
Countries with Higher Vaccination Coverage Experienced Reduced Fatality During the COVID-19 “Omicron” Fifth Wave – A Post Wave Analysis

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Abstract: By the end of 2021, the outbreak of the COVID-19 caused approximately 265 million confirmed cases and 5.2 million deaths globally. On November 2021, the “Omicron” variant of the COVID-19 has emerged, and led to a massive outbreak in many countries worldwide. Despite the fact that the Omicron variant was considered less fatal compared to the previous variants, its prompt spread caused the biggest number of cases, and as a result the biggest number of deaths. At the beginning of the Omicron wave, some vaccines against COVID-19 existed. These vaccines were proved to be effective against the previous COVID-19 variants. However, their efficiency against the Omicron variant was questionable. This study examines whether, by the end of the Omicron wave, there is an association between the vaccination level of a country and the fatality of the Omicron variant in this country during the fifth wave. To evaluate the association, data on COVID-19 cases, COVID-19 deaths, and doses of vaccination per 100 people for 20 countries in which fifth COVID-19 wave (the “Omicron” wave) was observed were retrieved from a real-time available website. Based on the collected data, Case Fatality Rate (CFR) accumulated for the “Omicron” wave period was evaluated for each country. A linear regression model was conducted to predict the CFR of each country for the COVID-19 “Omicron” variant wave as a function of the vaccine administered per 100 people. The results of this study suggest a strong statistically significant negative association between the vaccination level of a country and the fatality of the Omicron variant during the Omicron wave, i.e., countries which entered the “Omicron” wave with higher vaccination level had lower CFR. This post-wave analysis demonstrates that the vaccines developed so far have a protective effect against the fatality of the Omicron variant. Promoting the administration of the vaccine and by that increasing the vaccination level of a country may reduce fatality in the next coming COVID-19 waves.

Keywords: Pandemic, Linear Regression, Vaccine, Vaccination Level, Case Fatality Rate, COVID-19, Omicron Variant

1. Introduction

By the end of 2021, the outbreak of the COVID-19 caused approximately 265 million confirmed cases and 5.2 million deaths globally [1]. Among the factors found to be associated with increased fatality of the COVID-19 virus on the country level were countries with higher percent of elderly population, countries with higher cardiovascular death rate, and countries higher percent of fully vaccinated

people [2]. On November 2021, the “Omicron” variant of the COVID-19 has emerged, and led to a massive outbreak in many countries worldwide [3]. The Omicron variant was first introduced to the World Health Organization (WHO) from South Africa on 24 November 2021, and was quickly classified as a variant of concern by 26 November 2021, due to its ability to aggregate 50 mutations [3]. In many countries worldwide, the Omicron variant formed the fifth wave of the COVID-19 pandemic, which was the longest

wave since the beginning of the pandemic on March 2020 [4]. Despite the fact that the Omicron variant was considered less fatal compared to the previous variants, its prompt spread caused the biggest number of cases, and as a result the biggest number of deaths [4]. At the beginning of the Omicron wave, some vaccines against COVID-19 existed. Among them were SARS-CoV-2-BNT162b2 mRNA (Pfizer-BioNTech), mRNA-1273 (Moderna), and Ad26.COV2.S (Janssen) [5]. These vaccines were found to be efficient during the previous waves, and by the beginning of the Omicron variant, many countries worldwide enjoyed a significant vaccination coverage [6, 7]. Since the approval of the vaccines, approximately 11 billion doses of COVID-19 vaccine have been administered worldwide [8]. Updated to December 1st 2021, 3.49 billion people globally are fully vaccinated against COVID-19 disease, as prescribed by the vaccination protocol [9]. However, there were differences between countries with respect to vaccination coverage. These differences were partially due to differences in health systems quality between countries, which resulted in differences in the availability of the vaccines, and partially due to differences in the compliance of a country’s population to the vaccine [10, 11]. At the beginning of the Omicron variant, it was doubtful whether the existing vaccines, which were found to be efficient against the previous variants, were also efficient against the Omicron variant. This doubt aroused the question whether a booster of the vaccine should be administered to protect against the Omicron variant. Some works indeed demonstrated a reduced efficiency of the existing vaccines for becoming infected with the Omicron variant, and, indeed, many new cases of vaccinated people were observed worldwide [12, 13]. However, studies during the Omicron wave showed that the existing vaccines are efficient in reducing the severity and the fatality of the disease among infected vaccinated people [14]. An Israeli study found that the second booster vaccine reduced the mortality in elderly aged 60 years and above by 78% [15].

