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## **State-Level Policies and Their Impact on National Pandemic Responses**

### **Abstract**

This report utilizes the Oxford COVID-19 Government Response Tracker (OxCGRT) dataset to perform detailed analysis using Python. The goal is to examine various government pandemic responses across numerous countries to establish noticeable trends during the period of COVID-19. Through exploratory data analysis, data cleaning, correlation analysis, and geospatial mapping, we examine stringency in policy over time. The dataset, tracking measures like school closures, travel restrictions, and social gathering restrictions, illuminates the effects of policy severity and timing on pandemic control. Future federal and state strategies and policy implementations are also recommended based on these findings.

### **Introduction**

The COVID-19 pandemic prompted a diverse range of government responses worldwide, as countries implemented measures to control the spread of the virus and mitigate its impact on public health, economies, and societies. Understanding the relationship between state-level policies and national pandemic responses is crucial for assessing the effectiveness of these measures and informing future crisis management strategies.

The focus is on three large, diverse nations—India, the United States, and Brazil—each with distinct federal and state level governance. This analysis aims to explore how state-level policies within these federal systems influenced the overall effectiveness of national pandemic responses from March 2020 to 2021. Specifically, India and Brazil are both federal presidential republics, while the United States operates under a federal presidential system with more decentralized power between states. By examining state-level interventions and their impact on national outcomes, this report seeks to uncover patterns that could inform future pandemic preparedness in managing national health crises.

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## Research Questions

The key research questions addressed in this report are:

1. How did state-level policies within these federal government's impact the overall effectiveness of national pandemic responses between March 2020 to 2021?
2. To what extent did the inconsistencies between federal and state-level COVID-19 policies influence national health outcomes?
3. How did the stringency and timing of lockdowns and reopening phases affect the course of the pandemic in Brazil, India, and the USA?

## Data Analysis

### *Data Cleaning and Processing*

The Python script begins by loading the OxCGRT dataset and performing essential data cleaning and preprocessing. This includes converting the 'Date' column to datetime format, checking for missing values, and ensuring columns have appropriate data types.

Missing data is a common issue in real-world datasets, and the script analyzes the extent of missing values across different columns. Notably, the 'RegionName' and 'RegionCode' columns have a high number of missing values, likely indicating that many records lack regional specifications. Several pandemic-related columns, such as 'V2B\_Vaccine age eligibility', and 'V2C\_Vaccine age eligibility (at risk)', also contain significant gaps, possibly due to inconsistencies in reporting or irrelevance to certain entries. Additionally, vaccination-related fields like 'V4\_Mandatory Vaccination' and 'PopulationVaccinated' exhibit missing data, likely due to variations in data collection or reporting gaps.

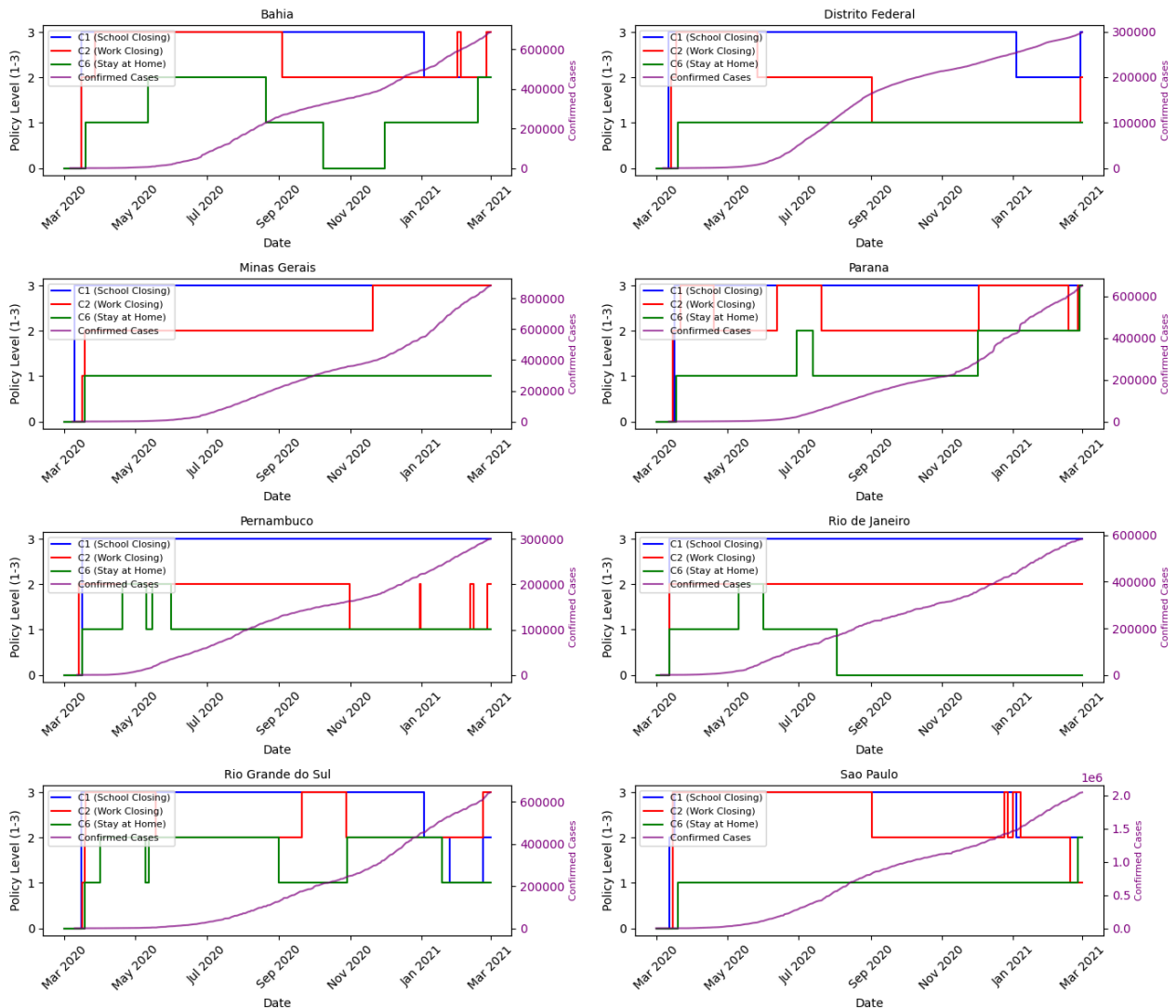
To address these issues, the script fills missing values in the 'ConfirmedCases' and 'ConfirmedDeaths' columns with zero, assuming no reported cases or deaths for those entries. In addition, the script also dropped columns that didn't focus on aspects that the research questions aligned with. These preprocessing steps give a cleaner dataset as well as provide a narrower focus for our analysis.

