

# COVID-19 does not need a passport: The interrelationship of the COVID-19 pandemic along the U.S.-Mexico border

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## Background

The U.S.-Mexico border is a divide of incredible importance. It is a region with unique social, economic, environmental, and epidemiological factors that impact disease transmission. Prior research into infectious disease dynamics within this geographic corridor identified high rates of tuberculosis, HIV, and influenza H1N1 than non-border areas. We propose that the COVID-19 pandemic followed similar trends along the U.S.-Mexico border. To investigate this hypothesis, we compared COVID-19 case rates and mortality data from U.S.-Mexico border and non-border regions. We then contrasted disparities in these epidemiologic markers, discussed the interrelationship of the COVID-19 epidemic on both sides of the border, and explored potential reasons of differing outcomes along the border.

## Aims

- Establish an in-depth analysis of the COVID-19 pandemic's mortality in the U.S.-Mexico border region.
- Create a cross-country metric which allows us to compare statistics from the U.S. and Mexico.
- Observe disease trends over time to provide further context for differences in the COVID-19's effect on different areas.
- Evaluate the relationship between HDI and disease trends along the border.

## Methods

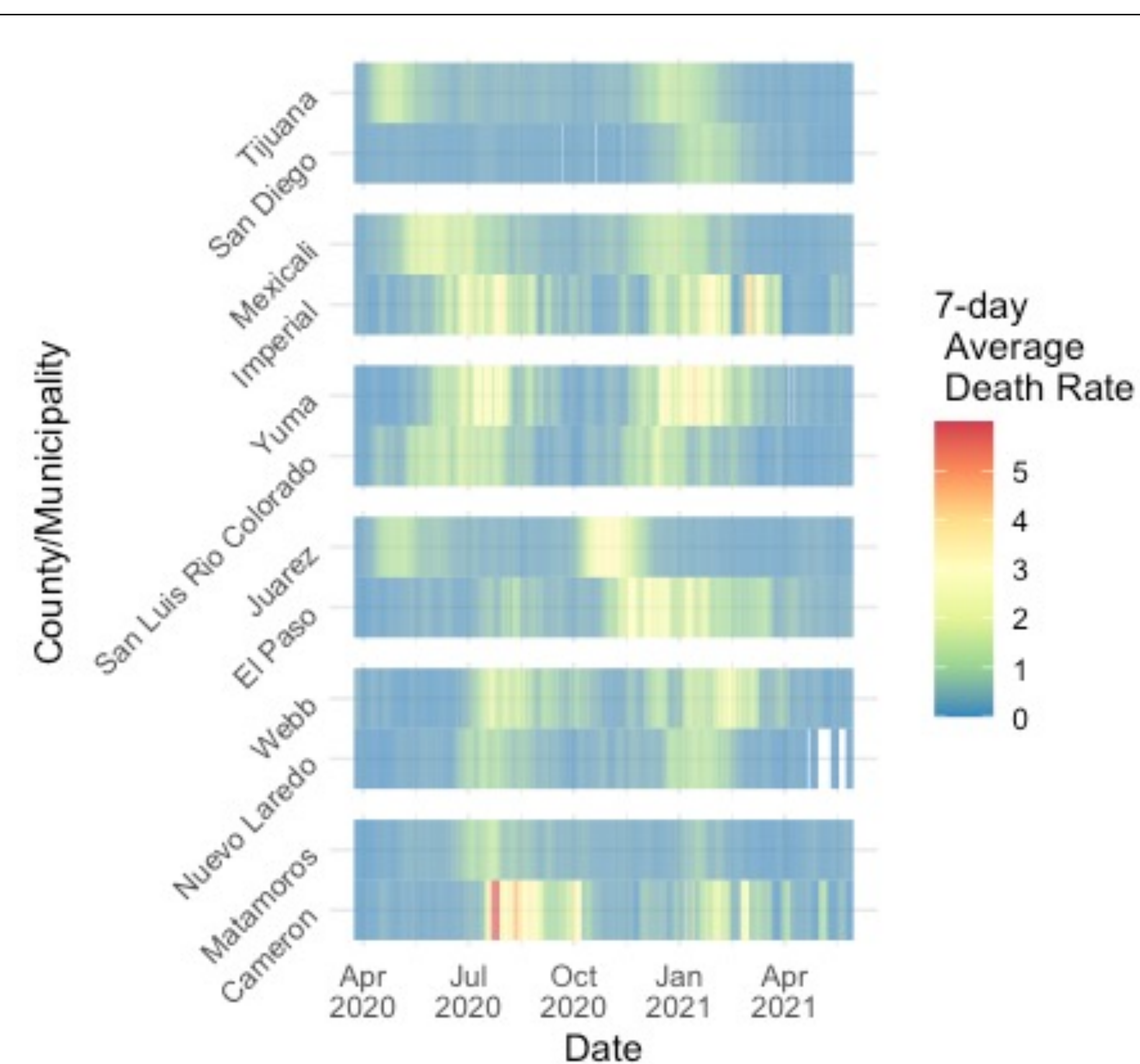
- Indirect standardization was used to create a cross-country metric (SMR) to assess the toll of COVID-19 by county in both the USA and Mexico.
- Human development index (HDI) was used as a proxy for socioeconomic status. HDI incorporates life expectancy, education, and country wealth.
- Choropleth maps were used to compare areas along the U.S.-Mexico border.
- Analyses were done in R.
- Data sources here all dates are cut off at 7/1/2021 unless otherwise specified.

