

Original Article

Making the Case for Cross-Border Public Health Strategies: A comparative Assessment of Covid-19 Epidemiological Trends in the Balkan Countries Across 17 Months

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ABSTRACT

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Introduction: COVID-19 spread globally, including across the Balkans, resulting in different morbidity and mortality outcomes in different countries. The aim of this study was to review the impact of COVID-19 over 17 months with regards to pandemic progression, implemented mitigation strategies, and COVID-19 vaccination programs across the Balkan countries, while identifying any valuable pieces of information acquired serendipitously throughout the pandemic that can be implemented in future action plans.

Methods: A longitudinal ecological study was conducted across the Balkan countries from the onset of COVID-19 in these countries up until 1st August 2021. Epidemiological data was obtained from Our World in Data databases, while Ministry of Health websites for each respective country as well as local newspapers were utilized to review COVID-19-related mitigation and vaccination strategies. Comparisons of vaccination coverage, incident cases and mortality were made across neighboring countries, by converting the respective data to rates per 100,000 population for each country using Microsoft® Excel for mac (Version 16.59).

Results: More than 10 million positive COVID-19 cases and 164,470 deaths were observed across the Balkan countries up until 1st August 2021. Trends in COVID morbidity and mortality outcomes were evident across neighbouring countries. A staggered vaccination rollout was observed, with various rollout speeds, although gradual decline in both morbidity and mortality occurred.

Conclusion: Results obtained from this study strongly indicate that COVID-19 outcome for a particular country is not only dependent on the country's own level of viral transmission, mitigations, and vaccination rates but also on neighbouring countries' COVID-19 situation. Hence, cross-border governance action and recovery plans are recommended along with targeting vaccination hesitance.

Introduction

COVID-19 disease was first identified in

Wuhan, China at the end of 2019, with the first cases reported in Europe in January 2020.^{1,2} Transmission across the European continent

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occurred within weeks and by March 11th 2020, COVID-19 was declared a pandemic.^{2,3} The Balkan countries experienced the spread of COVID-19 disease among their populations in early 2020.⁴ This was similar to what occurred within the rest of the European continent. This led countries to implement preventive measures and actions to try to curb viral spread.

Amongst the European countries are the Balkan countries: Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Greece, Kosovo, Moldova, Montenegro, North Macedonia, Romania, Slovenia, Serbia, and Turkey. These countries have a distinct geopolitical landscape in comparison to central Europe, which is likely to result in differences in not only the epidemiology of COVID-19 but also in their response to the pandemic, in comparison to other European countries. Moreover, only Bulgaria, Croatia, Greece, Romania, and Slovenia are member states of the European Union, which may have resulted in differences in vaccination efforts between the Balkan countries.

Thus, studying the COVID-19 situation in the Balkan countries is of high importance. To the best of the authors' knowledge, the impact of COVID-19 on the entire Balkan region has yet to be documented. Current evidence suggests that Balkan countries have demonstrated a slow vaccine rollout, however this has not been analysed in relation to incidence and mortality rates across all Balkan countries.⁵

Understanding the impact of the COVID-19 pandemic in the Balkan countries will help guide policy as well as pandemic contingency strategies, including post-pandemic recovery plans, for this region. This information is also of importance to countries that share similar history and geopolitical demographics. Therefore the aim of this study was to target this

lacuna by evaluating pandemic progression, the implemented mitigation strategies, and the COVID-19 vaccination process across the Balkan countries, while also exploring their impact on the COVID-19 outcome over 17 months.

Materials and Methods

This was a descriptive longitudinal ecological study across the Balkan countries, coupled with a review of the literature detailing mitigative measures and vaccine rollout strategies. For the purposes of this study, the Balkan countries considered were Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Greece, Kosovo, Moldova, Montenegro, North Macedonia, Romania, Slovenia, Serbia, and Turkey.

Data sources

All data collected covered the period from the onset of COVID-19 in the Balkan countries under study up until the 1st of August 2021 (i.e., week 30 of 2021). Epidemiological data (COVID-19 cases, deaths and vaccination) was obtained from the 'Our World in Data' (OWID) database.⁴ Data pertaining to mitigation measures and COVID-19 vaccination prioritization strategies was obtained from the respective countries' Ministry of Health websites, Public Health websites, published articles and local newspapers. The STROBE guidelines we utilized and provided as supplementary material.