### *Exploratory Data Analysis Per State*

The subplot analysis focused on select states that reveal how their policies for Work at Home, School Closings, and Stay at Home fluctuated over the course of the

period studied– March 2020 to March 2021. The purple line further depicts the correlation between these policies and their effect on confirmed cases in that state.

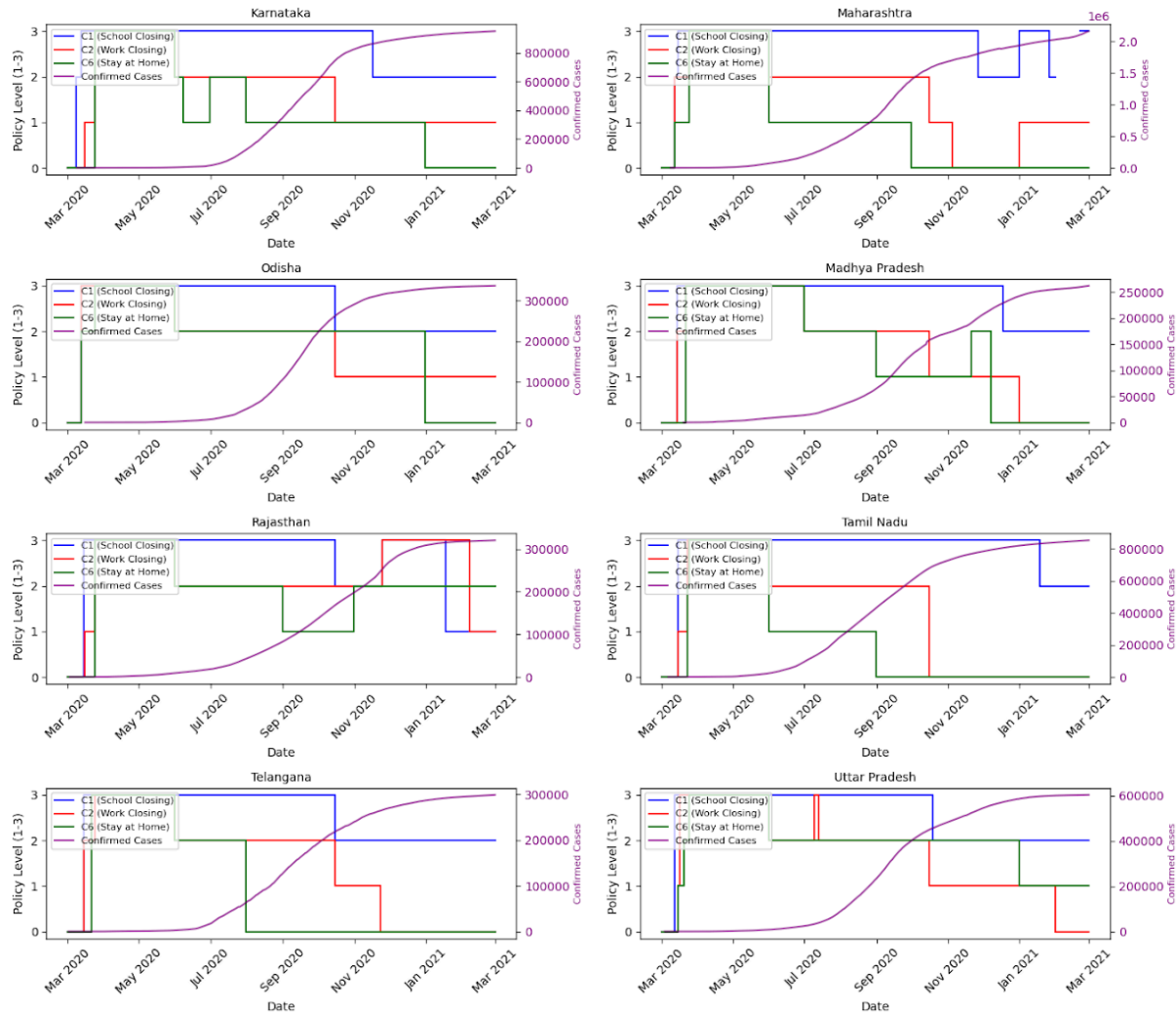
The state-level policy responses in Brazil during the COVID-19 pandemic highlight significant inconsistencies in how different states managed lockdown measures and stay-at-home orders. Over the course of 2020, school and workplace closures increased, reflecting an evolving awareness of the pandemic's severity. School closures remained at the highest level (Level 3) throughout the year, while workplace closures fluctuated between Levels 2 and 3, indicating intermittent tightening and relaxation of restrictions. However, stay-at-home orders varied widely between states, underscoring a lack of coordinated response between federal and state governments.



