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Contesting views on mobility restrictions in urban green spaces amid COVID-19—Insights from Twitter in Latin America and Spain

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1. Introduction

With over 90% of COVID-19 cases occurring in urban contexts (United Nations, 2020), authorities worldwide restricted access to urban green spaces (UGS) in an attempt to fight its spread. Cities' administrators issued full closures on and off through the pandemic, with different levels of enforcement. At the same time, the positive role that green spaces (UGS) in an attempt to fight its spread. Cities' administrators issued full closures on and off through the pandemic, with different levels of enforcement. At the same time, the positive role that green spaces (UGS) in an attempt to fight its spread. Cities' administrators issued full closures on and off through the pandemic, with different levels of enforcement. At the same time, the positive role that green spaces (UGS) play in residents' mental and physical health became even more salient during the pandemic (Honey-Rosés et al., 2020; Kleinschroth & Kowarik, 2020; Lai et al., 2020; Sainz-Santamaría, 2021; Uchiyama & Kohsaka, 2020).

In this context, urban residents engaged in debates pondering whether authorities should drop strict mobility restrictions and instead focus on balancing social distancing and public health. Nowadays, views on practically every aspect of life are showcased in social media, and views on pandemic-related mobility restrictions are not the exception.

Thus, taking advantage of Twitter posts addressing mobility restrictions applicable to UGS, this paper tackles the question of how did urban residents' views on such restrictions evolve during the first year of the pandemic?

This paper focuses on views of residents in three Latin American countries—Argentina, Colombia, and Mexico—and Spain. The focus on Latin America is motivated by the documented lack of compliance with mobility restrictions; Spain works as a comparison point to learn differences with respect to other regions.

Understanding and following in real-time the evolution of contesting views amid a pandemic is useful for managers and city planners to inform adaptation measures—e.g. communication strategies can be tailored to residents with specific views.
demand to restrict access to UGS due to concerns about non-compliance with mobility restrictions applicable to UGS. With these inferred views at hand, this paper explores their evolution using a mixed methods approach that combines four methods—analysis of evolution of views, analysis of frequencies of views by topic, qualitative content analysis of verbatim quotation, and conditional association between stringency of restrictions and percentage of views denouncing non-compliance.

Findings from this paper illustrate that urban residents’ views mirror the trade-off that managers of UGS faced during the pandemic. That is, on a given date, a segment of urban residents demanded access to UGS—expressing discontent with mobility restrictions applicable to UGS—and a second segment of residents reported concerns about non-compliance observed within UGS, demanding (more) restrictions to access UGS. These findings are in line with those reported by, for instance, De Meo et al. (2022) for the Italian case amid COVID-19—a segment of residents increased their visits to UGS; and a different segment was reluctant to visit UGS for fear of being infected despite the fact that the majority reported that UGS were important or very important for human health.

This paper contributes to a number of academic- and policy-relevant conversations. First, it contributes to the literature that documents the role of UGS in residents’ mental and physical health amid COVID-19. A line of research within this literature has documented residents’ sentiments towards UGS but, to the best to our knowledge, no previous study has documented views on mobility restrictions applicable to UGS. The distinction between sentiments and views is policy-relevant. To illustrate this point, we highlight that while positive sentiments towards UGS have unequivocally increased worldwide during the pandemic (e.g. Beckmann-Wübbelt et al., 2021; De Meo et al., 2022; Huang et al., 2022; Lopez et al., 2020; Marchi et al., 2022; Venter et al., 2020), this paper documents the contested nature of views on mobility restrictions applicable to UGS. The implication of these contrasting findings is that, while urban residents report unambiguous positive sentiments towards UGS, they do not share views on how to administer access to UGS—which is a matter of public policy.

A second literature that this paper contributes to is the one analyzing content in social media to learn about a wide range of social issues (e.g. Alizadeh et al., 2019; García-Palomares et al., 2018; Monachesi, 2020; Osorio-Arjona & García-Palomares, 2019). A subset of this literature has approached UGS-related topics (Cui et al., 2022; Huang et al., 2022; Marchi et al., 2022; Plunz et al., 2019; Roberts et al., 2019; Schwartz et al., 2019; Zhu & Xu, 2021). This paper contributes to this strand in the literature by focusing on i) mobility restrictions applicable to UGS; and ii) Latin America—a region chronically struggling with provision of UGS (Cortez-O’Ryan et al., 2020).

By implementing a strategy to infer residents’ views on a specific topic and by analyzing such views through a comprehensive four-method mixed approach, this paper puts forward a systematic empirical framework to understand and to follow residents’ views about a wide range of public policies. While social networks are composed of unstructured data that reflect desires, attitudes, requests, and occasionally proposals and debates, the exercise of aggregating such statements meaningfully allows us to observe patterns resembling the underlying motives of the public deliberation—a permanent struggle of values and ideas that Stone (2011) considers the essence of policy making. In this respect, methods and findings in this paper illustrate how social media represent a real-time source of information for policies that aim to be resident by incorporating residents’ views—a feature that has been highlighted in the context of the current pandemic but that becomes relevant in the face of future public health shocks as well (Cortez-O’Ryan et al., 2020; Cui et al., 2022; Lai et al., 2020; Samuelsson et al., 2020; Venter et al., 2020).