Data analysis

Weekly epidemiological data obtained from the

OWID database was combined to fit within a fiscal month distribution. Descriptive statistics were conducted including frequencies of cases, mortality and vaccination. The monthly cases and deaths were then converted to incidence rates per 100,000 population for ease of comparison. Each Balkan country was analyzed in relation to the surrounding neighbouring countries. Neighbouring countries were considered to be countries that are geographically adjacent to each other, or which are landlocked, thus, countries were grouped as follows: (i) Bosnia Herzegovina, Croatia and Slovenia; (ii) Kosovo, Montenegro and Serbia; (iii) Albania, Greece and North Macedonia; and (iv) Bulgaria, Moldova, Romania and Turkey). Analysis was conducted using Microsoft® Excel for mac (Version 16.59).

Total vaccinated population data for each country was converted into cumulative vaccination per 100,000 population and comparisons were made between countries through a heatmap for the months of January, March, May, and July 2021 respectively. The heatmaps were created by using MapChart© 2022 software.

Results

Epidemiological data

More than 10 million positive COVID-19 cases and 164,470 deaths had been reported across the Balkan countries between February 2020 and 1st of August 2021.⁶ The onset of COVID-19 across the Balkans varied, with Croatia, Greece, North Macedonia, and Romania reporting their first few cases in week 9 of 2020 (February 24th to March 1st). Bosnia and Herzegovina, Moldova, Slovenia, and Serbia reported their first cases a week later

(March 2nd to March 8th), while week 11 of 2020 saw COVID-19 emerge in Albania, Bulgaria, Kosovo, and Turkey. Montenegro was the last Balkan country to report COVID-19 entry, in week 12 of 2020, however (up until 1st August 2021), it seems that Montenegro has reported the highest COVID-19 infectivity rate overall at 16,255 per 100,000 population, followed by Slovenia at 12,471 per 100,000 population. Table 1 provides an overall descriptive comparison of the epidemiological COVID-19 situation across all Balkan countries up until week 30 of 2021 (July 26th to August 1st).

COVID-19 situation across time February to June 2020

A seemingly similarly low infectivity rate was shared between all countries during the first COVID-19 wave (February till June 2020), as shown in Figure 1, with 219,274 positive cases overall (147.39 per 100,000 population) and 7,223 deaths (4.86 per 100,000 population). It was noted that most of the Balkan countries responded quickly to the entry of COVID-19 and instituted mitigations to curb the spread, as shown in Supplement Figures. Indeed, lockdowns were instituted within the same week that the first COVID-19 cases were reported by Albania, Bulgaria, and Kosovo. The rest of the Balkan countries (except for Montenegro and North Macedonia) instituted lockdowns within one or two weeks from the first reported COVID-19 case/s (Supplement Figure 1). Other preventive mitigations were also instituted around the same period. These included the closure of non-essential shops, airports, schools, and restaurants among others (refer to Supplement Figures). Greece was the first of the Balkan countries to institute a mask