By January 2021, state governments began to impose stricter measures, with many shifting from Level 1 closures to Level 2 or 3. Nevertheless, this enforcement remained inconsistent across regions. For example, Rio de Janeiro relaxed its stay-at-home orders to Level 0 by August 2020, demonstrating a more lenient approach, whereas Pernambuco oscillated between Levels 1 and 2 for both workplace and stay-at-home closures throughout the analyzed period. The confirmed COVID-19 cases, as depicted in the visual, show a continuous upward trend despite varying levels of restrictions. This suggests that while some states enacted stringent policies to curb transmission, others were more lenient, ultimately contributing to an uneven national response. The lack of synchronization in policy implementation likely hampered the overall effectiveness of Brazil's pandemic strategy, leading to prolonged outbreaks in certain regions while others attempted stricter containment measures.

India's state-level response to the COVID-19 pandemic exhibited a structured yet highly variable pattern. The country implemented a strict nationwide lockdown from March 25, 2020, to May 31, 2020, during which all states enforced Level 3 restrictions—mandatory closures of schools, workplaces, and strict stay-at-home orders. This period saw relatively low infection rates, indicating that stringent policies were effective in containing the virus. However, after the lockdown ended, a gradual relaxation of policies took place across most states, despite a continued rise in confirmed cases.

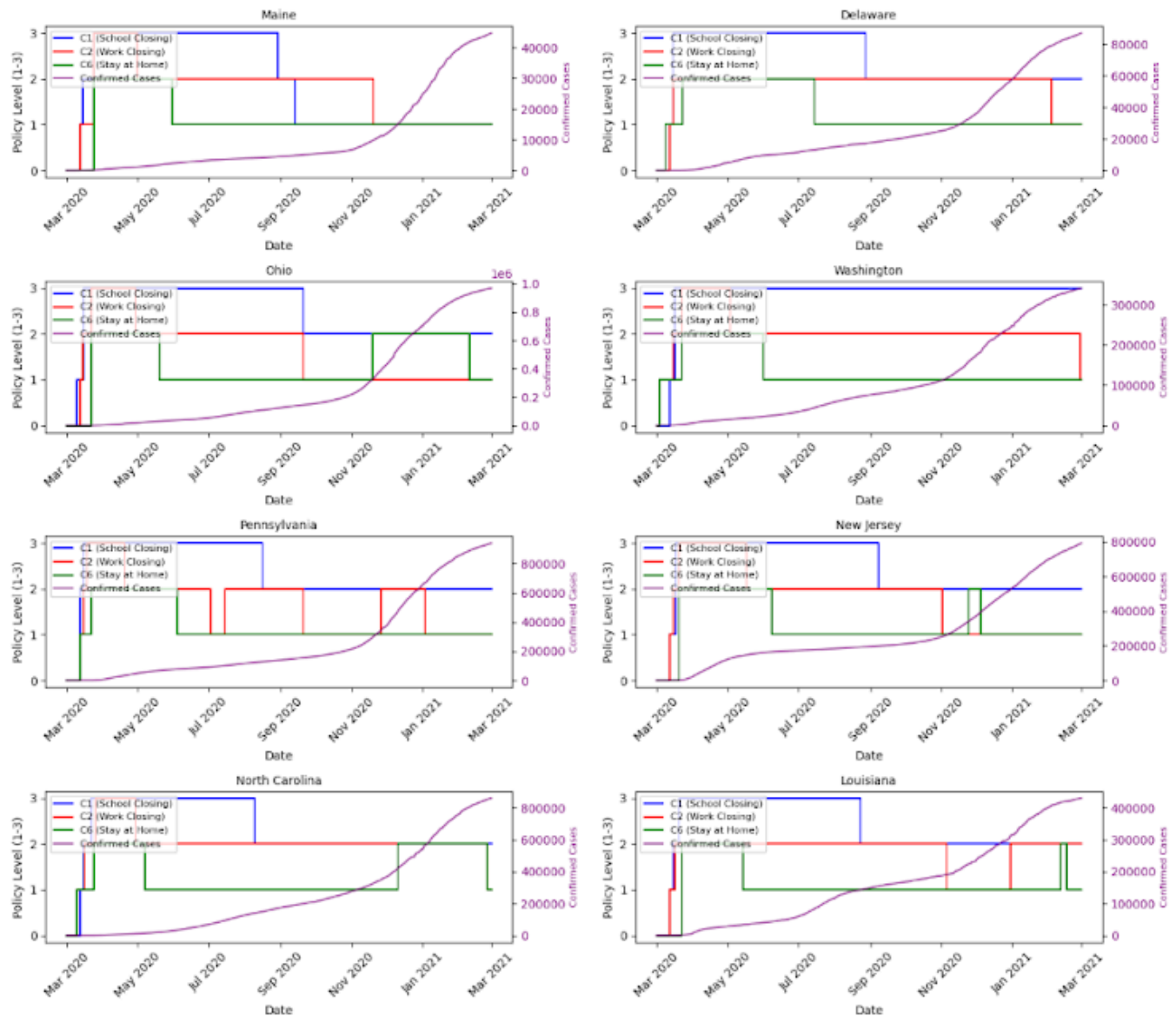
By August and September 2020, states such as Tamil Nadu, Madhya Pradesh, and Maharashtra systematically downgraded their restrictions, moving school and stay-at-home policies to Levels 2 and 1. Workplaces, however, remained at Level 3 in some states or fluctuated between Levels 2 and 3. By January 2021, stay-at-home policies had largely been removed (Level 0) in most states, even as cases continued to rise. Rajasthan, in contrast, initially relaxed restrictions but reinstated stricter workplace and stay-at-home measures in response to surging cases, demonstrating a reactive approach rather than proactive containment.