The rest of this paper is organized as follows. Section 2 describes strands in the literature to which this paper contributes. Section 3 describes this paper’s data collection strategy and the algorithm used to infer views. Section 4 reports findings. Section 5 puts findings in context and discusses policy-related implications. Section 6 presents conclusions.

2. Related literature

2.1. Trade-offs in the provision of urban green spaces

Based on quantitative and qualitative assessments of services provided by UGS, previous studies have predominantly documented how UGS contribute to societies’ welfare—with particular emphasis on urban contexts (Beatty & Newman, 2013; Bedimo-Rung et al., 2005; Hartz et al., 2014; van den Berg et al., 2015; Vanaken & Danckaerts, 2018; Wolch et al., 2014; Wood et al., 2017). Accordingly, a related line of research has documented residents’ positive opinion and perception towards UGS—both prior to and during the COVID-19 pandemic (Gozalo et al., 2018; Jim & Chen, 2006; Kothenz et al., 2017; Lopez et al., 2020; Zhu & Xu, 2021). Overall, policy recommendations—from a diverse scholarly body of work in terms of disciplinary approaches, topics, and methods—advocate the enhancement, maintenance, and promotion of UGS (Ambrose-Oji et al., 2017; Anderson et al., 2014; Aronson et al., 2017; Baycan-Levent & Nijkamp, 2009; Bonilla-Bedoya et al., 2020; Yu et al., 2017).

This focus on the positive dimension of UGS is present also in the emerging literature on the role of UGS amid COVID-19 (e.g. Lai et al., 2020; Samuelsson et al., 2020; Shari et al., 2020; Slater et al., 2020; Ugoz et al., 2020; Venter et al., 2020; Xie et al., 2020). For instance, Hanzl (2020) and Kleinschroth and Kowarik (2020) have pointed out that cities must develop policies that guarantee provision of more and better green spaces. Focusing on Latin America, Cortez-O’Ryan et al. (2020) have warned against potential increase in health inequalities due to the severe restrictions to mobility and use of UGS during the COVID-19 pandemic. This literature has highlighted previous research showing that reduction of interaction with UGS produces negative impacts on humans’ health (Roberts et al., 2019; Soga et al., 2015; Soga & Gaston, 2016).

The scholarly conversation on UGS has mostly overlooked the trade-off embedded in the provision of UGS. The literature on urban ecosystems provides a few studies discussing the nuisances or disservices of UGS (Lyytimäki et al., 2008; Shaketton et al., 2016; Tian et al., 2020; von Döhrn & Haase, 2015). The disservices from UGS are sometimes a consequence of pernicious human behavior such as drug addiction and crime that occur at UGS (Shakleton et al., 2016; von Döhrn & Haase, 2015). This association between social hazards and green spaces determine residents’ attitudes, perceptions, and ultimately demand for UGS—which is well documented by literature studying crime within urban parks (Gropp & McCord, 2012; Han et al., 2018; Hilborn, 2009; Troy & Grove, 2008).

This paper belongs to the studies documenting trade-offs in the provision of UGS. In particular, managers of UGS across Latin America have not successfully implemented and/or enforced social distancing measures within and/or around UGS premises (Sainz-Santamaria & Martinez-Cruz, 2022). In this context, this paper documents that the views expressed by Twitter users mirror the trade-off that managers have faced during this pandemic. That is, urban residents have demanded access to UGS, expressing discontent with mobility restrictions; at the same time, residents have reported concerns about hazards associated with use of UGS during the pandemic. In this sense, this paper illustrates how messages posted by Twitter users provide an opportunity to understand and follow residents’ conversations about trade-offs associated with provision of UGS.

2.2. Urban green spaces and online social media

Even before the COVID-19 pandemic hit, online social media had become an extraordinary repository of attitudes, sentiments, and demands with respect to a wide range of topics. For instance, Twitter posts
have been analyzed to characterize city dynamics, land use and mobility or activity patterns (García-Palomares et al., 2018; Osorio-Arjona & García-Palomares, 2019); to identify emerging discourses about a city (Monachesi, 2020); and to document how citizens use social networks to engage in and feel about decision-making of local governments (Alizadeh et al., 2019).

Thus, it does not come as a surprise that a nascent but rapidly growing literature is analyzing social media messages to gain insights into residents’ reactions to COVID-19. For instance, Cabezas et al. (2021) have documented emotional evolution towards COVID-19 by analyzing a year’s worth of tweets posted in Chile, Mexico, Peru, and Spain.

A subset of this literature has approached UGS-related topics amid COVID-19 (Cui et al., 2022; Huang et al., 2022; Marchi et al., 2022; Zhu & Xu, 2021). However, none of these studies have focused on Latin America—a region chronically struggling with provision of UGS (Cortínez-O’Ryan et al., 2020). Also, previous studies focused on UGS have documented positive sentiments towards UGS, mostly overlooking nuances arising from the trade-offs associated with the use of UGS (Gozalo et al., 2018; Jim & Chen, 2006; Lo & Jim, 2010; Lopez et al., 2020).