## Discussion

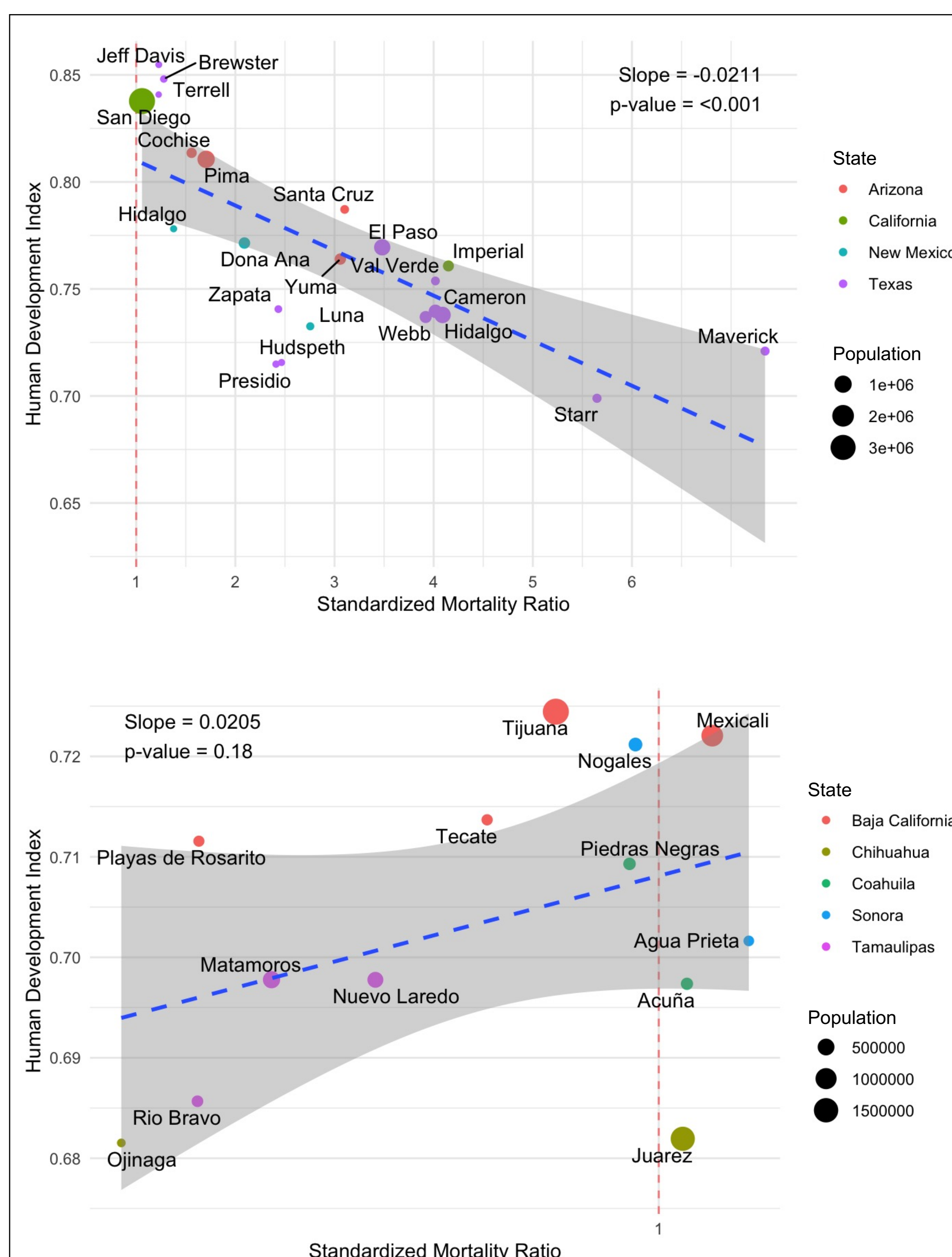
- The interrelationship of COVID-19 surges in dyad cities can be seen clearly when plotted over time despite differing policies and practices (Figure 1).
- The U.S.-Mexico border area had higher COVID death rates than non-border areas. (Figure 2, Table 1).
- In US border states, there was a negative correlation between SMR and HDI resulting in a higher SMR in the border region compared to the rest of the counties. Conversely in Mexican border states, there no association between SMR and HDI (Figure 2).
- Vaccination campaigns have proceeded rapidly in the U.S. leading to decreases in cases and deaths in both border and non-border counties (Figures 4 and 5).