The visual representation highlights that each state followed independent trajectories in their policy decisions, often misaligned with the severity of local outbreaks. The lack of a uniform, sustained response contributed to continued case growth. This decentralized decision-making suggests that while some states prioritized economic reopening, others attempted to balance public health concerns by adjusting policies dynamically. The overall trend, however, indicates that many states relaxed restrictions prematurely, potentially exacerbating the spread of COVID-19 across the country.

The U.S. response to COVID-19 was highly fragmented, with states implementing school (C1) and workplace (C2) closures at different times and enforcing stay-at-home orders (C6) with varying intensity. While most states initially imposed strict policies in March–April 2020, many relaxed them by mid-year, even as cases continued to rise. Some reinstated restrictions in late 2020 to combat surging

infections, but the overall approach was largely reactive rather than proactive. States like New York acted aggressively early on, while others delayed, likely worsening national transmission.

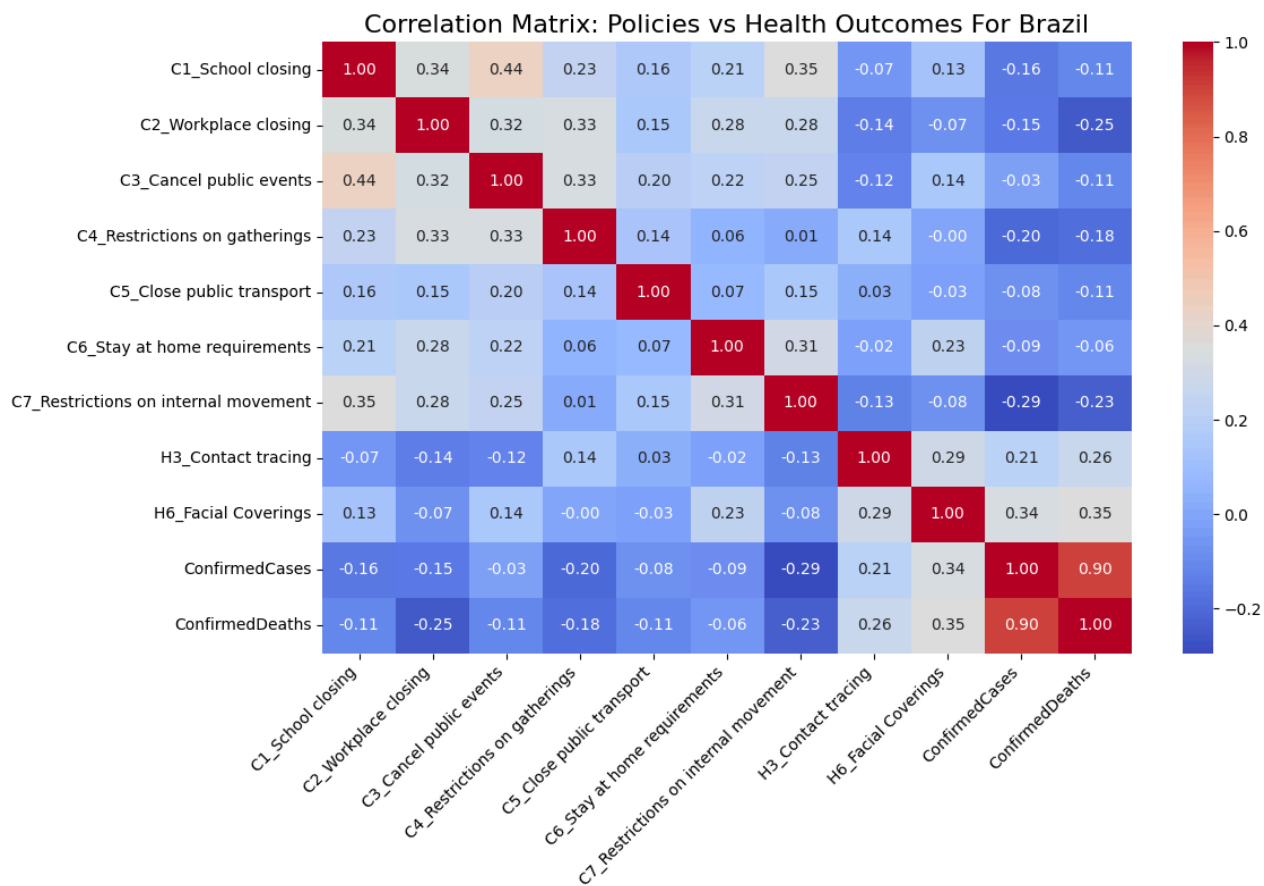


This decentralized approach created inconsistencies that allowed the virus to spread more easily between states with weaker restrictions. The lack of federal coordination meant policies were not uniformly applied, leading to recurring surges and vulnerabilities, particularly through interstate travel. While some states managed containment better, the overall response highlighted the challenges of managing a national crisis without a unified strategy.