2.3. Online social media as a platform for policy-relevant debate

Beyond social media analysis, the public policy literature represents a broader approach to decision making based on public problems emerging from public deliberation within a democratic regime framework (DeLeon, 2006; Nelson, 1996). Either from the perspective of policy-making as a permanent struggle about values and ideas (Stone, 2011) or from an analytical perspective that classifies policy process stages—from agenda setting to formulation, from implementations to evaluation (Wu et al., 2017), public policy scholars have highlighted the centrality of citizens’ views for decision-making.

Within the public policy literature, understanding citizens signals plays a key role in i) identifying situations that should be considered public problems and, consequently, should be addressed through public policies; ii) influencing criteria to be used in assessing available alternatives; and iii) participating directly in implementation of specific programs through mechanisms of co-production and co-creation. In this context, understanding of public views and their evolution becomes useful for decision-making.

For the specific case of governance of UGS, the scholarly literature is interested on how to incorporate views and demands of citizens in the policy process, not only as an input but as active participants in the supply and co-production of public services (Alizadeh et al., 2019; Ambrose-Oji et al., 2017; Boulton et al., 2021).

When it comes to literature analyzing social media, there is a wide interest in understanding citizens’ messages in relation to decision-making, both as an input or as a window into the policy process. In addition to inferring views on demand of UGS and denounce of non-compliance amid COVID-19, we highlight that a subset of messages analyzed in this paper are directed to public officials and politicians. These messages reflect petitions, denounce of people’s behavior, and/or criticize public officials and politicians. Consequently, messages posted in Twitter have been analyzed in this paper to gain insights about public debate among citizens, advocacy groups and decision-makers—as it has been done in previous studies (e.g. Alizadeh et al., 2019; Gupta et al., 2018; Hubert et al., 2020; Park et al., 2016; Schuster et al., 2021; Sobaci & Karkin, 2013; Siter et al., 2018; Tromble, 2018). This is a promising research agenda for urban policy. For instance, Alizadeh et al. (2019) have stressed that conversations in online social media represent a two-way communication process that open an avenue for participatory processes. Tromble (2018) has described two-way conversations between politicians and citizens. Hubert et al. (2020) and Schuster et al. (2021) have documented effective strategies by advocacy groups to advance their policy preferences via Twitter.

A related avenue of research—known as stance analysis—has approached public deliberation to identify in-favor or against arguments (Küçük & Can, 2020). Stance analysis is useful when a well-defined topic is discussed and concrete in-favor or against arguments are advanced. However, social media conversations are unstructured in nature and specific topics are not clearly defined as they are usually emerging in real-time. In the case of deliberations about UGS-related mobility restrictions, there is no clear prior structure that we assume and therefore stance analysis is less useful in this context. Consequently, we have decided to develop a context-specific algorithm that we describe in Section 3.

Regarding the use of social media analysis as a tool for policy, Ceron and Negri (2016) and Ceron and Negri (2015) argue—based on different policy issues from the Italian case—that is possible to construct indicators useful as fire alarms, rate policy alternatives, and monitoring citizen’s behaviors.

We wish to highlight that, from a methodological perspective, this paper departs in two ways from previous studies analyzing messages posted in social media. Most of previous academic work focuses on sentiments about UGS (e.g. Cabezas et al., 2021; Huang et al., 2022). In contrast, this paper categorizes messages into categories reflecting views about UGS-related mobility restrictions. This categorization is useful to inform public policies as people with views in favor of mobility restrictions may share positive sentiments with people against mobility restrictions—i.e. while COVID-19 has brought an unambiguous increase in positive sentiments towards UGS, the focus on views about mobility restrictions seeks to identify stances on a specific public policy.

The second way this paper departs from previous studies analyzing social media is in its use of geolocation of messages. By geolocation we refer to the coordinates reflecting precise latitude and longitude where a message is posted. Most of previous studies based their analysis on coordinates reflecting the exact location where messages are posted. In contrast, as we detail in Section 3, we take advantage of precise geolocation of a subset of messages to infer the country in which a different subset has been posted; and then we proceed to analyze messages at country level, gaining insights on residents’ views irrespective of specific location—which is in itself an important contribution because, in general, the bulk of available information in social media is not geolocated at the coordinates level.

3. Materials and methods

We have accessed publicly available messages posted by Twitter users in Argentina, Colombia, Mexico, and Spain, from January 1st to October 1st, 2020. The focus on these countries is justified on two grounds. First, the three Latin American countries are among the most populous in the region—after Brazil, Mexico ranks second (129 million); Colombia, third (51 million); Argentina, fourth (45 million). The three Latin American countries together host 225 million people; and 272 million people when including Spain (47 million). The second reason of our focus is that, in terms of Twitter users, the four countries are among the top 20—Mexico is ranked 9th (11 million); Argentina, 16th (5 million); Colombia, 18th (3.5 million); and Spain, 11th (7.5 million). Together, these numbers imply that this paper aims to uncover views of residents of the most populated countries in the region, and that Twitter seems to be fitted to provide information to uncover such views.