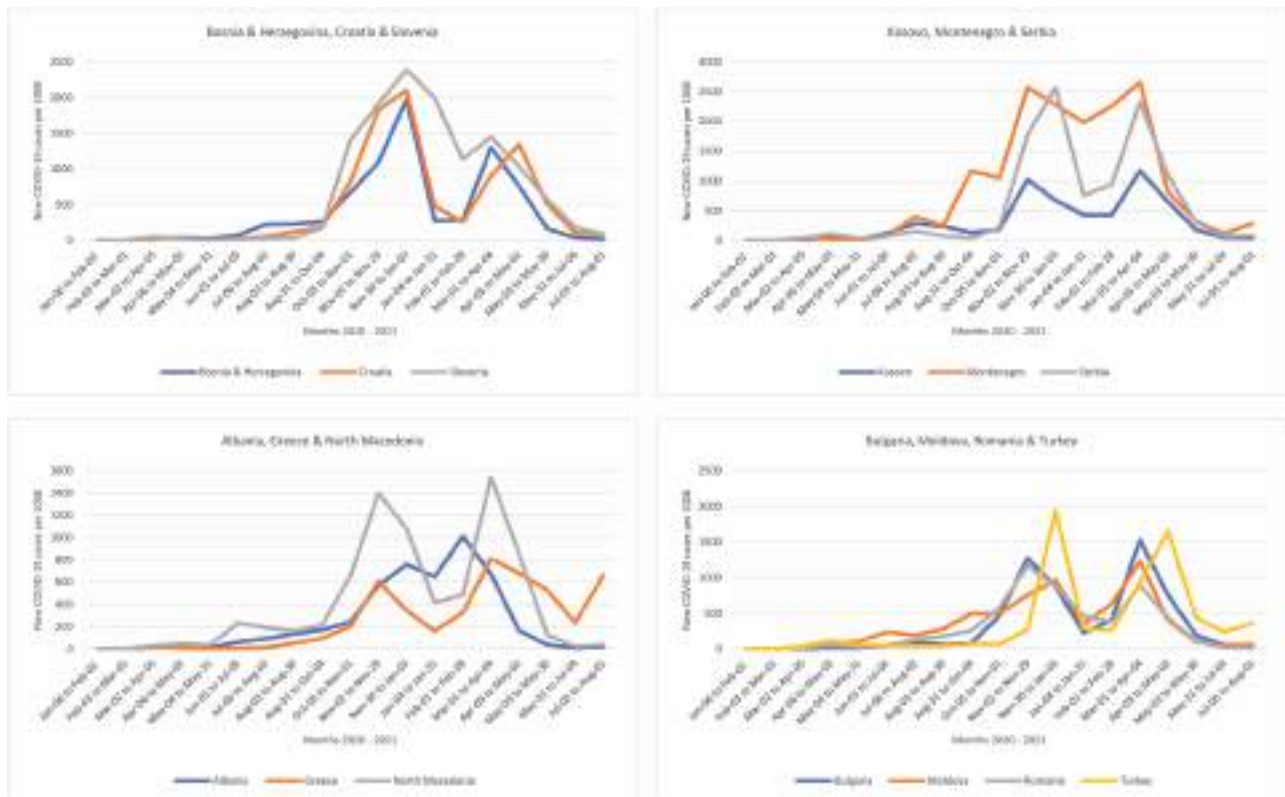


Figure 1. Comparative COVID19 cases per 100,000 population across neighbouring countries within the Balkan region