Mortality measures are frequently used to estimate the severity of a pandemic. Among them is the Case Fatality Rate (CFR), which is defined as the number of deaths to date divided by the number of all confirmed cases to date. CFR measures how severe or fatal is the disease [16]. This study examines whether, at the end of the Omicron wave, there is an association between the vaccination level of a country and the fatality of the Omicron variant in this country during the fifth wave. In other words, this study evaluates whether countries that entered the Omicron wave with higher vaccination rate have benefitted from lower fatality during this wave.

2. Materials and Methods

2.1. Demographic and Clinical Data

Data on COVID-19 cases, COVID-19 deaths, and doses of vaccination per 100 people for 20 countries were retrieved

from “Our world in data”, a real-time available website [13]. European countries (except Israel which is not a European country but has similar characteristics), in which fifth pandemic COVID-19 wave (the “Omicron” wave) was observed (a continuous increase in daily new confirmed cases starting from November 2021 or later until a continuous decrease occurred from March 1 2022) were selected. The start point and the end point of the “Omicron” wave were slightly different in each selected country, but the date ranges were similar. CFR was calculated as the number of deaths attributed to COVID-19 occurred during the “Omicron” wave identified for each country, divided by the accumulated new COVID-19 cases during this period. Doses of vaccination per 100 people at the beginning of the Omicron wave was used as an indicator of the vaccination level of a country.

2.2. Statistical Analysis

IBM SPSS software version 25 was used to assess the distribution of the study variables, and to develop a linear regression model to predict the CFR of each country for the COVID-19 “Omicron” variant wave as a function of the vaccine administered per 100 people. First, the distribution of each variable was examined. Next, single linear regression was conducted to assess the association between doses per 100 people and CFR.

3. Results

3.1. Demographic Information

The distribution of the study variables is summarized in table 1:

Table 1. Distribution of the study variables (total cases, total deaths, vaccine doses per 100 people, and CFR) of 20 European countries (data updated for March 21, 2022).

Country	Total Cases	Total deaths	Doses of Vaccination per 100	CFR (per 100,000)
Czechia	511761	8741	20	1708.0
Belgium	134264	2948	30	2195.7
Romania	937490	6147	83	655.7
Poland	1571819	14532	124	924.5
Turkey	5537731	16932	147	305.8
France	15609653	20797	149	133.2
Italy	8047170	22776	150	283.0
Lithuania	447725	1364	151	304.7
UK	9003827	19368	154	215.1
Switzerland	1591325	1089	155	68.4
Hungary	569043	6442	156	1132.1
Spain	5993365	12236	158	204.2
Greece	1005630	4200	159	417.6
Sweden	1254432	2628	161	209.5
Austria	1544535	2349	162	152.1
Norway	1095320	733	162	66.9
Netherlands	3272840	803	163	24.5
Denmark	2430771	2077	170	85.4
Portugal	2126375	2645	173	124.4
Israel	1217872	1737	192	142.6

3.2. Examination of the Distribution of the Variables from Table 1

A wide variation between countries in CFR during the “Omicron” wave was observed (Mean = 467.7; SD = 589.2). A wide variation in doses of vaccination per 100 people was also observed (Mean = 141.0; SD = 45.0). We can base on these variations as a background to exploring the association

between these two variables.

3.3. Linear Model for Predicting Case Fatality Rate from COVID-19

Based on the data presented in table 1, a linear regression was conducted for predicting CFR, using the doses of vaccination per 100 as an explanatory variable. The results of the linear regression are presented in Table 2 and in Figure 1.

Table 2. Linear regression model for predicting case fatality rate from COVID-19 in 20 European countries by doses of vaccination per 100.