From the universe of messages posted in Twitter during the period and countries of interest, collection of messages has relied on searching for keywords relating to green spaces within the content of posted

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1 The package Tweepy has been used to gain access to these messages.
2 Population data according to the World Bank data services updated to 2020: https://data.worldbank.org/indicator/SP.POP.TOTL?most_recent_value_desc=t
3 https://www.statista.com/statistics/242606/number-of-active-twitter-users-in-selected-countries/
messages. Collected tweets have been filtered, processed, and classified to unveil and document views on mobility restrictions applicable to UGS. Step-wise, the algorithm first chooses messages that contain the phrase green spaces. Then, messages are filtered to keep only those reflecting access to UGS. These messages are identified through five sets of keywords that reflect topics related to access (or lack of) to UGS. The first set of keywords—which reflects a topic that we label open/lockdown—includes open, distance, closed, close down. The second set of keywords—reflecting a topic that we label children use—includes play, kids. The third set includes the words workout, sports, football soccer, walk, take a walk—and captures a topic that we label sport. The fourth set includes words such as mental health, emotions, stress, depression, relaxation—and reflects a topic that we label mental health. The fifth set of keywords includes mask, hygiene gel, fever, pain, coronavirus—reflecting the topic that we label COVID-19 protocols. This categorization aims to capture views directly related to mobility restrictions in UGS—via COVID-19 protocols and open/lockdown categories, and views on services that UGS provide on regular basis—via children use, sports, and mental health. This strategy to gather and classify information from social media messages is used regularly when analyzing content of social media (e.g. Acchrek et al., 2011; Hernandez-Suarez et al., 2019).

Fig. 1 illustrates and summarizes the steps implemented to obtain our working dataset. Starting with the set of messages containing information about UGS (Step 1), only those posted in the four countries of interest were considered. Due to lack of information about geographic location for a large portion of messages, Step 2 infers the country in which messages were posted. Step 2 uses a text classification model that takes advantage of the written expressions and geo-localization information of messages that were certainly posted in each of the four countries under study—below, more details on Step 2. In Step 3, a second classification model was used to assign messages into two categories that we have labeled as demand for UGS, and Denounce of non-compliance. Step 4 ensures a high quality data by dropping messages with less than 25 % of probability of belonging to one of those two categories.

Step 2 addresses the fact that a large portion of retrieved messages has no information on geographic location attached. Had we focused only on messages with geographical location, there would not be enough observations to analyze a trend in views—messages with geographical location are 1243 in Argentina; 1202 in Colombia; 1399 in Mexico; and 2263 in Spain. Thus, Step 2 develops and implements a classification algorithm that uses messages containing information about country of origin to infer the country from which a message without location in — which reflects a topic that we label COVID-19 protocols—ruptures in UGS. A second set of findings reported in Section 4.1—arises from analyzing the evolution of views on mobility restrictions in UGS. A second set of findings—reported in Section

1. Label message as Demand for UGS when content expresses a desire to either i) visit a UGS; or ii) see that UGS area open. These messages include requests to authorities to open UGS—expressing the need of people (or specific subsets of population such as children) to use UGS. These messages also include references to UGS being closed, and check-in to a UGS.

2. Label message as Denounce of Non-Compliance when it denounces or criticizes or complains about public behavior of people within UGS or about authorities decisions to allow access to UGS.

This labeled dataset was used to train a model that, based on the text categorization algorithm μTC, classifies messages into the two categories. The performance of this model is of 80% accuracy. This model was used to classify messages that were not labeled manually.

Regarding accuracy of classification of 72 % and 80 % of our algorithms, previous studies report similar levels of accuracy when it comes to automatic classification of social media messages. For instance, Mahmud et al., 2014 report a location classification model reaching 60 % to 78 % of accuracy. Similar accuracy values on Twitter posts are reported by Mahmud et al., 2012 and Vashisth and Meehan, 2020.

Fig. 3 illustrates the composition of our working dataset. Panel (a) splits the dataset by topic, and panel (b) splits it by country. Accordingly, panel (a) shows that 33 % of messages in our working dataset directly relates to views on mobility restrictions in UGS—as captured by the 17 % in the open/lockdown category, and the 16 % in the COVID-19 protocol category. Panel (a) also illustrates that around 67 % of our working dataset relates to services that UGS usually provide—33 % reflect views on sports in UGS; 28 % reflect use of UGS by children; and 6 % reflect mental health topics and associate them with UGS. Panel (b) in Fig. 3 illustrates that 52 % of our working data is provided by Twitter users in Spain; 34 %, by users in Mexico; 9 %, by users in Argentina; and 5 %, by users in Colombia.

The reader may wonder whether our working dataset actually reflects views of urban residents—we have not been able to implement an urban filter, and so this question deserves consideration. We believe that our keywords implicitly filter out messages posted in non-urban contexts—i.e. mobility restrictions applicable to green spaces have mostly been implemented in urban contexts. To make our point, we have mapped messages in our working dataset for which we know location at point level in Mexico. Fig. 4 shows that most messages have been posted in main cities or metropolitan areas of Mexico—particularly, Mexico City, Monterrey, and Guadalajara.

4. Findings

Our working dataset consists of messages posted in Twitter from January to October 2020, by urban residents in Argentina, Colombia, Mexico, and Spain. Each message in our working dataset addresses one of five topics in relation to UGS: open/lockdown, children use, sports, mental health, and COVID-19 protocols—as detailed in Section 3. Each message has been categorized as reflecting either a view that favors or demands access to UGS, or a view expressing a denounce of non-compliance with COVID-19 restrictions, and calling for further restrictions to access to UGS.