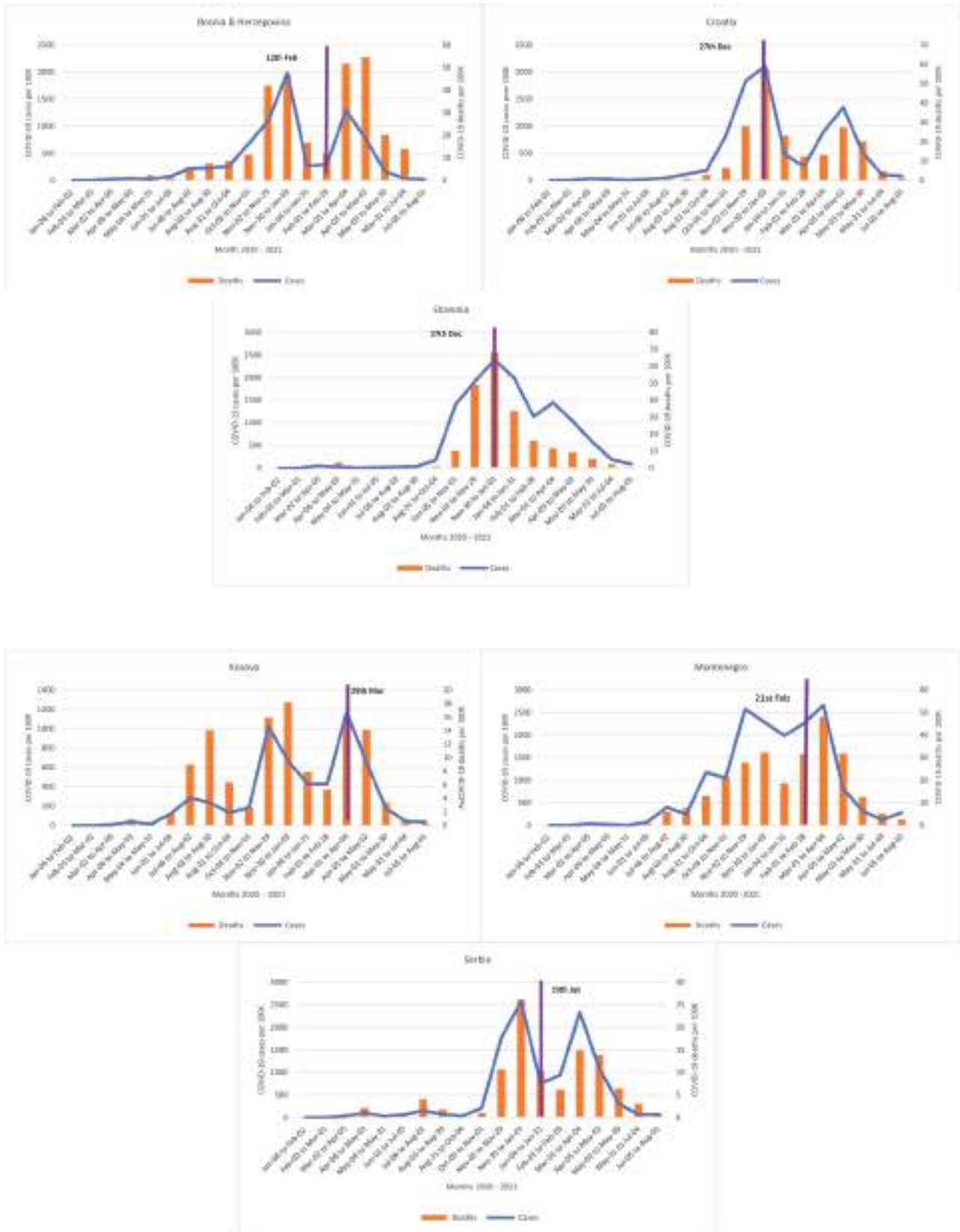
mandate while indoors and outdoors (May 2020). Bosnia and Herzegovina, and Romania instituted this same mandate in May 2020. (Refer to Supplement figure 9).

