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Public Health 207 (2022) 105–107

Contents lists available at ScienceDirect

Public Health

journal homepage: www.elsevier.com/locate/puhe

Short Communication

First-generation BNT162b2 and AZD1222 vaccines protect from COVID-19 pneumonia during the Omicron variant emergence

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ARTICLE INFO

Article history:
Received 23 February 2022
Accepted 5 April 2022
Available online 20 April 2022

Keywords:
COVID-19
BNT162 vaccine
ChAdOx1 nCoV-19
SARS-CoV-2 variants
Pneumonia

ABSTRACT

Objective: This study aimed to identify factors predicting pneumonia in adults with coronavirus disease 2019 (COVID-19) during the Omicron variant (B.1.1.529) emergence. We also evaluated, in fully vaccinated (BNT162b2 or AZD1222) individuals, if the time (<6 or ≥6 months) elapsed since the last shot was received was associated with the risk of severe illness.
Study design: A retrospective cohort study was conducted in Mexico.
Methods: Data from 409,493 were analyzed, and risk ratios (RRs) and 95% confidence intervals (CIs) were computed through generalized linear models.
Results: We documented a total of 3513 COVID-19 pneumonia cases (69.5 per 100,000 person-days). In multiple analyses, a protective effect was observed in vaccinated adults (RR = 0.996, 95% CI 0.995–0.997). Male gender, increasing age, and smoking were associated with a greater risk of pneumonia. Individuals with chronic comorbidities (pulmonary obstructive disease, type 2 diabetes mellitus, arterial hypertension, kidney disease, and immunosuppression) were also at higher risk. Among fully vaccinated subjects (n = 166,869), those who had received the last shot at 6 more months were at increased risk for developing pneumonia (RR = 1.002, 95% CI 1.001–1.003).
Conclusions: Our results suggest that the first-generation BNT162b2 and AZD1222 vaccines reduce the risk of COVID-19 pneumonia during the Omicron emergence. We also found that adults with longer interval from the administration of the second shot to illness onset were at increased risk of severe manifestations.

Introduction

The B.1.1.529 (Omicron) variant from the severe acute respiratory syndrome coronavirus 2 (SARS-COV-2) was first identified in South Africa in early November 2021. Since this variant has been shown higher transmission rates than previous circulating variants, it rapidly became dominant all around the globe,[1] and it peaked in Mexico between December 2021 and January 2022.[2]

The BNT162b2 (Pfizer, Inc./BioNTech) and AZD1222 (AstraZeneca) have been widely used in Mexico since the last bimester of 2020. When compared with the Delta variant, reduced vaccine effectiveness has been documented in fully vaccinated individuals against the Omicron infection.[3,4] Therefore, concerns have arisen regarding the impact of current vaccines on COVID-19 pneumonia prevention and reduction in hospital utilization. This study aimed to identify factors predicting COVID-19-related pneumonia in adults during the Omicron variant emergence. In addition, we evaluated if the time elapsed since the last COVID-19 vaccine shot received was associated with the risk of developing pneumonia in a subset of fully vaccinated subjects.

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https://doi.org/10.1016/j.puhe.2022.04.001
0033-3506/

Methods

We performed a nationwide retrospective cohort study in Mexico during the first bimester of 2022. Subjects aged ≥18 years, with laboratory-confirmed (reverse transcription-polymerase chain reaction or antigen-based testing in nasopharyngeal swabs) COVID-19 and symptoms onset from December 2021 to January 2022 were eligible. A broader description of the used laboratory methods was previously published.[5]

Eligible participants were identified from the nominal records of a normative and national system of the epidemiological surveillance of respiratory viral pathogens, which primary data sources are the medical files and, if applicable, death certificates. This system is called Online Notification System for Epidemiological Surveillance (*SINOLAVE*, the Spanish acronym) and belongs to the Mexican Institute of Social Security (*IMSS*, the Spanish acronym), which provides healthcare and social services to more than 83 million users all across the country.

Patients with missing clinical or epidemiological data of interest and those who received other COVID-19 vaccines than BNT162b2 or AZD1222 were excluded.

Vaccinated adults were those two shots of BNT162b2 or AZD1222. Unvaccinated participants were those who had not received any COVID-19 vaccine dose from any pharmaceutical company. The interval (months) between the last vaccine shot was received, and the date of symptoms onset was computed and dichotomized (<6 or ≥6 months).