This section reports findings from four approaches implemented on messages in each country of interest. A first set of findings—reported in Section 4.1—arises from analyzing the evolution of views on mobility restrictions in UGS. A second set of findings—reported in Section...
4.2—results from analyzing frequencies of messages across topic and view. A third set of findings—reported in Section 4.3—arises from quoting verbatim tweets that illustrate the contentious nature of views with respect to mobility restrictions in UGS. A fourth set of findings—reported in Section 4.4—arises from a conditional analysis exploring country-level association between stringency of mobility restrictions and percentage of messages denouncing non-compliance.

4.1. Evolution of views on mobility restrictions in UGS

Fig. 5 reports, for each country under analysis, weekly evolution of messages by view. Dashed lines denote messages reflecting demand for access to UGS, and straight lines denote tweets reflecting denounce of non-compliance. Views in Fig. 5 refer to any of the five topics under analysis—open/lockdown, children use, sports, mental health, and COVID-19 protocols. Dotted vertical lines in Fig. 5 denote week that a first directive on mobility restrictions was issued and subsequent weeks that mobility restrictions were strengthened; and straight vertical lines denote weeks that restrictions were officially softened—we have identified these weeks based on the stringency index reported by Hale et al. (2021) at the country level.

Focusing on the panel referring to Spain in Fig. 5, we observe an
The evolution of contrasting views that closely follows the issuing and subsequent strengthening/softening of mobility restrictions. That is, Twitter messages posted by urban residents reflect a demand for opening of UGS when restrictions were first issued and later on strengthened. Correspondingly, messages reflect concerns with non-compliance when restrictions were officially softened. In particular, we highlight that evolution of both *denounce of non-compliance* and *demand for UGS* categories start as soon as the first official restrictions were issued during the third week of January 2020. During week four and ten, Twitter messages that reflect *demand for UGS* increase and those reflecting *denounce of non-compliance* decrease—i.e. urban residents’ initial reaction in Spain to mobility restriction was to demand access to UGS. Once these restrictions were strengthened in week ten, we can observe a pattern that clearly signals the contentious nature of views with respect...
to availability of UGS during a public health crisis such as COVID-19 pandemic. In particular, notice the jump in number of weekly tweets for both categories—for the demand category, tweets go from around a steady 40 to peaks that reach 400; for the denounce category, tweets jump from an average of 100 to peaks above 600 and up to 800. Indeed, from week ten to 21, denounce dominates demand. In week 21, restrictions were softened and denounce tweets drop and we observe the highest peak in demand tweets in week 25, just a couple of weeks before measures are strengthened again. From week 27 to week 38, we observe more denounce messages but then, by the end of our period of analysis, demand seems to dominate the conversation.

Focusing on the panel referring to Argentina in Fig. 5, we observe an evolution of contrasting views that is dominated by a demand of access to UGS—this pattern holds almost at any point during the period under analysis, with few exceptions. In particular, immediately after the first restrictions were issued in the third week, demand for access to UGS is stronger than denounce of non-compliance. Denounce peaks immediately after week 10, when restrictions were strengthened; but through the rest of the period of analysis, demand remains stronger than denounce, regardless restrictions measures are softened or strengthened. The exception to this pattern is week 27 and week 35 but while absolute frequencies of denounce reach 50 during these week, demand’s peaks are above 100.

Focusing on the panel referring to Colombia in Fig. 5, we observe an evolution of contrasting views that is dominated by denounce of non-compliance. This exception to the pattern is observed right after the first restrictions were issued in the third week and until the second wave of restrictions were issued in the ninth week. Starting week 10, denounce tweets surpass demand tweets with exception of four weeks—week 14, week 22, week 31, and week 38.

Focusing on the panel referring to Mexico in Fig. 5, we observe an evolution of contrasting views that is dominated by denounce of non-compliance—resembling the pattern observed in the Colombian case. In general, denounce messages surpass demand messages during most of the period under analysis, and a peak in demand messages is observed only by the end of our period of analysis—in week 39. A particularity of the Mexican case is that there are a number of weeks when both categories of views are observed with remarkable similar frequency—the Spaniard case somehow resembles this pattern but it is not observed neither in the Argentinian case nor in the Colombian case. That is, while taking into consideration the entire period under analysis, the conversation is dominated by denounce, there are specific weeks when the conversation is divided between the two views (Table 1).

4.2. Frequency by topic and view on mobility restrictions in UGS

For each country under study, Fig. 6 reports number of messages by topic and views—this frequency is accumulated over the entire period under analysis. The color of a brick in Fig. 6 refers to a topic. Orange stands for open/lockdown; red, for children use; blue, for sports; green, for mental health; and yellow, for COVID-19 protocols. For each topic/color, a brick reports number of tweets of each view category—demand for UGS and denounce of non-compliance. Taking as reference the number of messages in a country, the size of the brick reflects relative frequency of tweets discussing a topic from a point of view.