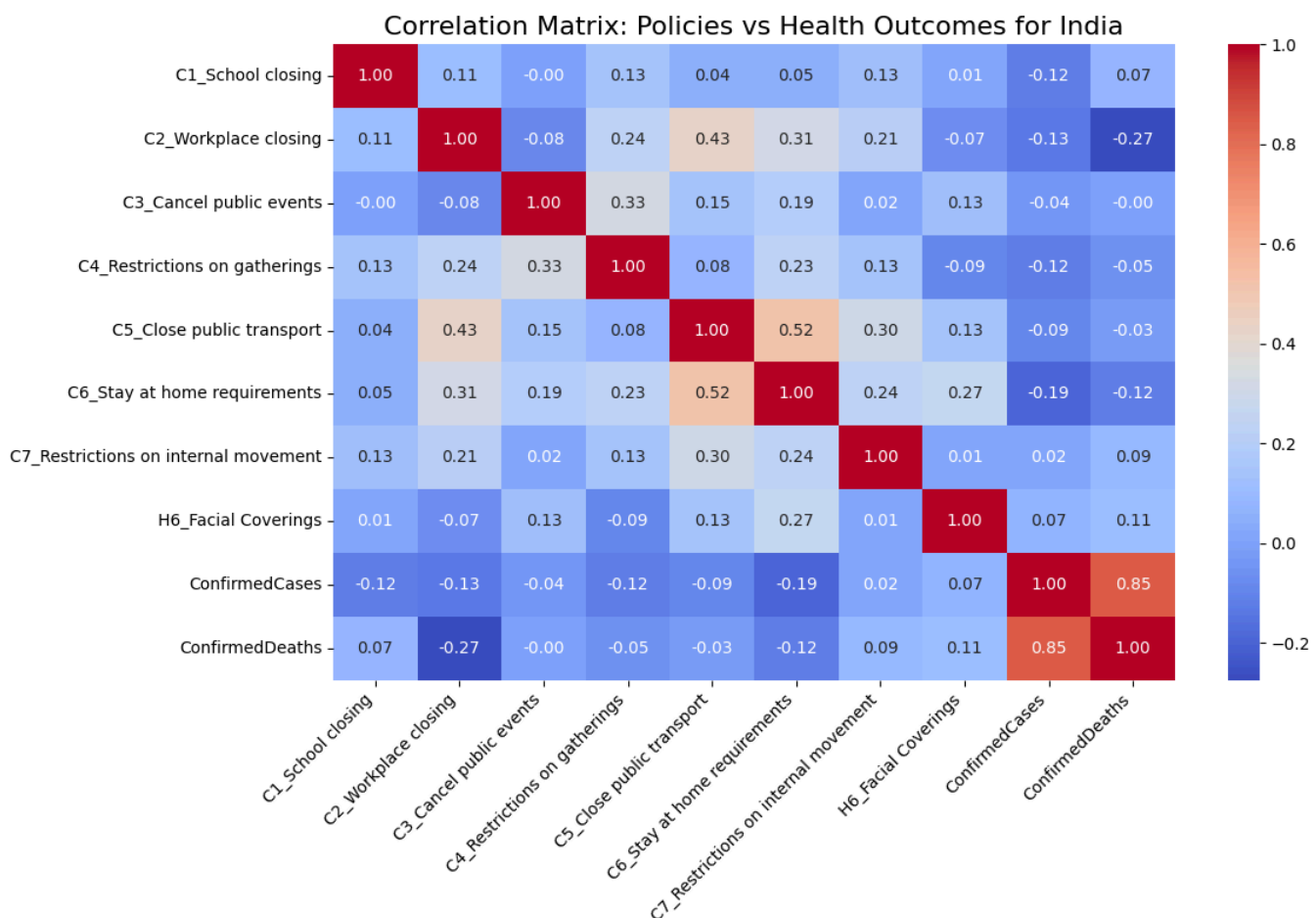
### Analysis across Countries

The correlation analysis conducted using the heatmap reveals important insights into how various policies correlated with health outcomes (confirmed cases and deaths) across Brazil, India, and the United States.

In Brazil, the correlation between facial coverings (H6) and confirmed deaths (0.35) suggests that inconsistent enforcement of mask mandates may have weakened their effectiveness. Other policies, such as workplace closures (C2) and internal movement restrictions (C7), showed moderate to weak correlations with both confirmed cases and deaths, indicating that political factors and uneven enforcement at the state level likely influenced the outcomes.