## Acknowledgments

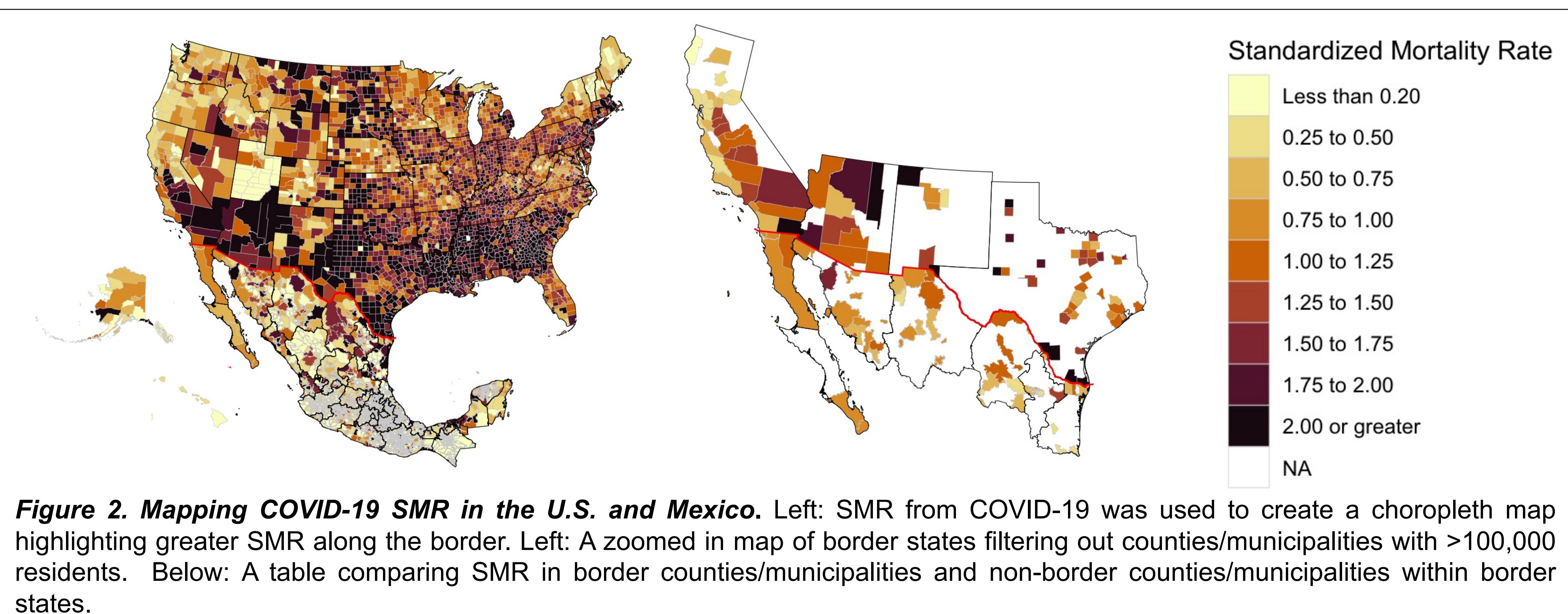
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**Figure 1. Waves of COVID-19.** County/municipality new daily deaths were averaged over a 7-day period, scaled to per 100,000 people, and plotted over time from March 2020 to May 2021.