Variables entered	Unstandardized coefficients		t	Sig.	Adjusted R ²	F value (df) (Sig.)
	B	Standard Error				
Constant	2084.1	221.0				F(1, 18) = 58.66
Doses of vaccination per 100	-11.5	1.5	-7.7	< 0.0001	0.752	P < 0.0001

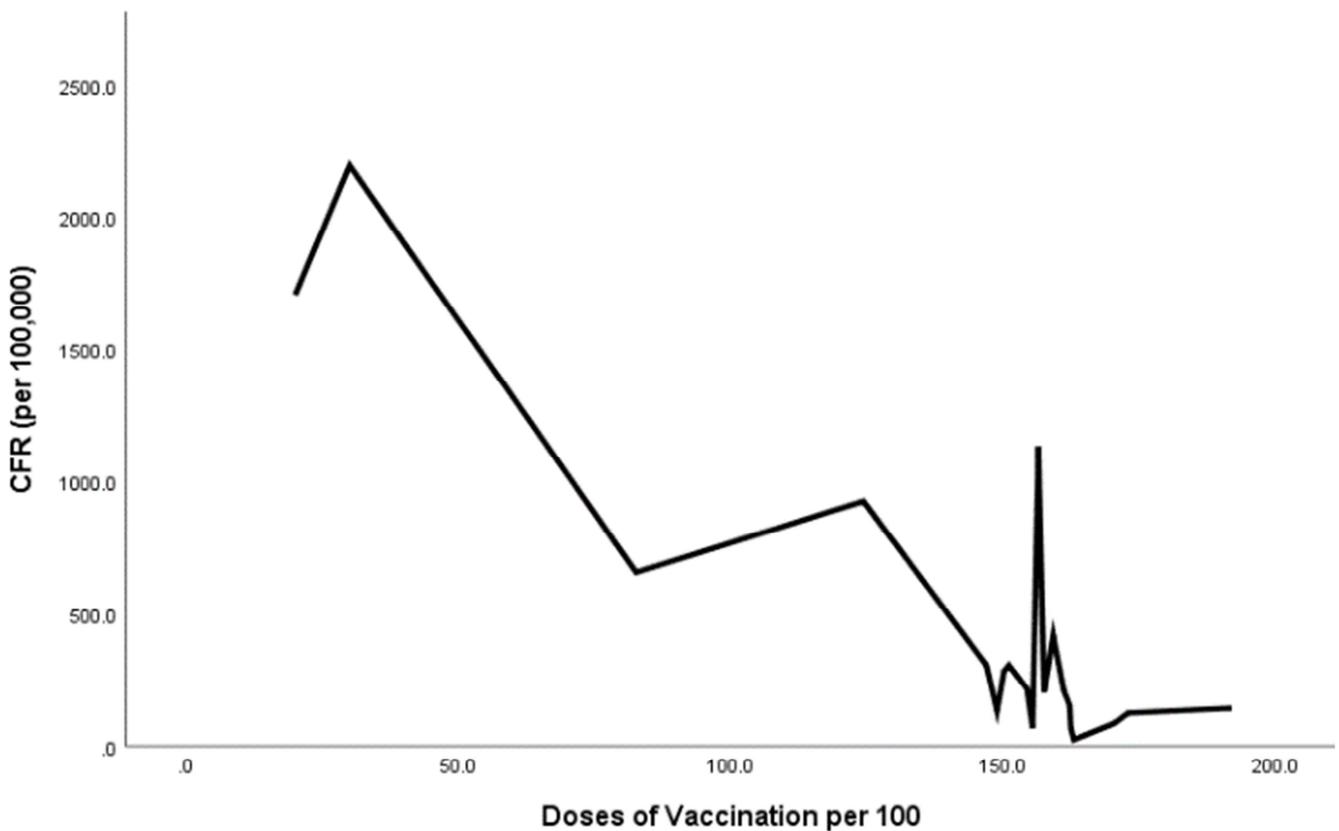


Figure 1. COVID-19 CFR of the “Omicron” Variant by Doses of Vaccination During the Fifth Wave.