The period between April 6th and May 3rd, 2020, saw the highest number of reported COVID-19 cases across the Balkans, with an overall 125,806 positive cases (84.56 per 100,000 population) and 4,123 deaths (2.77 per 100,000 population). Indeed, Slovenia (3.27 per 100,000 population), Serbia (2.09 per 100,000 population), North Macedonia (3.17 per 100,000 population), Moldova (2.73 per 100,000 population), Romania (3.32 per 100,000 population) and Turkey (3.35 per 100,000 population) reported the highest mortality rates since the onset of COVID-19 (Figure 2).

June to August 2020

On a general note, a low infectivity rate seemed to be present in most Balkan countries in June 2020, however, COVID-19 cases appeared to increase with a corresponding rise in mortality rates between July to August 2020 (Figure 2). Indeed, during this period (June 1st to August 2nd, 2020) a total of 183,623 positive cases (123.42 per 100,000 population) and 4,461 deaths (3.00 per 100,000 population) were reported across these countries. Several mitigation measures were relaxed during this period. These included the lifting of lockdowns and curfews and the opening of non-essential shops, airports, and restaurants. (Refer to Supplement Figures).

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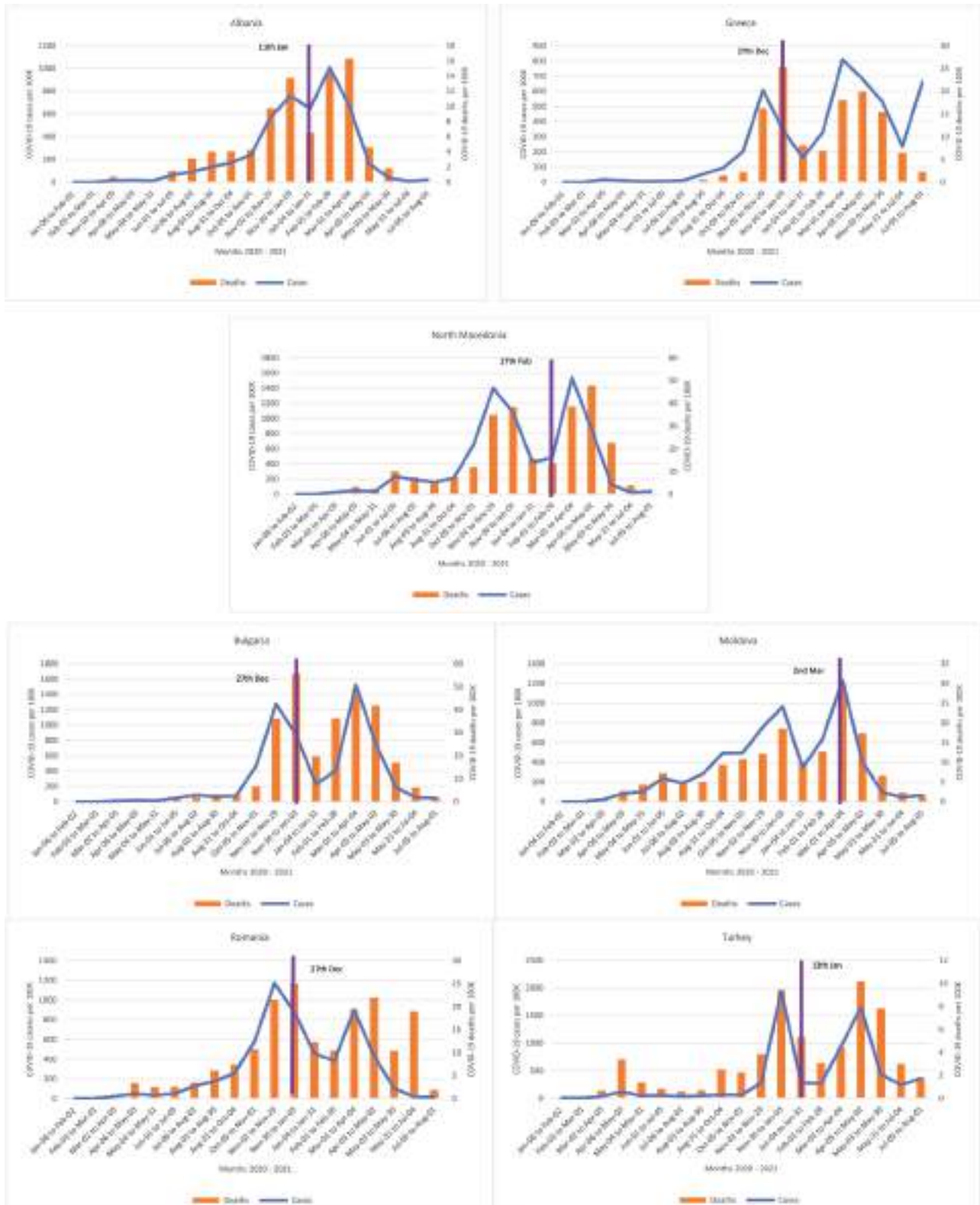


Figure 2. Comparison assessment between COVID-19 cases, mortality and initiation of vaccine programme across Balkan countries over 17 months

August 2020 to August 2021

The infectivity rate in the Balkan countries from August 2020 up until April – May 2021 was observed to be much higher than that experienced during the first few months of the pandemic. A total of 9,051,570 positive cases (6084.11 per 100,000 population) and 141,947 deaths (95.41 per 100,000 population) were reported across the Balkans between August 3rd, 2020, and May 30th, 2021. Montenegro (15,340 per 100,000 population) and Slovenia (12,095 per 100,000 population) reported the highest number of positive cases within this period. Bosnia and Herzegovina (270 per 100,000 population) and Bulgaria (249 per 100,000 population) reported the highest mortality for the same period. Interestingly, a similar trend in COVID-19 transmission was apparent across neighbouring countries in-tandem with mortality cases, as shown in Figure 1 and Figure 2, with peaks observed between November to December 2020 and March to April 2021. Indeed, these periods saw the re-introduction of a few of the mitigation measures by some of the Balkan countries. In fact, different mitigation measures were instituted by the Balkan governments, as shown in the Supplement Figures. Lockdowns were re-instituted at different stages by some of the Balkans as follows: Serbia (July 2020); Slovenia (October 2020 and April 2021); Bulgaria, Croatia, Greece, and Romania (November 2020); parts of Montenegro (February 2021); Greece and Bulgaria (March 2021), Slovenia and Turkey (April 2021). It is worth noting that vaccination programmes (as indicated in Figure 2 vertical line) had commenced across all Balkan countries by the end of March 2021. The COVID-19 outcome

