

Strengthening Health Systems to Face Pandemics: Subnational Policy Responses to Covid-19 in Latin America

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Abstract

Non-pharmaceutical interventions (NPIs) such as stay-at-home orders continue to be the main policy response to the COVID-19 pandemic in countries with limited or slow vaccine rollout. Often, NPI are managed or implemented at the sub-national level, yet little information exists on within country variation in NPI policies. We focus on Latin America, a COVID-19 epicenter, and collect and analyze daily subnational data on public health measures in Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Mexico, and Peru to compare within- and across-country NPI. We show high heterogeneity in the adoption of NPIs at the subnational level in Mexico and Brazil, consistent national guidelines with subnational heterogeneity in Argentina and Colombia, and homogeneous policies guided by centralized national policies in Bolivia, Chile and Peru. Our results point to the role of subnational policies and governments in responding to health crises. We find that subnational responses cannot replace coordinated national policy. Our findings imply that governments should focus on evidence-based national policies while coordinating with subnational governments to tailor local responses to changing local conditions.

Keywords: COVID-19, Latin America, Non-pharmaceutical interventions, public health, policy implementation

Introduction

Latin America is one of the regions most affected by the COVID-19 pandemic and has been an epicenter throughout. Although it is home to only 8% of the global population, it accounted for over 30% of accumulated COVID-19 deaths as of mid-May of 2021.¹ The patterns over time of deaths and cases differ, yet no country can attest to having implemented a national non-pharmaceutical intervention (NPI) strategy that has been effective in containing the spread of COVID-19.¹⁻⁴

NPIs are critical to containing the pandemic until vaccination reaches the majority of the population in Latin America and around the world.⁵⁻¹⁵ Vaccination will be a lengthy process as rollout has often been slow and uneven despite the approval of several vaccines. Yet, the timeliness, mix, and rigor of NPIs in Latin America has varied both across and within countries since the first COVID-19 case was reported on February 25th, 2020 in São Paulo, Brazil.^{16, 17}

By the end of March 2020, many countries had implemented at least some national restrictions, yet the rigor and types of NPI waxed and waned over the entire pandemic period and continues to do so.¹⁸ In Brazil and Mexico, accounting for 55% of the region's

population, federal governments delegated or “punted” NPI responsibility to state governments, leading to large-scale variation within each country with no central, evidence-based planning.¹⁹ In other countries, national leaders relaxed policies at the sub-national level in an attempt to balance health imperatives, economic outcomes, and limited compliance due to lockdown fatigue. Countries in the region struggled to gather adequate evidence to guide their subnational policymaking. Only Uruguay – also a country with high per capita deaths – and Chile focused on access to testing.²¹ However, access to diagnostic tests was often scarce and unequally distributed between rich and poor.²⁰ This produced a patchwork of NPIs within and across countries, sometimes reactively yet seldom proactively responding to geographic variation in risk based on evidence given the limited testing and contact tracing.

We describe the adoption of NPIs at the state or departmental level for Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Mexico, and Peru – covering 80% of the region’s population -- from the date of the first case in each country through February 2021,²¹ approximately a year following the first detected cases in the region. Our descriptive data suggest that countries with comprehensive national responses implemented containment policies throughout their territories.

Few studies have analyzed subnational variation in the use of NPI in the COVID-19 response, even though variation exists in all countries, and almost no data are available for LMICs.^{6, 10} Our analysis is based on a unique data set that records daily adoption of NPIs at the state or departmental level for Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Mexico, and Peru since the first case in each country. These data come from the Observatory for the Containment of COVID-19 in the Americas (the Observatory),²² which provides data on the adoption of public policies at the national and subnational levels in Latin America.

Data and Methods

As part of the Observatory for the Containment of COVID-19 in the Americas,²³ we collected data on NPIs related to physical distancing and containment of SARS-CoV-2 in each of the eight countries' subnational territories, beginning with the first reported case in each country. We focus on the state, department, or provincial level of government administration. The data presented in this article are from February 25, when the first COVID-19 case was confirmed in Latin America in São Paulo, Brazil, to the end of February 2021, spanning the first year of the pandemic in the region for half of the countries in the dataset.