**Figure 3. Relationship of COVID-19 SMR and HDI along U.S. and Mexico Border.** SMR and HDI were calculated for every county or municipality in states along the border and plotted. Above: United States. Below: Mexico.

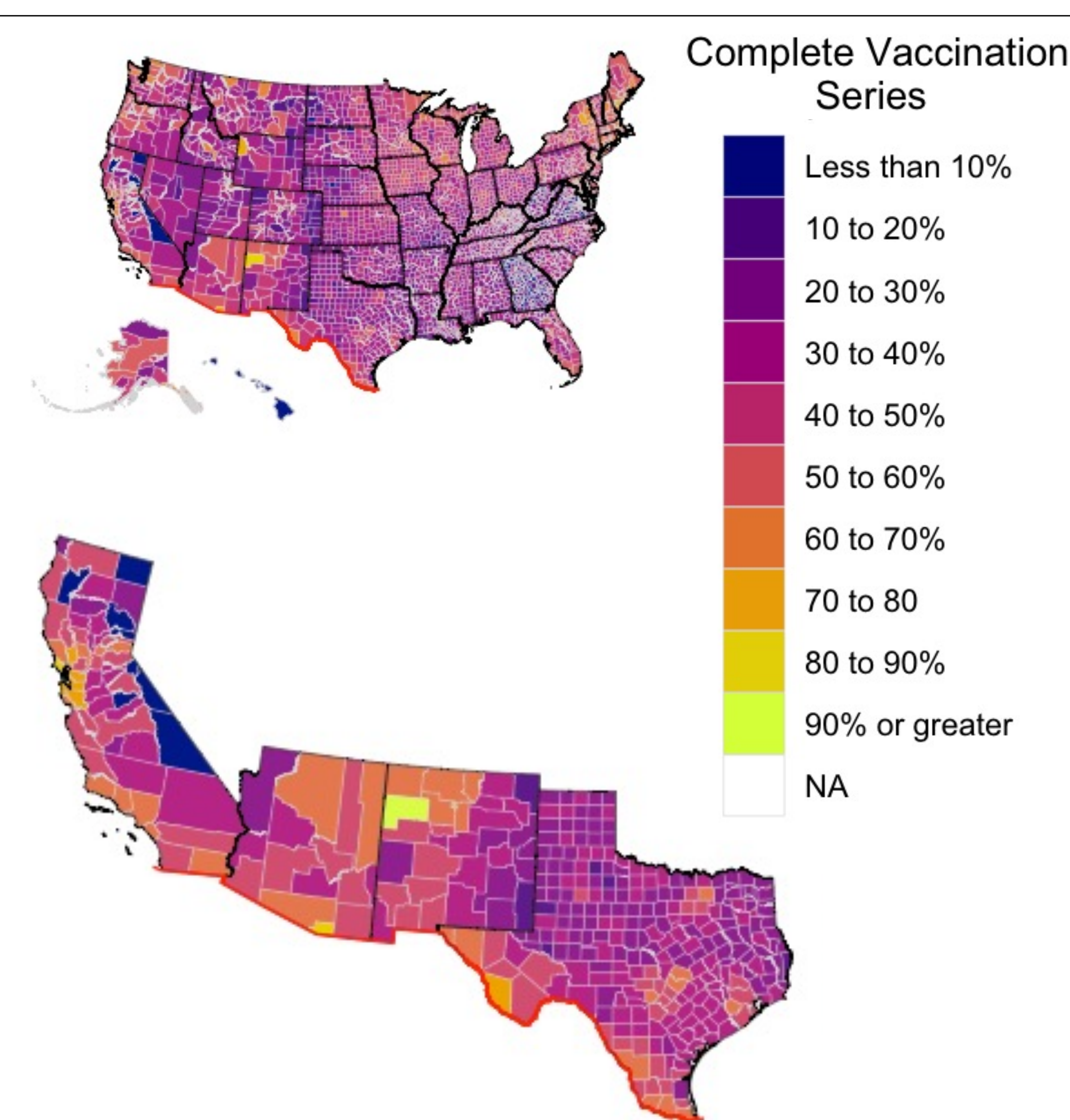


**Figure 2. Mapping COVID-19 SMR in the U.S. and Mexico.** Left: SMR from COVID-19 was used to create a choropleth map