The main binary outcome (no/yes) was pneumonia due to COVID-19, and it was defined by clinical and radiographic findings that required hospital admission. Clinical and epidemiological data of interest, as well as the COVID-19 vaccination status and dates of their administration, were retrieved from the audited surveillance system.

We used generalized linear regression models to compute risk ratios (RRs) and 95% confidence intervals (CIs). Two multiple regression models were built. The first model was used to evaluate predictors of COVID-19 pneumonia during the Omicron emergence; the latter one evaluated the effect of the time elapsed since the last vaccine shot with the risk of pneumonia in fully immunized subjects.

Results

Data from 409,493 laboratory-confirmed cases of COVID-19 were analyzed. The mean age (± standard deviation) of participants was aged 39.0 ± 13.3 years, and most of them were female (56.1%). The total follow-up was 5,052,192 person-days, and 3513 cases of COVID-19 pneumonia were registered (69.5 per 100,000 person-days). A fatal outcome was documented in one-third (33.8%) of patients with severe manifestations.

The vaccinated group was integrated by 166,869 participants (40.8%), and AZD1222 was administered in most of them (60.7%). Table 1 shows the characteristics of the study sample for the analyzed variables. Pneumonia patients were more likely to be

Table 1
Predictors of pneumonia in laboratory-confirmed cases of COVID-19 (n = 409,493) during the Omicron variant emergence, Mexico 2021–2022.

Characteristic	Pneumonia (n)			Bivariate analysis			Multiple analysis		
	no	/	yes	RR	(95% CI)	P	RR	(95% CI)	P
Sex									
Female	227,962	/	1583	1.000			1.000		
Male	178,018	/	1930	1.004	(1.003–1.005)	<0.001	1.002	(1.001–1.003)	<0.001
Age group (years)									
18–39	236,874	/	401	1.000			1.000		
40–59	144,697	/	969	1.005	(1.004–1.006)	<0.001	1.002	(1.001–1.003)	<0.001
≥60	24,409	/	2143	1.082	(1.079–1.086)	<0.001	1.065	(1.062–1.068)	<0.001
COVID-19 vaccination status [a]									
Unvaccinated	240,145	/	2479	1.000			1.000		
Vaccinated	165,835	/	1034	0.996	(0.995–0.997)	<0.001	0.996	(0.995–0.997)	<0.001
Personal history of:									
Obesity									
No	240,145	/	2479	1.000			1.000		
Yes	165,835	/	1034	1.008	(1.006–1.009)	<0.001	1.001	(0.998–1.002)	0.620
Smoking (current)									
No	389,275	/	3222	1.000			1.000		
Yes	16,705	/	291	1.009	(1.007–1.011)	<0.001	1.001	(1.004–1.007)	<0.001
Chronic pulmonary obstructive disease									
No	404,561	/	3317	1.000			1.000		
Yes	1419	/	196	1.120	(1.102–1.138)	<0.001	1.058	(1.042–1.075)	<0.001
Type 2 diabetes mellitus									
No	384,050	/	2261	1.000			1.000		
Yes	21,930	/	1252	1.049	(1.046–1.052)	<0.001	1.018	(1.015–1.021)	<0.001
Arterial hypertension									
No	371,552	/	1864	1.000			1.000		
Yes	34,428	/	1649	1.042	(1.039–1.044)	<0.001	1.012	(1.010–1.015)	<0.001
Chronic kidney disease (any stage)									
No	403,438	/	3020	1.000			1.000		
Yes	2542	/	493	1.168	(1.152–1.183)	<0.001	1.119	(1.105–1.134)	<0.001
Immunosuppression [b]									
No	404,590	/	3387	1.000			1.000		
Yes	1390	/	126	1.078	(1.063–1.093)	<0.001	1.037	(1.023–1.052)	<0.001

RR, risk ratios; CI, confidence interval.
(1) Generalized linear regression models were used to obtain the presented estimates; (2) RR and 95% CI from the multiple analysis were adjusted by the variables presented in the table.
[a] Vaccinated adults were those two shots of BNT162b2 (Pfizer, Inc./BioNTech) or AZD1222 Covishield (AstraZeneca); unvaccinated participants were those who had not received any COVID-19 vaccine dose from any pharmaceutical company.
[b] Any cause (excepting type 2 diabetes mellitus).

male and to be older than mild cases ($P < 0.001$). Patients with severe illness were also more likely to be unvaccinated or to present any comorbid condition ($P < 0.001$ in all of them).