3.4. Examination of the Suggested Linear Model from Table 2 and Figure 1

The single linear regression described in table 2 demonstrates a strong statistically significant negative association between doses of vaccination per 100 and CFR, i.e. – countries which entered the Omicron wave with higher doses of vaccination per 100 people had lower CFR during this wave. In other words, the fatality of the “Omicron” variant during this wave was lower in highly vaccinated countries. One can observe in Figure 1 that the CFR is significantly lower, starting from 147 doses of vaccination per 100 people.

4. Discussion

The results of this study demonstrate an inverse association between a country’s vaccination level and the fatality of the Omicron variant in this country. In other words, countries which entered the Omicron wave with higher vaccination level had lower fatality rate during this wave. At the beginning of the Omicron wave, there was a concern that the efficiency of the existing vaccines against the Omicron variant was low [12, 13]. Indeed, it was demonstrated that the protection of the vaccine against being infected by the Omicron variant was lower compared to its protection against the previous variants

[12, 13], however, on the other hand, few works showed that the severity and the lethality of the Omicron variant was reduced in fully vaccinated people [14, 15]. Recently, the Food and Drug Association (FDA) approved the second booster for people aged 50 years and above, emphasizing that “Current evidence suggests some waning of protection over time against serious outcomes from COVID-19 in older and immunocompromised individuals. Based on an analysis of emerging data, a second booster dose of either the Pfizer-BioNTech or Moderna COVID-19 vaccine could help increase protection levels for these higher-risk individuals” [17]. Following the FDA, the Centers for Disease Control and Prevention (CDC) declared that during the Omicron wave, those who were boosted were 21-times less likely to die from COVID-19 compared to those who were unvaccinated, and 7-times less likely to be hospitalized. Hence, the CDC has recommended an additional (second) booster for people aged 50 years and above who received an initial booster dose at least 4 months ago [18]. This study strengthens previous works regarding the ability of the vaccine to reduce the fatality of the Omicron variant, and demonstrates this effect on the “country level”, by providing an overview on selected countries, and showing that countries that took care and entered the Omicron wave with better vaccination level, experienced a reduced fatality of the Omicron wave. This study has some strengths and limitations. Due to its ecological nature, it cannot be determined whether those who died from the Omicron variant were the unvaccinated ones. Yet, this study, up to our knowledge, is the first one which examines the efficacy of the COVID-19 against the Omicron variant at the “country level”, and, as such, provides evidence on the success of the vaccines to reduce fatality in higher vaccinated countries. Moreover, there is a variability between the countries with respect to the population’s composition, the population’s density, the quality of health services and more. However, despite of this variation, the same regularity persists: countries with higher vaccination level were more protected with respect to the Omicron fatality. The results of this study teach us that the preparedness of a country to the next wave, which is partially implemented by increasing the vaccination level within the country, may protect the population from the fatality of the variant during the wave. In particular, vaccination of high-risk populations, including the elderly has a special importance [19].

5. Conclusion

The COVID-19 vaccines developed so far have a protective effect against the fatality of the Omicron variant. A country which enters a COVID-19 wave with a higher vaccination level may be more protected against the fatality of the variant during the wave, regardless the lack of specificity of the vaccine to the specific variant. It is recommended that decision makers in each country will encourage and promote the administration of the vaccine, and by that increase the vaccination level and the protection of the population in the next coming waves.