highlighting greater SMR along the border. Left: A zoomed in map of border states filtering out counties/municipalities with >100,000 residents. Below: A table comparing SMR in border counties/municipalities and non-border counties/municipalities within border states.

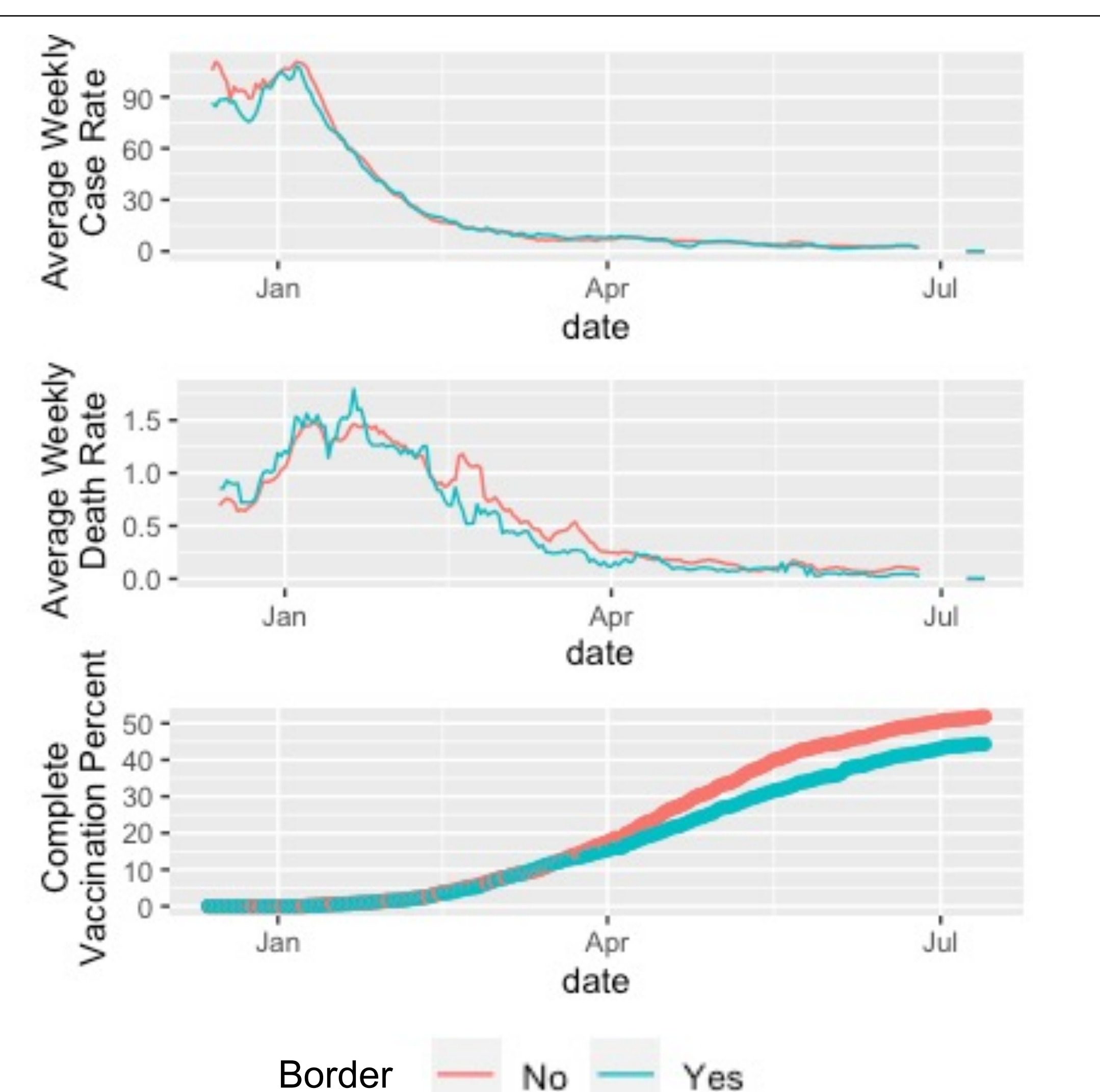
Table. Comparison of COVID-19 rates by country and border proximity