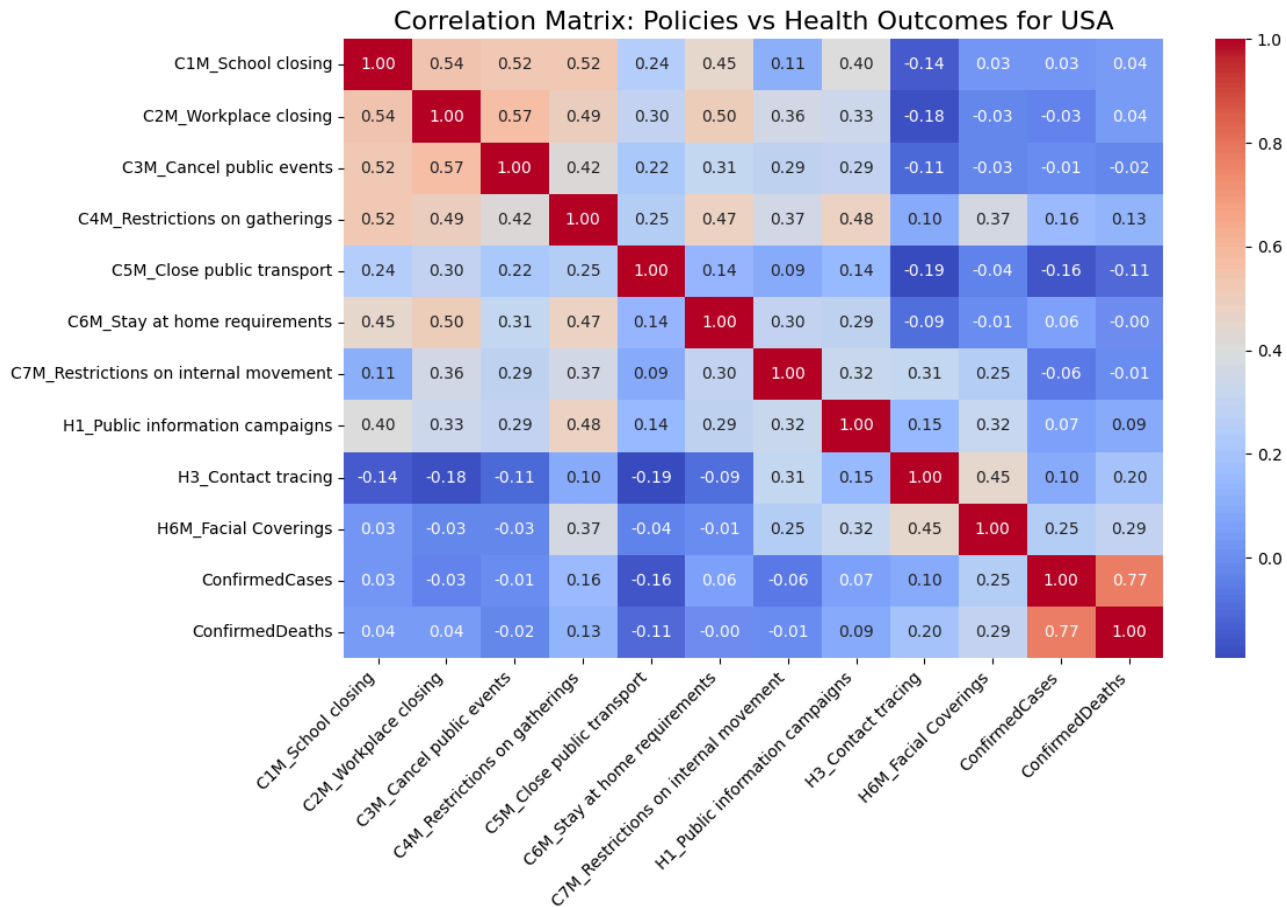
In India, policies such as workplace closures (C2) and public transport restrictions (C5) exhibited stronger negative correlations with confirmed deaths (-0.27 and -0.52), pointing to their role in reducing fatalities, particularly in densely populated states like Maharashtra and Delhi. However, stay-at-home requirements (C6) had a weaker correlation with confirmed cases (-0.12), suggesting that enforcement challenges at the state level may have reduced the overall effectiveness of these measures.



The U.S. heatmap reveals weaker correlations for policies such as school closures (C1) and workplace closures (C2) with both confirmed cases (-0.16) and deaths (-0.15), which suggests that delays in policy implementation and inconsistent adherence across states may have diluted their overall effectiveness. On the other



hand, restrictions on internal movement (C7) demonstrated a stronger negative correlation with both confirmed cases (-0.29) and deaths (-0.23), highlighting the effectiveness of such measures in reducing transmission and fatalities.