References

- [1] Karim SS, Karim QA. Omicron SARS-CoV-2 variant: a new chapter in the COVID-19 pandemic. *The Lancet*. 2021 Dec 11; 398 (10317): 2126-8.
- [2] Benisti G, Magid A. Predictors of COVID-19 Case Fatality Rate in Highly Populated Developed Countries During the Emergence of the Delta Variant.
- [3] Al-Tawfiq JA, Hoang VT, Le Bui N, Chu DT, Memish ZA. The Emergence of the Omicron (B. 1.1. 529) SARS-CoV-2 Variant: What is the Impact on the Continued Pandemic?. *Journal of Epidemiology and Global Health*. 2022 Jan 28: 1-4.
- [4] Mathieu E, Ritchie H, Ortiz-Ospina E, Roser M, Hasell J, Appel C, Giattino C, Rodés-Guirao L. A global database of COVID-19 vaccinations. *Nature human behaviour*. 2021 Jul; 5 (7): 947-53.
- [5] Chhatwal J, Mueller PC, Ayer T, Adey MG, Dalgic O, Ladd MA, Linas B. Changing Dynamics of COVID-19 in the US with the Emergence of the Delta Variant: Projections of the COVID-19 Simulator. *medRxiv*. 2021 Jan 1.
- [6] Diesel J, Sterrett N, Dasgupta S, Kriss JL, Barry V, Esschert KV, Whiteman A, Cadwell BL, Weller D, Qualters JR, Harris L. COVID-19 vaccination coverage among adults—United States, December 14, 2020–May 22, 2021. *Morbidity and Mortality Weekly Report*. 2021 Jun 25; 70 (25): 922.
- [7] Barda N, Dagan N, Cohen C, Hernán MA, Lipsitch M, Kohane IS, Reis BY, Balicer RD. Effectiveness of a third dose of the BNT162b2 mRNA COVID-19 vaccine for preventing severe outcomes in Israel: an observational study. *The Lancet*. 2021 Dec 4; 398 (10316): 2093-100.
- [8] Yamey G, Garcia P, Hassan F, Mao W, McDade KK, Pai M, Saha S, Schellekens P, Taylor A, Udayakumar K. It is not too late to achieve global COVID-19 vaccine equity. *bmj*. 2022 Mar 24; 376.
- [9] Ritchie H, Mathieu E, Rodés-Guirao L, et al. Coronavirus vaccinations (COVID-19). *Our World in Data 2020*. <https://ourworldindata.org/covid-vaccinations>
- [10] Abdelkader H, Siham J, Aimad D. Access to COVID-19 vaccines: inequality between developed and developing countries. *Algerian Scientific Journal Platform*. November 2021.
- [11] Green MS, Abdullah R, Vered S, Nitzan D. A study of ethnic, gender and educational differences in attitudes toward COVID-19 vaccines in Israel—implications for vaccination implementation policies. *Israel Journal of Health Policy Research*. 2021 Dec; 10 (1): 1-2.
- [12] Willyard C. What the Omicron wave is revealing about human immunity. *Nature*. 2022 Feb 1; 602 (7895): 22-5.
- [13] Nemet I, Kliker L, Lustig Y, Zuckerman N, Erster O, Cohen C, Kreiss Y, Alroy-Preis S, Regev-Yochay G, Mendelson E, Mandelboim M. Third BNT162b2 vaccination neutralization of SARS-CoV-2 Omicron infection. *New England Journal of Medicine*. 2022 Feb 3; 386 (5): 492-4.
- [14] Regev-Yochay G, Gonen T, Gilboa M, Mandelboim M, Indenbaum V, Amit S, Meltzer L, Asraf K, Cohen C, Fluss R, Biber A. Efficacy of a fourth dose of COVID-19 mRNA vaccine against omicron. *New England Journal of Medicine*. 2022 Mar 16.

- [15] Arbel R, Sergienko R, Friger M, Peretz A, Beckenstein T, Yaron S, Netzer D, Hammerman A. Second Booster Vaccine and COVID-19 Mortality in Adults 60 to 100 Years Old. <https://www.fda.gov/news-events/press-announcements/coronavirus-COVID-19-update-fda-authorizes-second-booster-dose-two-COVID-19-vaccines-older-and>
- [16] Böttcher, Lucas, Mingtao Xia, and Tom Chou. "Why case fatality ratios can be misleading: individual-and population-based mortality estimates and factors influencing them." *Physical biology* 17, no. 6 (2020): 065003.
- [17] The U.S. Food and Drug Administration. Coronavirus (COVID-19) Update: FDA Authorizes Second Booster Dose of Two COVID-19 Vaccines for Older and Immunocompromised Individuals. March 2022.
- [18] Centers for Disease Control and Prevention. CDC Recommends Additional Boosters for Certain Individuals. March 2022. <https://www.cdc.gov/media/releases/2022/s0328-COVID-19-boosters.html>
- [19] Sadarangani M, Raya BA, Conway JM, Iyaniwura SA, Falcao RC, Colijn C, Coombs D, Gantt S. Importance of COVID-19 vaccine efficacy in older age groups. *Vaccine*. 2021 Apr 8; 39 (15): 2020-3.