following the start of inoculation varied. COVID-19 cases appeared to decline a month after the start of the vaccination programme in Bosnia and Herzegovina, Albania, Montenegro, and North Macedonia. Interestingly, Bulgaria, Croatia, Greece, and Romania, initially experienced an apparent decline in case numbers following the start of the vaccination programme (27th December 2020), however they still experienced a spike in cases between March – April 2021. This is comparable to the remaining countries and can be seen in Figure 2. Nonetheless, a seemingly general decline in positive cases and mortality was observed from June till August 1st, 2021, during which the COVID-19 population vaccination rollouts were underway.

COVID-19 vaccination

Only Bulgaria, Croatia, Greece, Romania, and Slovenia form part of the European Union (EU) and benefited from EU joint procurement.⁷ Indeed, these countries had access to the first batch of vaccines on December 27th, as the Pfizer BioNTech vaccine began to be purchased and distributed among EU countries. This was not the case in the rest of the Balkan countries.⁸ These five Balkan countries also had access to the other three European Medical Agency approved vaccines (Moderna, AstraZeneca, Johnson and Johnson) through EU joint procurement.^{9–14} The other Balkan countries purchased vaccines through other modalities, resulting in different onsets of their respective vaccination programmes and acquisition of vaccine brands, however a seemingly similar vaccine strategy could be observed across all Balkan countries. Supplement Table 1 provides a detailed account of the vaccines available, and

the vaccine strategy implemented by each of the Balkan countries. However, the vaccination roll-out speed varied across countries, as shown in the heatmaps (Figure 3). Indeed, up until August 1st, 2021, the population vaccination coverage varied between the Balkan countries, as shown in Table 1.

Discussion

COVID-19 was introduced to the European continent by travellers arriving from China, with Italy being the original epicentre for the COVID-19 outbreak within Europe.¹⁵ Free movement across European countries enabled the transmission of SARS-CoV-2 to other countries including the Balkans.¹⁶ Indeed, it is evident from this study that a cross-border

transmission effect was present, resulting in similar morbidity and mortality trends across neighbouring Balkan countries. This trend was similarly observed in both countries within Europe¹⁷ and outside of Europe.^{18, 19}

The first wave of COVID-19 saw the lowest infectivity and mortality rates, similar to the rest of Europe, as lockdowns and restriction measures were instituted throughout.²⁰ Early lifting of lockdowns and relaxation of some mitigation measures in April – May 2020 could have led to the peak in mortality cases in some of the Balkan countries. Similarly, the different public health interventions instituted in Summer 2020, along with COVID-19 fatigue and the emergence of new variants, resulted in higher COVID-19 burden within the Balkan countries across the successive