In this paper, we focused on the following NPIs: school closings, suspension of work, cancellation of public events, suspension of public transport, development of information campaigns, travel restrictions within the state, international travel controls, stay-at-home orders, restrictions on the size of gatherings, and the use of facemasks. We selected these variables based on a literature review at the beginning of the pandemic to identify measures influencing the level of COVID-19 cases and deaths.²⁴⁻²⁹ We also relied on the Oxford COVID-19 Government Response Tracker (OxCGRT) 5.0,³⁰ which records data on country policy responses to the pandemic at the national level as a guide to select the 10 NPI response variables. Other studies of NPIs to contain COVID-19 generally emphasize a subset of these variables.^{5-7, 14, 15, 31, 32} We adjusted each policy response variable to categorize state-level policy implementation.

We examined whether each policy was in effect each day, from the first case detected in the country. If a measure was in effect, we coded its application as partial or total to measure the policy's implementation intensity. Table 1 in the appendix describes the 10 policy variables and their possible values.³³ We assigned several discrete levels to the variables to achieve greater granularity in the analysis. Variables range from 0 to 1 in discrete levels; detailed variable descriptions, labels, and coding appear in the first section of the online Appendix.³³

To gather the data, we first reviewed official government websites to capture laws, decrees, and news items specifying the implementation of each public policy variable. Then, we cross-referenced this material against publications in news outlets and journalists' coverage of laws, decrees, cases, and deaths. Finally, we gathered information from official state or departmental social media accounts, primarily Twitter and Facebook, when other official sources did not report data. We then carried out an internal, random coding review whereby two authors not involved in the original coding independently verified daily subnational scores for specific policy variables to ensure validity and inter-coder reliability. A detailed log of sources is listed in the online Appendix.³³

We analyzed the 10 NPI variables individually and combined into a composite measure for each country. This paper focuses on the composite measure. To analyze the NPIs as a block and allow for comparison across and within countries of the overall policy response to COVID-19, we build on the Stringency Index developed by the Oxford COVID-19 Government Response Tracker team to generate a measure of Public Policy Adoption (PPA) from all the NPI variables other than mask mandates.

Our PPA measure sums daily scores for each policy variable. The index takes time since implementation into account by multiplying the sum of policy scores by a ratio of the days

since implementation to the days since a country's first case. The Online Appendix contains a detailed discussion of the measure's construction.³³

For each country and policy implementation phase, we first estimate the mean PPA score by weighting PPA by the population of each state, province, or department. Then we document and describe subnational heterogeneity in the stringency of NPIs and compare the country responses against each other. We consider variation in NPI policies using PPA to measure the timeliness and intensity of implementing a standard set of policies.

We analyze mask mandates separately because the use of face masks behaves differently from the other measures. Mask recommendations or requirements tended to be a reopening feature and are not designed to restrict movement. Instead, they modulate distancing and facilitate closer, safer contacts among the population. They were often implemented much later than the other indicators we collect based on the WHO's release of general guidance about the use of face coverings by the public on June 5, 2020.²³

Limitations

This is a descriptive study of 10 NPI policies at the subnational level across eight countries. Our data suggest patterns for further investigation, but we cannot make causal

claims or draw causal inferences from these data at this point. While the eight countries in our dataset cover 80% of the population in Latin America, there are important and diverse experiences in the countries that we could not cover.

Relatedly, the 10 NPIs for which we collect data are not the only NPIs possible. Additionally, the composite measures implicitly assume that the NPIs are additive and should be weighted equally. This is a simplifying assumption that could be interrogated critically in future research.

We do not consider the behavioral response to NPI across the region. The effectiveness of NPI for controlling COVID-19 transmission is contingent on compliance, which we know is not universal.^{34,35} However, we do not have cross-national, subnational data on compliance across NPI to incorporate in our analysis.