Focusing on the panel referring to Spain in Fig. 6, we observe that children use is the most mentioned topic—with 2365 tweets—and that it is more frequently approached from a denounce point of view—1555 tweets, equivalent to 65 %. The second and third most common topics in Spain are, respectively, open/lockdown (1595), and sports (1546). These topics are approached with more frequency from a demand point of view—61 % for the case of open/lockdown, and 82 % for sports. With 558 tweets, the topic COVID-19 protocols is not predominant in the conversation—its frequency is represents 24 % of the frequency of children use, the most frequent topic—but it is clear that its mention is associated with a denounce point of view—83 % are classified under this category.

Table 1

| Topic           | Class          | Text                                                                 |
|-----------------|----------------|----------------------------------------------------------------------|
| Sports          | Demand for parks | What is major Almeida waiting to open Madrid’s ample spaces while he is inviting its citizens to crowd in reduced spaces where the majority does not wear masks and it is impossible to keep the required distance between “athletes”? [A que espera el alcalde @AlmeidaPP para abrir los grandes parques de Madrid mientras invita a los madrileños a aglomerarse en espacios concretos y reducidos en los que la mayoría no lleva mascarillas y es imposible mantener las distancias exigibles entre “deportistas”?] It is nonsense to close the parks. In many cases, they are healthier that the very home, where many live crowded, without clean air, sunlight, without space for walking. Do not ban places that allow the recovery of physical and mental health. (@@3porciento_3 Pues yo tengo ganas de que mi hija pueda salir, ir al parque y pueda hacer una vida medio normal como tengo ganas de hacerla. De su higiene y salud me ocuparé yo no creo que por ir a ninguno lado se vaya a infectar.al reves, recuperara la alegría que ahora no tiene (@@3porciento_3) We can fence playgrounds and let the children go out for a minutes like we allow to do it with the dogs. Children will have severe cognitive and health consequences if we not reduce the strictness a little. (Podemos vallar los parques infantiles y dejar salir unos minutos igual que sale el perro. Los ninos pequeños van a padecer secuelas cognitivas y de salud grises si no aflojamos un poquito.) We have been many weeks in lockdown. WE ALL want and need to go out, for our physical and mental health. As we want to do it in the best way possible. But it is not justified that we have to crown in the sidewalks while the parks are closed. (Son muchas semanas de encierro. TODOS tenemos ganas y necesidad de salir, por nuestra salud física y mental. Y queremos hacerlo de la mejor forma posible. Pero es injustificable que tengamos a estar amontonados en aceras mientras los parques están cerrados.) Parks are still locked down. They should analyze the possibility of open them up according to a timeline and monitoring their capacity. Lockdown impacts mental and physical health. Implement a good health plan to mitigate the damage. (@alcaldiagye Parques cerrados aun. Sin importar el color del semaforo analizar la posibilidad de abrirlos segun horarios regulando el aforo bajo supervision. El encierro causa impacto en la salud fisica y mental. Implementar plan de salud en ese aspecto para mitigar estragos.) |
| Denounce        | Demand for parks | What is major Infante waiting to open Madrid’s ample spaces while he is inviting its citizens to crowd in reduced spaces where the majority does not wear masks and it is impossible to keep the required distance between “athletes”? [A que espera el alcalde @InfantePP para abrir los grandes parques de Madrid mientras invita a los madrileños a aglomerarse en espacios concretos y reducidos en los que la mayoría no lleva mascarillas y es imposible mantener las distancias exigibles entre “deportistas”?] It is nonsense to close the parks. In many cases, they are healthier that the very home, where many live crowded, without clean air, sunlight, without space for walking. Do not ban places that allow the recovery of physical and mental health. (El alcalde @AlmeidaPP_ espera a abrir los parques de Madrid si las mascarillas no se llevan. Pero es imposible mantener distancia en esos espacios. No hace falta cerrar los parques.) We have been many weeks in lockdown. WE ALL want and need to go out, for our physical and mental health. As we want to do it in the best way possible. But it is not justified that we have to crown in the sidewalks while the parks are closed. (Son muchas semanas de encierro. TODOS tenemos ganas y necesidad de salir, por nuestra salud física y mental. Y queremos hacerlo de la mejor forma posible. Pero es injustificable que tengamos a estar amontonados en aceras mientras los parques están cerrados.) Parks are still locked down. They should analyze the possibility of open them up according to a timeline and monitoring their capacity. Lockdown impacts mental and physical health. Implement a good health plan to mitigate the damage. (@alcaldiagye Parques cerrados aun. Sin importar el color del semaforo analizar la posibilidad de abrirlos segun horarios regulando el aforo bajo supervision. El encierro causa impacto en la salud fisica y mental. Implementar plan de salud en ese aspecto para mitigar estragos.) |

Mental health is barely discussed in Spaniard tweets included in our working dataset.

Focusing on the panel referring to Argentina in Fig. 6, we observe that sports is the most mentioned topic—with 653 tweets—and that it is more frequently approached from a demand point of view—525 tweets, equivalent to 80 %. The second and third most common topics in Argentina are, respectively, children use (135) and COVID-19 protocols (116). While children use is dominated by a demand point of view (82 %), COVID-19 protocols are mostly approached from a denounce point of view (83 %). Mental health and open/lockdown are topics that received little attention in Argentina.