In the first multiple regression model (Table 1), fully vaccinated subjects had a reduced risk of pneumonia (RR = 0.996, 95% CI 0.995–0.997). Male gender (RR = 1.002, 95% CI 1.001–1.003), increasing age (vs 18–39 years old: 40–59, RR = 1.002, 95% CI 1.001–1.003; 60 or older, RR = 1.065, 95% CI 1.062–1.068), as well as all the analyzed comorbidities (except for obesity), were also associated with an increased risk of COVID-19-related pneumonia. The greatest risk was conferred by the personal history of chronic kidney disease (any state; RR = 1.134, 95% CI 1.108–1.160).

In fully vaccinated adults (please see the Supplementary data 1), we documented that participants with a longer interval from the last vaccine shot and illness onset (6 or more months) had a slight but significantly reduced risk for developing severe illness (vs <6 months: RR = 1.002, 95% CI 1.001–1.003). This estimate was adjusted by host factors. When compared with the rest of the estimates from the first model, no major changes were observed in the ratios from the latter one.

Discussion

We characterized factors predicting pneumonia due to laboratory-confirmed COVID-19 in a large subset of adults during the Omicron emergence in Mexico. Our results suggest that even though this variant can evade neutralizing antibodies, the first-generation BNT162b2 and AZD1222 vaccines reduce the risk of developing pneumonia in fully immunized adults. Otherwise, we observed that host factors, such as gender, age, and chronic medical conditions, are associated with an increased risk of severe illness. If later replicated, these findings would highlight the relevance of promoting healthy lifestyles and immunization in eligible subjects to reducing the pandemic burden.

In our study, patients who had received the last vaccine shot at 6 or more months were at greater risk of developing pneumonia (vs <6 months: 1.002, 95% CI 1.001–1.003). This is consistent with previously published data where a decrease in anti-spike IgG and neutralizing antibodies were evidenced after 6 months of the BNT162b2 vaccine administration.[6]

We analyzed the BNT162b2 and AZD1222 vaccines because they had been broadly administered in Mexico. By February 7, 2022, about 51.5 and 90.6 million doses of BNT162b2 and AZD1222 had been received in our country.[7] When we evaluated de specific effect of each of these biological products on the risk of pneumonia, similar estimates were observed in both of them (BNT162b2, $n = 65{,}565$; AZD1222, $n = 101{,}304$). The same was documented when the interval between the last vaccine shot and illness star was evaluated.

Another aspect that must be highlighted is that most of the identified COVID-19 cases during the study period had mild symptoms, and pneumonia was observed in around 8 out of 1000 laboratory-positive cases. This is related to the smaller virulence of Omicron when compared with previous variants.[8] The pneumonia rate in our analysis is much lower than the observed during previous variant emergences in the same study setting, which was around 30%.[9] A fatal outcome was documented in nearly one-third (33.8%) of the enrolled individuals. Therefore, the case fatality rate in the study sample was 29.0 per 10,000.

The potential limitations of this study must be discussed. First, according to normative standards, the genomic sequencing is not performed in all laboratory-positive COVID-19 cases. Therefore, we are unable to ensure that all the analyzed participants were infected by the Omicron variant. However, we consider that most of these infections correspond to the variant of interest given (1) the documented peak in the incidence of COVID-19 in Mexico during the study period (please see the Supplementary data 2) and (2) in the United States, and also during the end of 2021 of start of 2022, the Omicron variant was identified in nearly 99% of genomic sequences.[10] Second, vaccines booster began to be applied to the general population during January 2022 in high-risk population, so a small fraction of participants may have had it at the time of symptoms onset. These data were not collected by the audited surveillance system at the time of recruitment.

Conclusions

Our results suggest that during the Omicron variant emergence, the first-generation BNT162b2 and AZD1222 COVID-19 vaccines are effective in reducing the risk of pneumonia. We also found that participants with a shorter interval between the second shot and illness onset were at reduced risk of severe manifestations. If later replicated, these findings may provide additional data to support the administration of a third vaccine shot to reduce the pandemic-related burden.

Author statements

Ethical approval

This study was reviewed and approved by the Committee of Ethics in Health Research (601) of the IMSS (approval R-2020-601-022).

Funding

None.

Competing interests

None declared.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.puhe.2022.04.001.

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