The data on COVID-19 cases and deaths across the region were of uneven quality and often incomplete due to different approaches to testing, laboratory capabilities, varying case definitions, and often limited capacity to record and report information at the national and subnational levels. Country teams had differing access to data depending on a given country's data collection, availability, and the size and access of the specific country team. As a result, we could not directly

assess the effect of subnational policy responses on COVID-19 and its associated health outcomes across countries.

Results

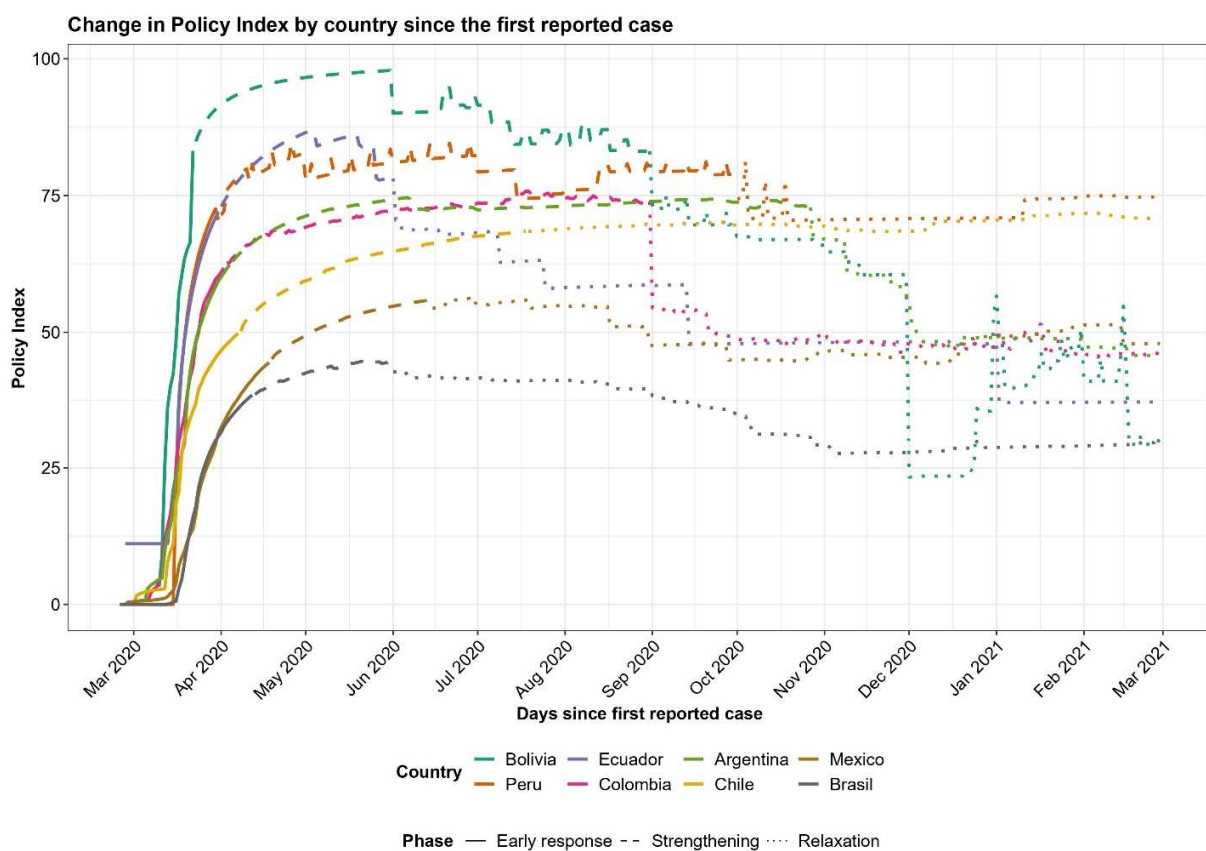
We identify three broad phases of NPI policy implementation across the countries: 1) early response, meaning the initial strategies, including school closures, event restrictions, stay-at-home orders, and other large-scale interventions. 2) lockdown, meaning the wholesale implementation of large-scale interventions, during which some countries also made adjustments to their initial strategy and mandated mask usage. 3) reopening, meaning the relaxation of national and state-level NPI policy, as testing and evidence became more widely available, and a more-localized, outbreak-driven response became the dominant approach to control the spread of the virus. We organize the results section according to these phases.