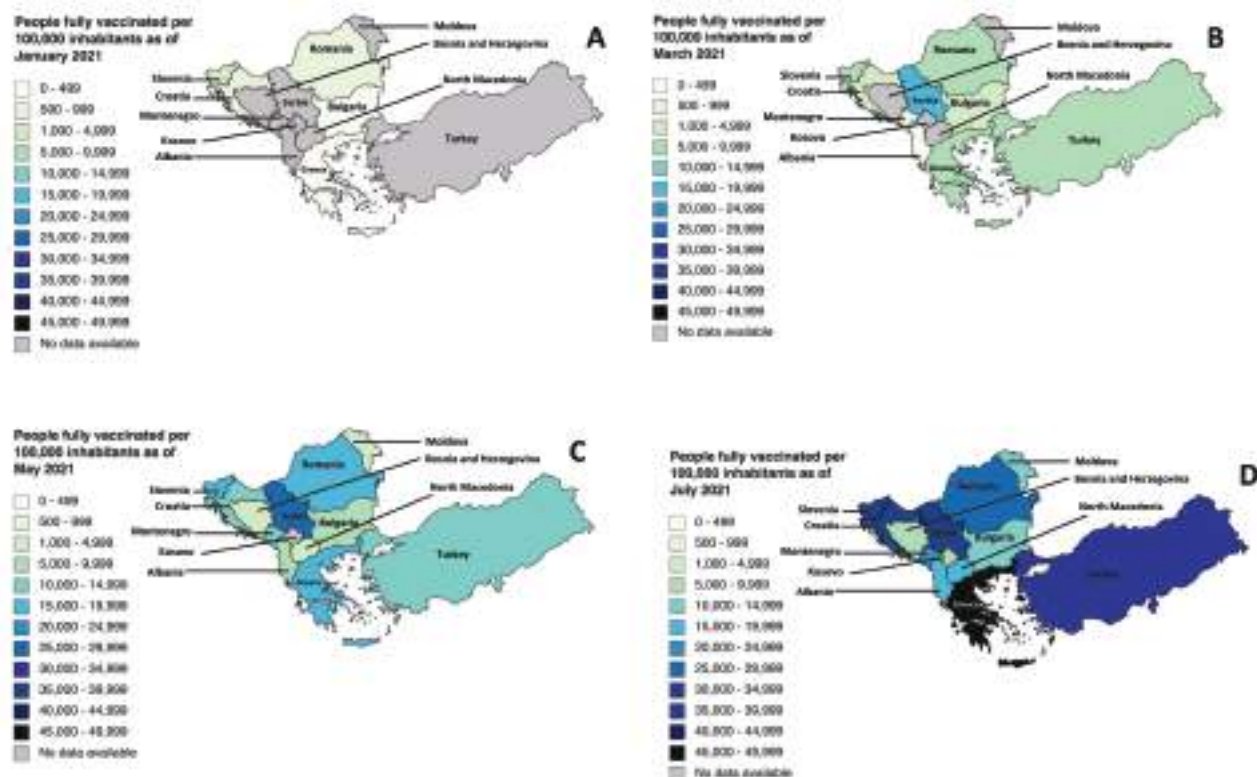


Figure 3. Heatmaps demonstrating cumulative fully vaccinated population per 100,000 in (A) January, (B) March, (C) May and (D) July 2021 across the Balkan countries

Table 1. Comparisons of the main COVID-19 epidemiological data across the Balkan countries up until the 30th Week of 2021 (July 26th to August 1st) [IFR – Infection fatality ratio].

	Albania	Bosnia & Herzegovina	Bulgaria	Croatia	Greece	Kosovo	Moldova	Montenegro	North Macedonia	Romania	Slovenia	Serbia	Turkey
Total population (n)	2,877,800	3,280,815	6,948,445	4,105,268	10,423,056	1,932,774	4,033,963	628,062	2,083,380	19,237,682	2,078,932	6,804,596	84,339,067
Total positive cases (n)	133,091	244,251	425,144	363,758	495,207	108,465	259,549	102,092	156,452	1,083,341	259,273	722,596	5,747,935
Total positive cases per 100,000 population	4,625	7,445	6,119	8,861	4,751	5,612	6,434	16,255	7,510	5,631	12,471	10,619	6,815
% cases of total population infected	4.62%	7.44%	6.12%	8.86%	4.75%	5.61%	6.43%	16.26%	7.51%	5.63%	12.47%	10.62%	6.82%
Recovered (n)	130,634	234,553	406,931	355,496	482,257	106,209	253,294	100,462	150,959	1,049,055	254,844	715,472	5,696,507
% of positive cases recovered	98.15%	96.03%	95.72%	97.73%	97.38%	97.92%	97.59%	98.40%	96.49%	96.84%	98.29%	99.01%	99.11%
Total deaths (n)	2,457	9,698	18,213	8,262	12,950	2,256	6,255	1,630	5,493	34,286	4,429	7,124	51,428
Total deaths per 100,000 population	85	296	262	201	124	117	155	260	264	178	213	105	61
% mortality of total population	0.09%	0.30%	0.26%	0.20%	0.12%	0.12%	0.16%	0.26%	0.26%	0.18%	0.21%	0.10%	0.06%
IFR	1.85%	3.97%	4.28%	2.27%	2.62%	2.08%	2.41%	1.60%	3.51%	3.16%	1.71%	0.99%	0.89%
Fully vaccinated (n)	530,322	235,453	991,143	1,482,878	5,167,260	152,167	495,051	154,265	398,165	4,869,906	2,707,576	808,888	27,472,882
% of population vaccinated	18%	7%	14%	36%	50%	8%	12%	25%	19%	25%	40%	39%	33%

months.²¹ Differing measures notwithstanding, COVID-19 transmission and mortality patterns were similar across bordering countries, supporting the notion countries need to work together to put forward a united front and implement policies jointly in order to control the spread of COVID-19.²²

