



At what frequency of vaccination do the vaccinated potentially pose an equal risk to the unvaccinated for transmission of SARS-CoV-2 inside restaurants in New York City?

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Summary From August 2021 to 7 March 2022, New York City prohibited indoor dining in restaurants selectively for persons who had not received a Coronavirus disease 2019 (COVID-19) vaccine. However, vaccinated persons may also be actively infected and potentially transmit severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Based on assuming a 7:1 ratio of COVID-19 cases in New York State for the unvaccinated versus the vaccinated, it can be estimated that when 87.5% of adults in New York City are vaccinated, the rate of unsuspected SARS-CoV-2 infections (asymptomatic or minimally symptomatic) among vaccinated adults going to restaurants would be equivalent to that for the unvaccinated.

Keywords COVID-19 · Coronavirus · Restaurants · Asymptomatic infection · Non-pharmaceutical measures · Mandates · SARS-CoV-2

From August 2021 to 7 March 2022, New York City prohibited indoor dining in restaurants selectively for persons who had not received a Coronavirus disease 2019 (COVID-19) vaccine. It is somewhat unclear as to what the primary objective was for this restriction. In the past when indoor dining was restricted, it pertained to everyone [1]. Was it to reduce the risk of acquiring severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection, i.e., COVID-19, in unvaccinated persons who might go to a restaurant and

become infected at that location? Was it to protect the vaccinated individuals from a breakthrough infection that might occur if an infected unvaccinated person were in attendance? Or was it intended primarily to motivate the public to get the vaccine? In New York State data exist on the number of cases of presumably symptomatic COVID-19 cases per 100,000 unvaccinated individuals versus per 100,000 vaccinated individuals; this information might enable an analysis of the theoretical impact of requiring vaccination for individuals who would like to go to a restaurant for indoor dining.

We are unaware of any systematic data collected on the ratio of asymptomatic to symptomatic cases of COVID-19 for vaccinated versus unvaccinated adults in New York State, but at least hypothetically it would not be surprising if the ratio would be different than the ratio for symptomatic infections, with a smaller difference in the number of cases per 100,000 individuals between vaccinated and unvaccinated. However, any difference is likely to be highly dependent on the SARS-CoV-2 variant causing the infection. In addition, the likelihood of having extremely mild symptoms, so mild that the individual might not suspect that they are infected with SARS-CoV-2 might be higher among vaccinated patients compared with those unvaccinated.

Methods and results

Available data on the frequency of COVID-19 cases per 100,000 adults in New York State among both unvaccinated and vaccinated persons were reviewed for the period of June 2021 through July 2021 preceding the August 2021 vaccine mandate requiring vaccination for indoor dining [2]. The ratio per week varied from 5.18 to 1, to 9.8 to 1, for COVID-19 cases in the unvaccinated compared with the vaccinated over this

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Table 1 Assumptions that were made for this analysis

Assumption	Comment
1. Same ratio of unvaccinated to vaccinated for cases of COVID-19 in New York City, as reported for the New York State and that this ratio is pertinent to asymptomatic infections	Limited data
2. Same ratio of unvaccinated to vaccinated for persons who eat in New York City restaurants, as for the general adult population in New York City	Limited data and hypothetically unvaccinated might be less likely to eat indoors in restaurants
3. Same duration and level of contagiousness for breakthrough cases among the unvaccinated compared with those who were vaccinated	Variable data exist on this assumption (see text)
4. Natural immunity not factored in	Among the unvaccinated, not all would be equally likely to become infected since natural immunity may also be protective
5. Highly symptomatic persons with SARS-CoV-2 infection would not go to restaurants, irrespective of vaccination status	–

2-month time period. For the purpose of this analysis a 7 to 1 ratio was assumed. Using this ratio, we calculated the frequency of vaccination required to reach a level among persons eating in a restaurant such that the absolute number of diners who had an asymptomatic or minimally symptomatic SARS-CoV-2 infection would be the same for the vaccinated as for the unvaccinated. The estimate of the frequency of vaccination necessary for the rate of unsuspected SARS-CoV-2 infection among unvaccinated diners to equal that among diners who had been vaccinated was 87.5% (calculated by dividing 7 by 8, i.e., the proportion of COVID-19 cases in the regional population occurring among the unvaccinated equals the proportion who would need to be vaccinated to achieve a 1:1 ratio). Of note, it was assumed that the proportion of those vaccinated among the general population would be identical to the proportion present in restaurants (Table 1).

Discussion

We have estimated that when 87.5% of adults in New York City are vaccinated, the rate of SARS-CoV-2 occult infections among vaccinated persons going to restaurants would be equivalent to that for the unvaccinated. The rate of vaccinated adults in New York City was estimated to be 87% as of early March 2022 [3]. However, whether this rate of vaccination per se was the impetus for removing the requirement for being vaccinated to dine indoors is unknown. During the first week of March, however, the ratio of COVID-19 cases per 100,000 in New York State for the unvaccinated versus the vaccinated was 7.09 [2], nearly identical to the 7.0 figure assumed for this analysis.

Numerous other assumptions were made in this analysis (Table 1). Although supporting data exist for

most of them, contradictory data exist for some as well. For example, it was assumed that the 7:1 ratio found for diagnosed cases of COVID-19 in the general New York State adult population for unvaccinated to vaccinated would pertain to presumably asymptomatic or minimally symptomatic persons with SARS-CoV-2 infection who would be the ones most likely to go to restaurants. Some studies, however, clearly show that those who are vaccinated and have SARS-CoV-2 infection are less likely to be symptomatic [4, 5]. However, in a study of asymptomatic patients (not from New York State and also from a different time period) undergoing preprocedural COVID-19 molecular testing, after adjusting for multiple confounding factors, there was still an 80% reduction in the risk of a positive COVID-19 test in persons who had received two vaccine doses compared with those who were unvaccinated [6]. We also assumed that the infectivity of those with SARS-CoV-2 infection would be similar irrespective of vaccination status. While several studies have found similar viral loads independent of vaccine status [7, 8], some studies have found that if vaccinated within 6 months before developing COVID-19, the viral loads might be lower [9]. Some studies have also suggested that viral loads decrease more rapidly in those who were vaccinated versus those who are unvaccinated [5, 7]. Also, there may be a distinction between the infectivity of presymptomatic COVID-19 cases compared with persistently asymptomatic cases, but again the data are not completely consistent [10]. Also, the mechanism(s) of transmission for asymptomatic cases is poorly understood [10].

Evidence exists that neither current vaccines nor having been naturally infected, or a combination of both, will offer long-term protection against mild COVID-19 illness [11]. Breakthrough infections have been especially common for certain variants [8, 12, 13]. SARS-CoV-2 infections are well recognized to occur in fully vaccinated persons, and it should never be assumed that transmission of SARS-CoV-2 would not occur in any indoor setting, irrespective of whether unvaccinated persons were excluded.

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