We observe extensive variation in containment policies across and within countries in the early response and lockdown phases and then a slight convergence during the reopening phase. The timing and rigor of the adoption of the nine clustered policies at the subnational level in all eight countries are presented in Exhibit 3A in the appendix.³³

Early Response

Exhibit 1 presents policy responses to the COVID-19 pandemic since the first reported cases. The solid line represents responses during the first phase, the dashed line reflects the second phase, and the dotted line the third phase.

Insert Exhibit 1.

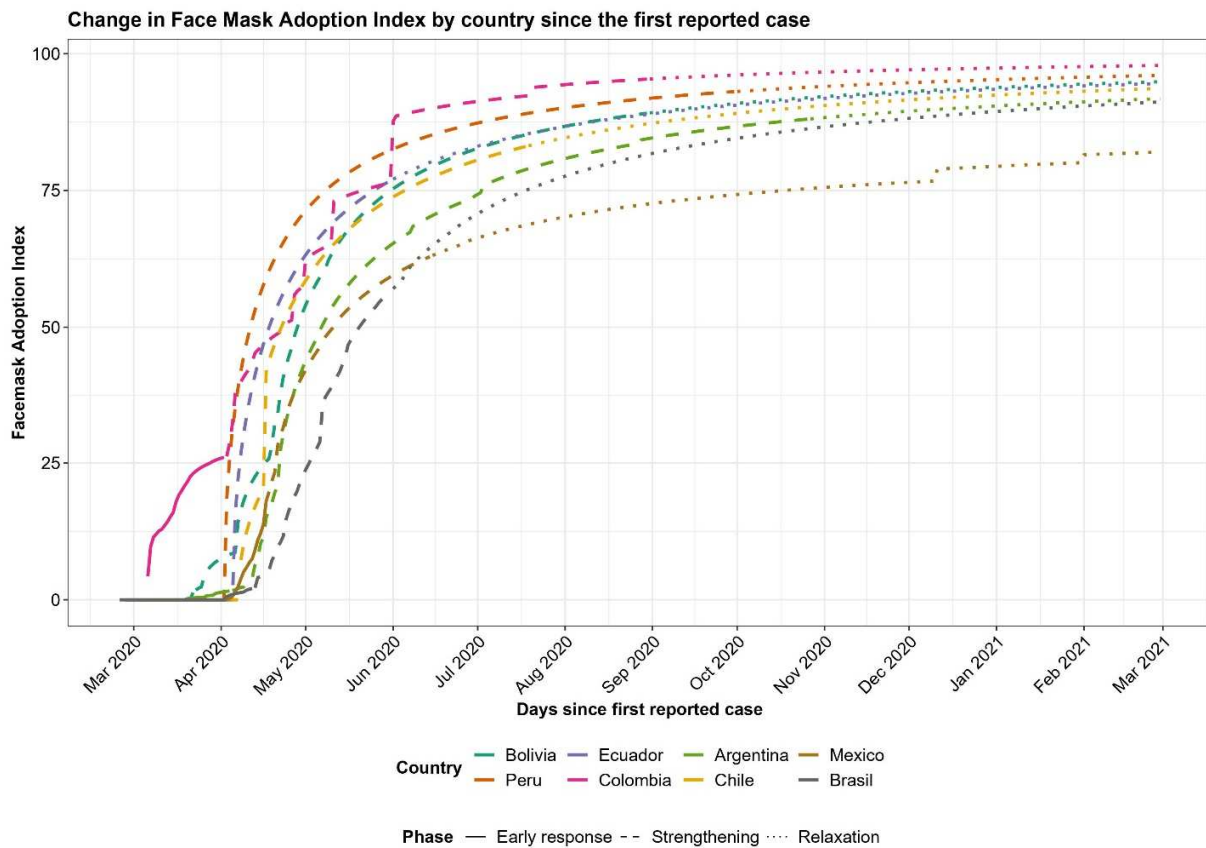