Country	Border Area <sup>a</sup>	Cases	Deaths	Population	Crude Case Rate per 100,000	Crude Death Rate per 100,000	Age-Adjusted Death Rate	95% Confidence interval		Standardized Mortality Ratio	95% Confidence interval		Beds per 10,000
								Lower	Upper		Lower	Upper	
USA	No	7,210,833	123,457	71,218,891	10,124.9	173.3	196.35	195.25	197.44	1.66	1.65	1.66	24.1
	Yes	880,822	18,283	7,875,484	11,184.4	232.2	253.68	250.03	257.38	2.14	2.11	2.17	23.4
Mexico	No	611,190	44,615	24,916,442	2,453.0	179.1	171.51	169.92	173.11	0.63	0.62	0.63	16.9
	Yes	197,698	21,227	9,254,343	2,136.3	229.4	261.41	257.91	264.95	0.96	0.94	0.97	8.1

<sup>a</sup>Only includes counties within states that are on the border



**Figure 4. Mapping COVID-19 Vaccination Rates in the U.S.** Top: Percent of county residents who have received a complete vaccination series was used to create a choropleth map of the U.S. Bottom: A zoomed in map of border states. Updated as of 7/9/2021.



**Figure 5. COVID-19 Vaccination Parallels Decreases in Death Rate.** Top: Average weekly new case rate per 100,000 people. Middle: Average weekly death rate per 100,000 people. Bottom: Percent of population with a completed vaccination series. Texas has been excluded due to a lack of data. Updated as of 7/13/2021.



# Abstract

The U.S.-Mexico border is a divide of incredible importance not only to immigration but as a region with unique social, economic, environmental, and epidemiological factors that impact disease transmission. We investigated how the COVID-19 pandemic followed trends of previously studied diseases in the corridor such as tuberculosis, HIV, and influenza H1N1. We used indirect standardization to age-adjust mortality rates (standardized mortality ratios [SMR]) in both countries. Mortality was higher in U.S. counties along the border compared to the national average (SMR 2.14, 95% CI 2.11-2.17). In Mexico, border counties had a slightly lower mortality to the national average (SMR 0.96, 95% CI 0.94-0.97). Over time, surges of cases and deaths were similar in dyad cities along the U.S.-Mexico border visualizing the interconnectedness of the region. In U.S. border states, SMR was shown to negatively correlate with human development index (HDI), a socioeconomic proxy, resulting in a higher SMR in the border region compared to the rest of the counties. Conversely in Mexican border states, there was no association between SMR and HDI. Additionally, as vaccination campaigns in U.S. counties accelerated, cases and deaths decreased similarly in both border and non-border counties. These data state how targeted intervention along the U.S.-Mexico border region is a necessity when confronting COVID-19 and have implications for future control of infectious diseases in the region.