Focusing on the panel referring to Colombia in Fig. 6, we observe that children use is the most mentioned topic—with 1555 tweets. This
topic is also the most mentioned in the Spaniard case. However, in contrast to the Spaniard case, children use is approached more frequently from a demand point of view—72 tweets, equivalent to 58%. The second most commented topic in Colombia is COVID-19 protocols (88 tweets), and is dominated by a denounce point of view (90%). Sports is the third most mentioned topic in Colombia (71), with 53% of the messages expressed from a denounce point of view. Open/lockdown and mental health receive little attention in Colombia.

Focusing on the panel referring to Mexico in Fig. 6, we observe that sports is the most mentioned topic—with 1628 tweets. This topic is also the most mentioned in Argentina. However, in contrast to the Argentinian case, the relative frequency of point of views is divided—with 51% under a demand view, and 49% under a denounce view. As in Argentina, the second most mentioned topic in Mexico is children use (1033), and it is more frequently approached from a demand point of view—616 tweets, equivalent to 59%. Also similarly to Argentina, the third most discussed topic in Mexico is COVID-19 protocols (405), with 95% of the messages falling in the denounce category. Open/lockdown is mentioned in 303 tweets, and 55% of them fall in the denounce category. Mental health is a topic barely mentioned in tweets posted in Mexico.

The analysis of frequencies by topic and view yields four findings holding across all four countries under analysis. A first finding is that mental health is by far the least mentioned topic in all four countries. Second, sports and children use together represent the most mentioned topics in all four countries—with children use most mentioned in Spain and Colombia; and sports, in Argentina and Mexico. Third, the two topics relating more closely to the current pandemic—open/lockdown and COVID-19 protocols—represent the second most mentioned topic in all four countries. Fourth, the topic COVID-19 protocols is more frequently approached from a denounce point of view in all four countries.

The analysis of frequencies by topic and view yields three differences across countries under analysis. First, while open/lockdown is the second topic most mentioned in Spain, it is the second to last in all three Latin American countries. Second, while in Spain and Argentina views on sports and children use are dominated by either demand or denounce point of views, in Colombia and Mexico the views on these topics are more contentious—as reflected by close to even distribution in relative frequencies. Third, while the most mentioned topic in Spain and Colombia is children use, the most mentioned topic in Argentina and Mexico is sports.

4.3. Messages illustrating contesting views on mobility restrictions in UGS

Table 2 reports a selection of messages that illustrate the conversation that has taken place in Twitter amid COVID-19 with respect to mobility restrictions in UGS. In particular, we illustrate how messages in our working dataset i) account for personal burden from closing UGS; ii) debate on the decision of closing UGS; iii) express outrage for non-compliance with mobility restrictions in UGS; and iv) reach out to politicians to demand enforcement of mobility restrictions.

4.3.1. Citizens’ burden from closing UGS

As part of the demand for access view, many citizens have expressed a sentiment of loss or burden when UGS are fully closed:

“I want to go back to my normal life. Working, playing soccer, going out with my friends, rest in a park and enjoy the sunlight.”

“I wish I can go for a walk or go jogging, play with our children in a park or plaza, feel the wind against my face. Taking a deep breath. Simply feel the freedom and tranquility of spending time outdoors.”

A feature that we want to highlight is that messages longing for UGS—without further content such as adding an opinion about decision-making or expressing an opposite view—were posted during the first stage of the mobility restrictions period. After two months, those messages started to include sentences to debate to what extent closing UGS was the right choice from a societal point of view.
Table 2

| Topic          | Class            | Text                                                                                                                                 |
|----------------|------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| Open/close parks | Demand for parks | At Park Saavedra it is impossible to keep more than one meter if you are running or walking in the park. This is because there are not many parks in the city and that is worse in the perurban area? [En Parque Saavedra es imposible no estar a un metro de distancia si estás corriendo o caminando en el parque. Eso es porque... hay pocos parques en la ciudad y ni tu cuesto en el conurbano. Sera esta una oportunidad para crear parques en Buenos Aires y el AMBA??] [Argentina] Mi opinion after gone jogging: lots of people, distance and schedule is observed in general, parks closed are a problem because on the streets is not always possible to keep the distance, people with pets is also there. [‘Mis impresiones al salir a correr: - Muchísima gente - En general, se respeta la distancia y el horario - Que, los parques esten cerrados es un problema porque por la calle no siempre se puede guardar distancia - Se han juntado los de los perros, que se podian esperar a las 10’] [Argentina] Botanic Park is officially locked down. But people goes there all the same and parks on the side of the rout. Something is wrong. [El Parque Botánico está cerrado oficialmente. Pero la gente lo ocupa igual y deja los autos al costado de la ruta. Algo está mal.] [Argentina] Mis impresiones al salir a correr: - Muchísima gente - En general, se respeta la distancia y el horario - Que, los parques esten cerrados es un problema porque por la calle no siempre se puede guardar distancia - Se han juntado los de los perros, que se podian esperar a las 10’] [Argentina] Botanic Park is officially locked down. But people goes there all the same and parks on the side of the rout. Something is wrong. [El Parque Botánico está cerrado oficialmente. Pero la gente lo ocupa igual y deja los autos al costado de la ruta. Algo está mal.] [Argentina]