Brazil and Mexico had the laxest early responses with considerable variation across the states. Chile had an intermediate early response with little subnational variation, primarily driven by localized lockdowns, followed by Colombia and Argentina, which exhibited similarly strict responses but

with significant subnational variation. Bolivia, Peru, and Ecuador stand out as the countries with the strictest early responses overall.

Exhibit 2 presents mask use mandates since the first reported COVID-19 cases. The solid line represents responses during the first phase, the dashed line reflects the second phase, and the dotted line the third phase.

Insert Exhibit 2.

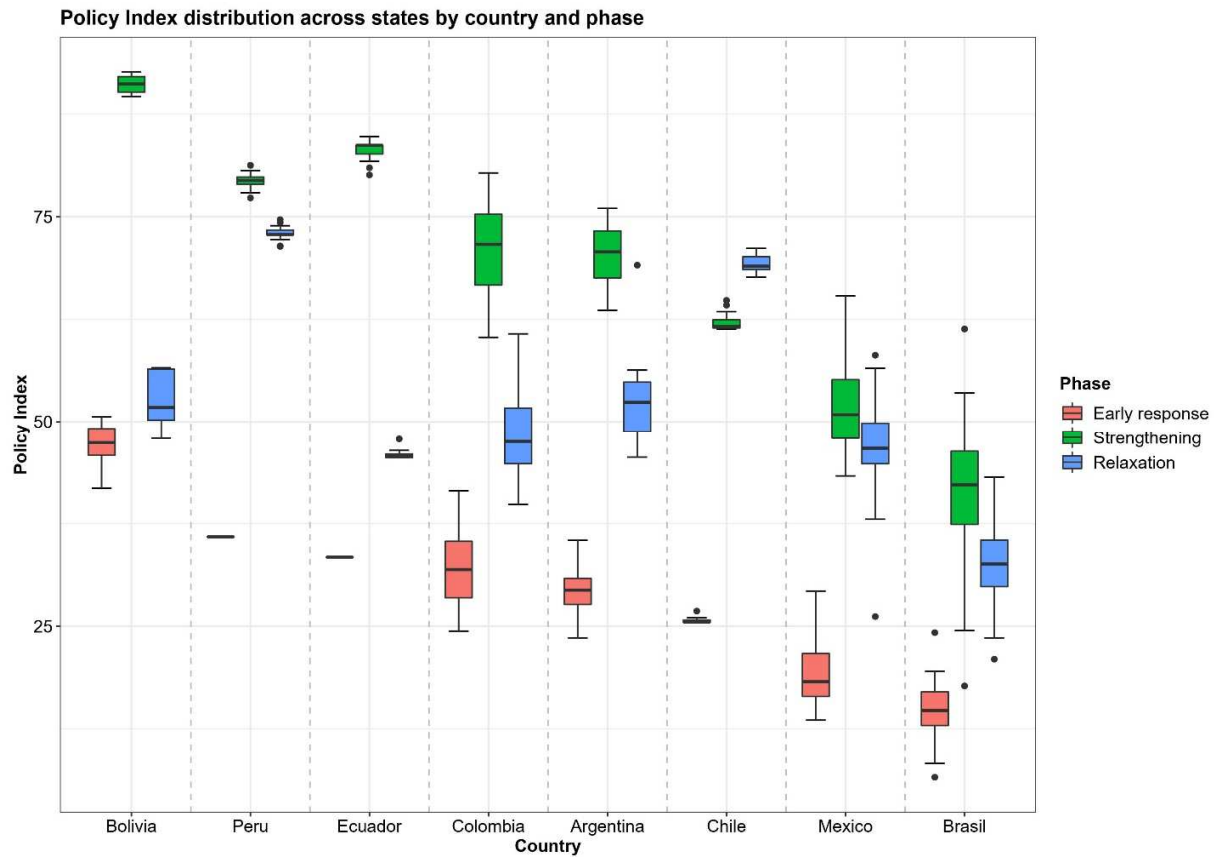


We find that Colombia was the first to act - even before the WHO's recommendation- followed by Bolivia, Peru, Chile,

