%	
			Ratio:	0.41	-146.46%
September	270569	1595	184416	3752	
	% Positive:	0.59%	% Positive:	2.03%	
			Ratio:	3.45	71.03%
October	346368	567	180153	785	
	% Positive:	0.164%	% Positive:	0.436%	
			Ratio:	2.66	62.43%
Total Aug-Oct	799633	5074	654952	6415	
	% Positive:	0.63%	% Positive:	0.98%	
			Ratio:	1.54	35.22%

Table 1: Number Vaccinated and Unvaccinated entering Israel and the respective COVID-19 cases detected

Graphs A and B in the Supplementary Appendix, show the daily confirmed infections in Israel and the daily national positivity rate throughout the months of June-October. The overall

¹³ Table 1 was created on Nov 1, 2021 from data published by the Israel MOH on the control dashboard. <https://datadashboard.health.gov.il/COVID-19/general>

national positivity rate in Israel varied a lot during this period. Specifically, August started at a positivity rate of 2.84% and ended at 6.73%. September started at 7.9% and ended at 3.8% and finally October started at 3.15% and ended at 0.64%.

Table 2 below reports on the estimated size and make-up of the respective Vaccinated and Unvaccinated groups, at the end of August, September and October, respectively.

Status	August	September	October
3rd Dose	2391409	3462642	3962602
2nd Dose (Under 6 Months)	2039984	831265	674548
Recovered + 1 Dose	266000	308000	363000
Total Vaccinated	4697393	4601907	5000150
2nd Dose (Over 6 Months)	1072333	1359238	1098104
No 2 Doses (Last 7 days)	3556274	3364855	3227746
Total Unvaccinated	4628607	4724093	4325850
Total Population	9,326,000	9,326,000	9,326,000

Table 2: Size and make-up of the Vaccinated and Unvaccinated groups

Discussion

Analyzing the three months of data provided in Table 1, suggests that the average positivity rate of tests conducted among Vaccinated (0.63%) is only 1.54-fold smaller than the respective positivity rate among Unvaccinated (0.98%). This is significantly lower than the 11.3-fold reduction estimate presented in the MOH's recent study. Notably, the positivity rates observed in the national airport data are significantly lower, probably because any traveler has to also take a PCR tests prior to leaving Israel.

The month-by-month analysis provides additional insights. It can be observed that in spite of the aggressive booster campaign throughout August during which more than 2.39 million individuals received the booster vaccine (see Table 2), the positivity rate among Vaccinated (1.59%) is significantly higher than the respective one among Unvaccinated (0.65%), specifically, 2.44-fold higher. One possible explanation could be that in the immediate weeks following the booster vaccination, the respective individuals become more vulnerable to acquiring COVID-19 infections. This hypothesis is somewhat supported by several studies who detected negative efficacy of the vaccine during the immediate weeks following the 1st dose^{14,15}. In September, during which a little more than 1 million additional individuals were

¹⁴ <https://www.nejm.org/doi/full/10.1056/NEJMoa2114114>

¹⁵ <https://www.medrxiv.org/content/10.1101/2021.05.27.21257583v1.full-text>

vaccinated with the booster (see Table 2), the trend is flipped and the positivity rate among Vaccinated (0.59%) is 3.45-fold smaller than the positivity rate among Unvaccinated (2.03%), which is equivalent to 71% relative efficacy, but still very far from the 11.3-fold estimate (corresponding to over 90% relative efficacy) reported in the MOH study.

Finally, in October, during which close to 0.5 million additional individuals received the booster (see Table 2), the positivity rate among Vaccinated (0.16%) is only 2.75-fold smaller than the one among Unvaccinated (0.44%), which is equivalent to 64%. The fact that the observed efficacy declines (from 71% to 64%), even within 1-2 months after the end of the booster campaign, is quite concerning, especially given the already observed rapid decline of the efficacy of the first two doses. Moreover, it is important to note that the mix of travelers during the month of October is likely to be significantly different than the ones in August-September. The latter two months included the school summer break and several long national holidays where many families tend to travel abroad. Thus, the number of children travelers in these months, including many that were not eligible to vaccinate was likely higher than usual. In contrast, in October, travelers are more likely to be adults, which makes the observed decline in efficacy even more concerning.

It is worthwhile to discuss some of the differences between the analysis presented in this study based on the airport data, and the analysis in the study by the MOH¹⁶. First, the MOH study only follows the over 60 population, whereas this study is based on data that pertain to individuals of all ages. Additionally, the MOH study period is very short and in fact follows individuals for an average of 13 days. In contrast, the current study provides 3-month analysis. Notably, the Vaccinated group in this study does not include only individuals who received the booster. However, from Table 2, it can be seen that during September this population grew from accounting for less than 50% of the Vaccinated group in August to accounting for 75% of the group at the end of September, and then further to 79% at the end of October. Thus, it is very likely that the protection of this population, particularly in September-October, has the highest impact on the overall protection of the Vaccinated group. Moreover, the Vaccinated group also includes recovered individuals that are known to have very strong protection against infections (with or without additional vaccination of a single dose). Finally, unlike the MOH study, the Unvaccinated group in this study includes not only individuals with two doses (more than 6 months ago), but also many unvaccinated individuals. All of these considerations, suggest that the above estimates are likely to be more favorable than the actual relative efficacy of the booster.

¹⁶ Protection of BNT162b2 Vaccine Booster against Covid-19 in Israel
<https://www.nejm.org/doi/full/10.1056/NEJMoa2114255>

Considering the Green Pass policy, the analysis in this study raises major concerns as to whether this policy has a sound epidemiological rationale. Note that most of the adults in Israel belong to the Vaccinated group. Since the current protection level of the booster vaccine against infection is likely to be around 60% at best (probably lower), and seems to be already declining, it follows that just as many Vaccinated individuals could be infected and infecting others, particularly, if they are not tested and have the perception they are protected from infections. It follows that the Green Pass policy not only does not provide the assumed protection against infections, but could even have adversarial impact and enhance the spread of infections, including among high risk individuals.

Limitations. This study has several limitations. First, it studies a cohort of individuals who traveled outside Israel and return. This population is likely to be different than the general population in terms of age distribution and socioeconomic characteristics. Second, the specific vaccination status of the individuals, who are returning to Israel is not known (i.e., whether they received to booster, 2nd dose recently or recovered) beyond the general definition of Vaccinated versus Unvaccinated. It is worthwhile to conduct more refined analysis to refine the analysis per specific vaccination status.