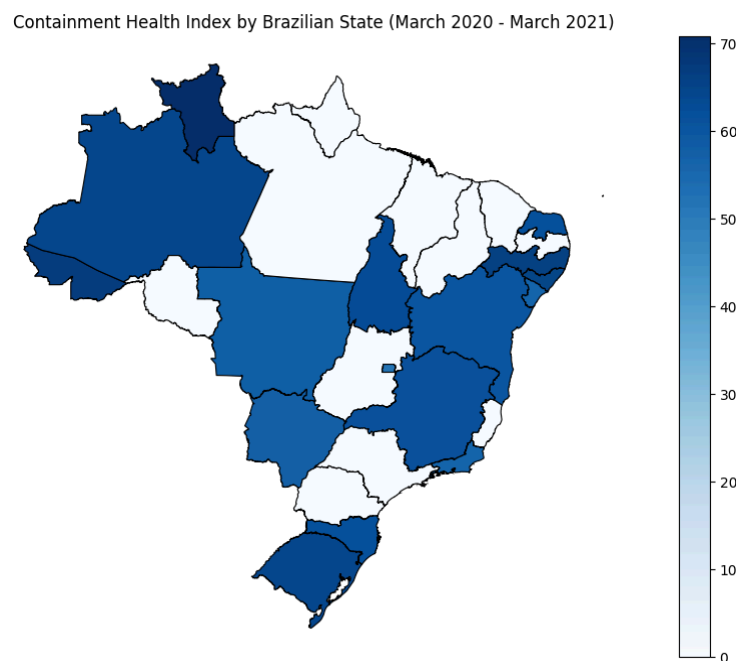


Overall, The heatmap analysis reveals that while policies like workplace closures (C2) and facial coverings (H6) correlated with better outcomes, their effectiveness depended on consistent enforcement at the state level. In Brazil, political divisions led to varied enforcement, with some states imposing strict lockdowns while others followed President Bolsonaro's lenient approach, weakening the overall response. India's abrupt lockdowns triggered mass migration, undermining internal movement restrictions (C7) as workers carried the virus to rural areas, as noted by Lahariya (2021). In the U.S., political polarization and inconsistent federal guidance led to divergent policies, reducing the impact of early closures and mask mandates in states that reopened quickly or had low compliance. Stronger correlations between internal movement restrictions (C7) and better health outcomes across all three

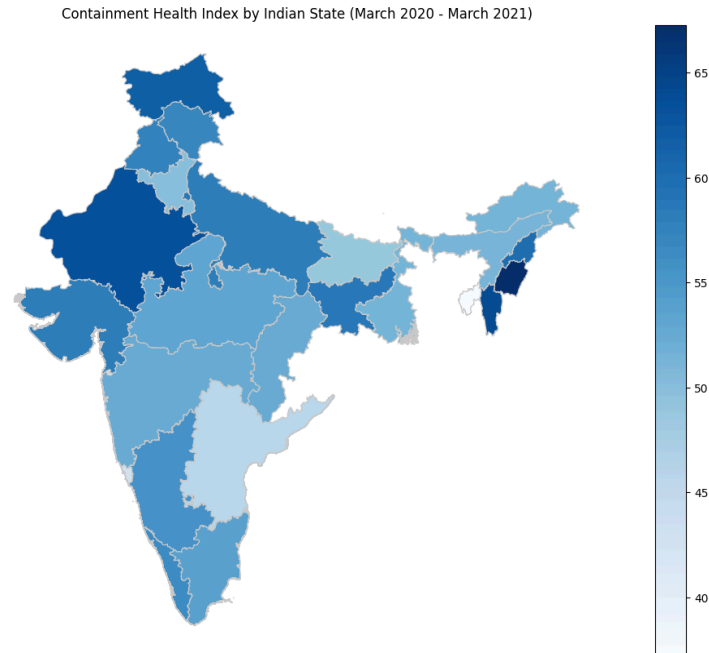
countries highlight the importance of coordinated, nationwide containment efforts. These findings underscore that policy success hinges on enforcement, coordination, and flexibility within each country's political and social landscape.

### *Geo-spatial Analysis*

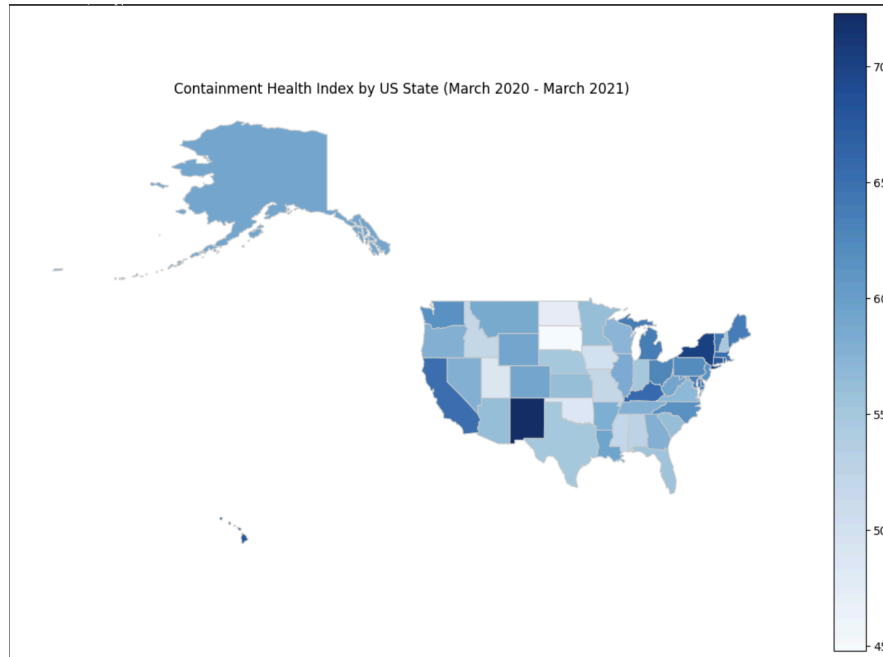
The purpose of the geospatial analysis is to examine regional variations in COVID-19 containment measures and their outcomes. By mapping the variation in policy enforcement and health outcomes, the analysis aims to identify patterns and correlations that could inform more targeted and efficient responses regarding regions of a country.