Ecuador, Argentina, Mexico, and finally Brazil. Countries adopted this policy at different phases of their response and with differing rigor. Further, comparing Exhibit 1 and Exhibit 2 shows that the eight countries continue to promote masks, while relaxing other containment policies.

Exhibit 3 differentiates within countries and presents state-level variation in policy implementation over time. Exhibit 3 is a box and whiskers plot that compares the nine clustered policy variable scores within and across countries for each pandemic phase (masks are excluded). Each circle represents the PPA of a subnational unit, and policy responses are color-coded for early response (red), lockdown (green), and reopening (blue). The line within the box plot represents a country's average score during that phase. We chart the daily evolution of the average policy response for the nine clustered variables for states, provinces, or departments broken out by country in the Appendix's Exhibit 3A and mask mandates and stay-at-home orders in Appendix Exhibits 1b and 1c for interested readers.³³

Insert Exhibit 3.



Bolivia, Peru, and Ecuador stand out as the countries with the least subnational variation in Exhibit 3.

Lockdown

Most countries implemented stay-at-home orders during the lockdown phase (lockdown is the dotted line in Exhibits 1 and 2 and green dots in Exhibit 3). The country with the lowest average response is Brazil, again with considerable subnational variation, followed by Mexico, Chile, Argentina, Colombia, Peru, Ecuador, and Bolivia. Half of the countries under study exhibit

significant subnational differences, although Brazil stands out as having the most heterogeneous response.

Mexico and Brazil had the least stringent NPI across countries: they were the last to enter the lockdown phase, and their lockdowns were brief and limited compared to those of other countries. Conversely, Argentinians endured the longest lockdown in the world based on the experience with the pandemic to date.²¹

Reopening

Brazil was the first of the eight countries to reopen, followed by Mexico, and then Ecuador. Reopening did not begin in Bolivia or Colombia until September 2020, in Peru until October 2020, and in Argentina until November 2020. In the reopening phase (reopening is the dashed line in Exhibits 1 and 2 and the blue dots in Exhibit 3), subnational policies in Bolivia and Ecuador that had been very strict became more heterogeneous and relaxed significantly. In Peru, some relaxation of policies took place as well, although to a lesser extent. In Argentina, Brazil, and Mexico, the policy index scores in this phase were unexpectedly similar to the previous stricter phase. In Colombia, the reopening entailed significant relaxation, visible in the drop in the average policy score. Chile began a 5-step reopening plan on July 19th,³⁶ gradually relaxing social

distancing or imposing stricter restrictions at the municipal level.³⁶ As a result, the policy scores for Chile's sub-national regions during the reopening phase are even higher than in the lockdown phase but mobility restrictions were tailored to the epidemiological situation at the municipality level.

In Peru, Ecuador, Chile, Colombia, Argentina, and Bolivia, national governments established a strict country-wide framework of restrictions to contain COVID-19. Instead of independent and contrasting subnational responses, the national governments in these six countries set a high policy floor that subnational governments typically complied with, although we observe considerable variation within Colombia and Argentina.

Discussion

Our analysis aligns with other studies showing wide variation in NPIs to contain COVID-19, both across and within countries.^{9, 11, 14, 15, 32} Two groups emerge among the countries in this study across the early response, lockdown, and reopening phases of the pandemic to date: Argentina, Bolivia, Colombia, Ecuador, and Peru's national governments responded within days of their first cases with strict containment policies, superseding any objections from local governments. Brazil and Mexico's national governments lagged in policy implementation, which produced considerable variation at the subnational level

and led to a lax aggregate response. Chile is between both groups, with a less strict response than the first group, based on Chile's localized lockdowns at the municipal level.³² However, Chile had an overarching national response that led to stricter measures than the second group of countries.