The main goals of the COVID-19 vaccine were to reduce COVID-19 severity and mortality, decrease the burden on healthcare systems, enable the re-opening of society and eliminate the disease eventually.²³ The availability of COVID-19 vaccines varied across the Balkan countries. Countries which form part of the EU had the upper hand in obtaining the approved vaccines earlier on.^{7, 8} Indeed, some countries struggled to obtain vaccination doses for their populations and were dependent on

donations from other countries. Diplomatic agreements were observed between Serbia and its neighbouring countries as vaccine donations were made to Montenegro, North Macedonia and Bosnia.²⁴ A gradual reduction in COVID-19 morbidity and mortality was observed following the initiation of the vaccination programme across the Balkans. However, the impact of vaccination on the population morbidity and mortality varied, even amongst the EU Balkan countries themselves. This may be the result of the different vaccination roll-out speeds, as well as varying levels of vaccine availability. Indeed, vaccination hesitancy, misinformation and conspiracy theories were reported across the Balkan countries. Hesitancy among the population to be inoculated with the AstraZeneca vaccine was reported by Albania

and Croatia.^{25, 26} Vaccination misinformation resulting in vaccine hesitancy was reported by Bosnia and Herzegovina, with only 25.17% opting to receive the vaccine.²⁷ A similar situation in Kosovo was reported as 40% of the population were willing to take the vaccine.²⁸ A low level of willingness to take the COVID-19 vaccine was also noted in Bulgaria (28% willing),²⁹ in North Macedonia (11.5% willing),³⁰ and Romania (50% willing).³¹ Unfounded conspiracy theories and general mistrust are factors contributing to vaccination hesitancy in Bosnia and Herzegovina,²⁷ Serbia,^{32, 33} and Turkey.³⁴ Nonetheless, an increase in vaccination acceptance across the population has been noted by Greece and Montenegro.^{35, 36}

Study limitations

The epidemiological data utilized for this study was obtained from freely available online databases and is therefore dependent on sources' accuracy and data reporting methodology. Hospital admissions and intensive care unit admissions data was lacking for some countries, preventing the authors from evaluating the impact of COVID-19 on healthcare systems. Additionally, data on care capacity, population, disease trends and tracking capacity were not available which limited our epidemiological analyses and data output quality. Data pertaining to mitigation measures and vaccination strategies employed within different countries was dependent on the online data available through ministerial websites, public health websites and online newsrooms. Every effort was made by the contributors to identify accurate data originating from reliable sources; however, this does not exclude the

possibility of some missing data.

Conclusion

Observing the COVID-19 situation in the Balkan countries demonstrated that the COVID-19 outcome is not only dependent on the country's level viral transmission, mitigations, and vaccination rates but also on the COVID-19 situation within the neighbouring countries. Hence, cross-border governance and recovery plans are recommended along with targeting vaccination hesitance.

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Ethics consideration

No ethical clearance was required as no human or animal subjects were involved.

Author contributions

SC was responsible for the study design, data analyses and writing of article. AC was responsible for North Macedonia data collection, coordination of COVID-19 epidemiological data and formulating of mitigation results. RC was responsible for Slovenia data collection and coordination of mitigation measures, MF was responsible for Serbia data collection and coordination of the vaccination results, AF was responsible for Croatia data collection, coordination of COVID-19 epidemiological data and formulating of mitigation results, EG was responsible for Greece data collection and

proof reading of the article, AP was responsible for the formulation of mitigation results proof reading the article, TAM was responsible for the formulation of mitigation results proof reading the article. NA was responsible for Montenegro data collection proof reading the article, NA was responsible for Romania data collection proof reading the article, EC was responsible for Albania data collection proof reading the article, JC was responsible for Bulgaria data collection proof reading the article, MB was responsible for Moldova data collection proof reading the article, DM was responsible for Kosovo data collection proof reading the article, NM was responsible for Bosnia & Herzegovina data collection proof reading the article, and AC was responsible for vaccination analyses producing the heatmaps, and proof reading the article.

Conflict of Interests

All authors declare no conflict of interest

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