The Containment Health Index by Brazilian State (March 2020 - March 2021) reveals significant variations in COVID-19 response measures across the country. States shaded in darker blue, particularly in the north, northeast, and southern regions, implemented stricter containment policies, likely due to high case numbers and healthcare system constraints. In contrast, states with lighter blue shades had relatively lower containment measures, possibly influenced by economic pressures or differing political approaches. Notably, several states appear in white, indicating missing data rather than an absence of containment measures. The decentralized nature of Brazil's federal system granted state governments substantial autonomy in shaping their pandemic responses, leading to disparities in containment effectiveness.



The Containment Health Index by Indian State (March 2020 - March 2021) highlights significant differences in how states handled COVID-19 restrictions. Urbanized states like Maharashtra, Delhi, and Tamil Nadu enforced stricter containment measures, such as prolonged lockdowns and stringent public health guidelines, due to their high population density and case numbers (PRS Legislative Research, 2020). On the other hand, some rural states opted for more relaxed restrictions, balancing public health concerns with economic sustainability. State autonomy played a crucial role in shaping containment strategies. Economically significant states like Karnataka and Kerala implemented strict lockdowns, while others adjusted policies based on local conditions (AIMS Press, 2021). Rajasthan, in particular, demonstrated strong containment efforts, imposing a statewide lockdown on March 22, 2020, even before the national lockdown, and implementing robust measures to control the virus's spread (PRS Legislative Research, 2020).



The Containment Health Index by US State (March 2020 - March 2021) shows how differently states handled COVID-19 restrictions over the course of the pandemic. Coastal states, especially in the Northeast and on the West Coast, generally had stricter containment measures, likely because of their large urban populations and high case numbers. In contrast, many states in the South and Midwest took a more relaxed approach, influenced by factors like local economies, politics, and COVID-19 caseloads. States like New York, California, and Massachusetts implemented some of the strictest lockdowns, with mask mandates, business closures, and stay-at-home orders. Meanwhile, states such as Florida and South Dakota leaned toward fewer restrictions, prioritizing personal responsibility over government mandates. Each state had the flexibility to adjust its approach based on local conditions, which meant that policies varied widely across the country.

## Recommendations

To improve future national pandemic responses, federal and state governments must establish a more coordinated and proactive strategy. A centralized federal framework should set baseline public health measures, including standardized lockdown criteria, mask mandates, and vaccination rollout strategies, while allowing states flexibility to adapt based on local conditions. Improved data-sharing mechanisms between federal agencies and states would ensure real-time tracking of outbreaks and policy effectiveness. Additionally, a federally mandated emergency

response fund can provide states with the necessary resources to implement timely interventions without political delays.

States should work in alignment with federal guidelines to ensure consistency in policy enforcement, reducing fragmentation that can lead to uncontrolled virus spread. Public communication must be unified and science-driven to combat misinformation and vaccine hesitancy. Establishing regional pandemic response coalitions between neighboring states can also enhance coordination and resource-sharing. By prioritizing preparedness, funding, and clear federal-state cooperation, governments can create a more effective and resilient response to future public health crises.

## **Conclusion**

This analysis of COVID-19 responses in Brazil, India, and the U.S. highlights the challenges of managing a public health crisis within federal systems. Strict containment measures like lockdowns and movement restrictions helped curb transmission, but their effectiveness depended on enforcement consistency, political alignment, and socio-economic factors. Decentralized governance, while allowing localized decision-making, often led to fragmented responses that weakened national containment efforts. In Brazil, political conflicts resulted in inconsistent policies, while India's abrupt lockdowns and relaxations exposed the difficulty of balancing public health and economic stability. The U.S. faced state-level variations due to political polarization, affecting mask mandates and business closures. Geospatial and correlation analyses reveal that consistent enforcement of policies like movement restrictions and workplace closures improved outcomes, but vaccine hesitancy and uneven public health enforcement reduced effectiveness in some regions.

Ultimately, this research provides valuable insights for policymakers, reinforcing the importance of early intervention, sustained enforcement, and coordinated governance in mitigating the impact of global health emergencies. Future pandemic preparedness should incorporate lessons from COVID-19 by fostering stronger federal-state collaboration, ensuring equitable resource distribution, and addressing public trust in health policies to achieve more effective outcomes.

## References

- AIMS Press. (2021). *Geospatial analysis of COVID-19 containment strategies in India*. Retrieved from [AIMS Press](#).
- Castro, J. A., et al. (2021). Political polarization and the response to COVID-19 in Brazil. *Journal of Politics*, 83(4), 1156-1172.
- Lahariya, C. (2021). India's response to COVID-19: The early response and the road ahead. *Journal of Public Health Policy*, 42(1), 53-61.
- Katz, J., Sanger-Katz, M., & Quealy, K. (2021). A Detailed Map of Who Is Wearing Masks in the U.S. *The New York Times*.
- Paltiel, A. D., & Zheng, A. (2021). The federal role in managing the COVID-19 pandemic in the United States: The case for national coordination. *Journal of Health Politics, Policy and Law*, 46(2), 243-258.
- PRS Legislative Research. (2020). *Rajasthan Government's Response to COVID-19*. Retrieved from [PRS India](#).