Our analysis is descriptive but relates to the broader literature on NPIs and health outcomes of the COVID-19 pandemic. Research on some NPI we analyze, such as mask mandates, is consistent in identifying a relationship between more stringent implementation and prevention of COVID-19 transmission^{7, 38, 39}. The caveat is that the efficacy of other NPI, such as lockdowns, wane over time as economic costs and fatigue mount, while compliance falls.³² Considerable scholarship proposes the NPI we analyze for combatting COVID-19.^{5, 6, 9, 32} Yet, there is great difficulty in estimating causal relationships between NPI, cases, and deaths from COVID-19. This partly due to the extensive subnational variation in NPI, cases, and deaths, coupled with the lack of data available at the sub-national level. It is also partly due to the knowledge that officially adopting a policy does not necessarily mean policy compliance in practice. Given these difficulties, our descriptive study sets the stage for causal analysis by identifying this variation across and within countries.

Autonomy and responsibility within the health system could explain some of the observed variation across countries. Brazil, Chile, and Mexico have decentralized health systems where state and local governments are responsible for a large portion of health spending and service delivery. Other countries, such as Ecuador, have more centralized systems, where subnational governments have less autonomy, fewer resources, and fewer responsibilities related to public health. However, some countries, such as Argentina, centralized a stringent NPI response in an otherwise decentralized health system. In others, such as Brazil, states and municipalities sued to retain decentralized rights to implement more stringent NPI in the face of the national government's attempt to centralize a limited response.

The decentralization of health decision-making pre-pandemic almost certainly influenced how a country implemented national policy.^{10, 11, 16} Additionally, some countries and subnational units were more equipped to close borders to travelers and trade than others, which may have influenced the expansion of the pandemic. National-level lockdowns are particularly difficult to sustain in a region where more than half of the working-age population remains precariously employed in the informal sector and has limited access to social protection, external financing, or savings, making it difficult to comply with stay-at-home orders

for extended periods. This reality almost certainly influenced policy-making decisions across Latin America.¹¹ Moreover, lockdowns are less effective in poor, densely populated communities, where household heads cannot work from home, and residential crowding is a concern.^{34, 40}

Our descriptive analysis suggests that the stringency of the early response may relate to the stringency of the lockdown phase: countries in which subnational governments initially responded quickly and with more restrictions quickly moved to strict lockdowns - as in the cases of Argentina, Bolivia, Peru, and Colombia. In contrast, countries with limited early reactions, such as Brazil and Mexico, also had limited reactions in the second phase and never locked down to the extent seen in other countries, despite attempts from some governors and mayors.

Countries that rolled out clear national policies appeared to display higher levels of policy stringency. Yet, this stringency did not preclude subnational heterogeneity. National responses were strictly implemented in subnational units across Bolivia and Chile, resulting in near-zero subnational policy variation, except for localized lockdowns in Chile. However, in Argentina and Colombia, we observe the coexistence of a national policy framework with subnational heterogeneity at high levels of stringency.

Countries with either absent or late national response have lower policy index scores and more subnational variation. Along the same lines, countries with less stringent responses during the pandemic's early response and lockdown phases maintained a similar policy level in the reopening phase because these countries did not have many containment policies to relax in the first place. In contrast, countries with stricter responses in the first two phases relaxed significantly during reopening as they pared back stringent policies.

Finally, whether a country has a federal or unitary national government structure does not appear to explain the stringency of the response, its speed, or the extent of subnational variation in our descriptive analysis. While Brazil and Mexico's federal governments had lax responses, Argentina, a federal country, and Bolivia, a decentralized country, implemented strict policy responses which were guided by national mandates. In comparison, Colombia, a unitary country, demonstrated considerable subnational variation.

Policy Implications

Countries face stark social and economic costs imposed by large-scale NPIs. At the same time, many countries have largely failed to control the spread of SARS-CoV-2.⁴¹ The potential tradeoffs between slowing the spread of the disease and supporting livelihoods are especially important in low-income

countries; rich countries have income support, but those in Latin America often do not.

Our data are the first to cover daily, subnational policy responses to the COVID-19 pandemic for a cross-national sample and show that NPI implementation differed significantly within and across countries. Many Latin American governments quickly implemented NPIs as a critical first response to the COVID-19 pandemic. By the end of March 2020, most countries had established a full suite of strong, nationally binding travel restrictions, school closures, entry bans, and mandatory lockdowns. But despite national responses - or lack thereof -, public health policies to contain COVID-19 in Latin American exhibit important cross-national and subnational variation.

Mexico and Brazil - the two largest countries in the region - implemented NPIs slowly and in a decentralized manner. Lacking a cohesive or evidence-based national policy, leaders understated the risk of the virus and relied on or defaulted to state governments to design, organize, and implement NPIs. COVID-19 policy responses in Brazil and Mexico exhibit dramatic subnational heterogeneity, more so in Brazil, which is the only country in our sample without a coordinated national response. Citizens' public health experiences during the pandemic likely

reflected subnational decision-making and implementation capacity.

Bolivia, Peru, and Ecuador displayed coherent and comprehensive national responses that left little autonomy to subnational governments, leading to higher policy scores in our data with little subnational variation. In Colombia and Argentina, comprehensive national responses left more room for subnational governments to implement additional policies, leading to moderate subnational variation and high policy scores. Chile, in contrast, implemented a policy response that was nationally controlled but sub-nationally differentiated, including localized lockdowns.

Bolivia, Ecuador, and Colombia's national leaders set rigorous policy during the early phases of the pandemic but responded to quarantine fatigue and shrinking economies by lifting most restrictions by late 2020. In general, most Latin American national and subnational governments relaxed containment policies beginning in August 2020. As cases and deaths rose, only a few countries have effectively transitioned to policies that respond to outbreaks rather than resorting to large-scale lockdowns.

Conclusion

One important takeaway from this novel subnational dataset is that subnational units cannot make up for a lax national response. In our data, subnational governments attempting to enact strict policies in countries without a comprehensive national response were unable to replicate the policy coverage of subnational governments in countries with a comprehensive response.

Finally, our study highlights the importance of collecting subnational data rather than simply taking an aggregate measure or assuming that national policies are uniformly implemented. Subnational response patterns may be either tailored local measures or an indication of ineffective national planning and lack of coordination. Smaller countries may be more effective in comprehensive NPI adoption and relaxation, but that may depend on their ability to close their borders to neighbors. Future pandemic responses require attention to local and subnational policymaking. This, in turn, depends on forging coordinated, evidence-based national policy and connecting it to NPIs at state and local levels.

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21. The Exhibits in this version include data for all eight countries through the first year of the COVID-19 pandemic. We add more recent data for these countries as they become available on the University of Miami Observatory for the Containment of COVID-19 in the Americas site:
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Exhibits

EXHIBIT 1 (FIGURE)

Caption: [Change in Policy Index by country since the first reported case]

Source/Notes: SOURCE [University of Miami. *COVID-19 Observatory*.

Available from: <http://observcovid.miami.edu/>].

EXHIBIT 2 (FIGURE)

Caption: [Change in Face Mask Adoption Index since the first reported case]

Source/Notes: SOURCE [University of Miami. *COVID-19 Observatory*.

Available from: <http://observcovid.miami.edu/>]

EXHIBIT 3 (FIGURE)

Caption: [Policy Index distribution across states by country and phase]

Source/Notes: SOURCE [University of Miami. *COVID-19 Observatory*.

Available from: <http://observcovid.miami.edu/>].