| Open/close parks | Denounce of noncompliance | How I miss to go to the park, drink mate and play cards... [Como extraño ir al parque tomar mates o te res en el parque y jugar al uno] [Argentina] I look forward to go again to the parks, dring beer and play ball [Crying emoticon] [q ganas d volver a cuando abamos con anto al parque a tomar bira y jugar a la bocha] [Argentina] I long to go out walking, jogging, play with our children in a park or plaza, feel the wind against our face. Dee breath. Just the feeling of liberty and tranquility of being outside. [Que ganas de salir a caminar, correr, jugar con nuestros hijos en un parque o plaza, sentir el viento rico golpeando nuestro rostro. Respirar profundo. Simplemente sentir la libertad y tranquilidad de estar fuera... ] [Argentina] I want to go back to my regular life, work, play soccer here and in Bahia, hang with friends, go to the park and enjoy the sun. [Quiero volver a mi vida normal, trabajar, jugar al futból aca y en Bahía, juntarme con mis amigos, ir al parque y tirarme al sol] [Argentina] I miss playing cards, drink mate in the park, I miss the open door! [RT @Valentina_Vvita: extraño jugar a las cartas, estar en el parque tomando mates, extraño el aire libre] I'm craving for going to the park to drink mate and see my daughter play. [Unas ganas de ir al parque a tomar mates y ver a mi hija jugar] [Argentina]

| Children       | Demand for parks   | How I miss to go to the park, drink mate and play cards... [Como extraño ir al parque tomar mates o te res en el parque y jugar al uno] [Argentina] I look forward to go again to the parks, dring beer and play ball [Crying emoticon] [q ganas d volver a cuando abamos con anto al parque a tomar bira y jugar a la bocha] [Argentina] I long to go out walking, jogging, play with our children in a park or plaza, feel the wind against our face. Dee breath. Just the feeling of liberty and tranquility of being outside. [Que ganas de salir a caminar, correr, jugar con nuestros hijos en un parque o plaza, sentir el viento rico golpeando nuestro rostro. Respirar profundo. Simplemente sentir la libertad y tranquilidad de estar fuera... ] [Argentina] I want to go back to my regular life, work, play soccer here and in Bahia, hang with friends, go to the park and enjoy the sun. [Quiero volver a mi vida normal, trabajar, jugar al futból aca y en Bahía, juntarme con mis amigos, ir al parque y tirarme al sol] [Argentina] I miss playing cards, drink mate in the park, I miss the open door! [RT @Valentina_Vvita: extraño jugar a las cartas, estar en el parque tomando mates, extraño el aire libre] I'm craving for going to the park to drink mate and see my daughter play. [Unas ganas de ir al parque a tomar mates y ver a mi hija jugar] [Argentina]

| Mental health  | Denounce of noncompliance | Mr Major, the linear parks if full as it is the soccer court, people is very irresponsible, can you do something? Close it down or make the aware that the health and economy of we all is at risk. [@julioLoc:meno Delegado el parque lineal esta lleno al igual que la cancha de futbol la gente es muy inconciente, podría hacer algo? Cerrar o algo que los haga crear conciencia la salud y economia de todos esta de por medio.] I come from my health clinic close to Av Ilustracion, and the park is full until La Paz, it is full of people taking a stroll, of all ages, without masks... it is nonsense. [@Paul_Tenorio Vengo de mi centro de salud cerca de Av. de la ilustración, y el parque que hay hasta casi La Paz, está lleno de gente paseando, de todas las edades, sin mascarillas... es un despropósito]

| COVID-19 protocols | Denounce of noncompliance | So the health is the most important? Haha. Go to work. Go to the shoel. Go shopping. The go to you home to infect your family, “but don't go to the park because you can get infected”. Go to hell. [Así que la salud es lo mas importante?. Jaja. Anda a trabajar. Anda al colegio. Anda a comprar. Despe arendate para la casa a contagiar a tu familia, pero no salgas a un parque por que tu puedas contagiar. Vayame a la chuca.] @EnriqueAlfonso Yesterday May 30, the city with street crowding, people without masks and policy just looking at the, in the red par there were hundreds of people, most youths not using masks, and there is an upsurge, we may end with curfewes. [@EnriqueAlfonso Ayer sábado 30 de mayo, la ciudad atascada en la calle, la gente sin cubrebocas y la policia viendolos, en el parque rojo había cientos de personas, los jovenes tampoco usan cubre bocas en su mayoría, después viene el rebote, a ver si no acabamos encerrados con ley marcial...]. While some workers are using masks waiting for their bus, those that get bore in their homes go to the park, let's think in the medical personnel that should not pay for their unawareness, look at the south side (continued on next page)

(continued on next page)
4.3.2. Debating the decision of closing UGS

As part of the demand for access to UGS view, messages debate whether the decision to close UGS is beneficial to society. These messages highlight the positive effects from UGS in terms of physical and mental human health, and point out the contradiction of closing UGS:

- “We can restrict access of children to playgrounds but we should allow children to go out for a walk—just as we make sure that dogs take regular walks. Small children will have negative cognitive and health sequel if we do not relax restrictions.”
- “It does not make sense that we have closed parks while we have to crowd the sidewalks out.”
- “We should allow entrance to parks by regulating entrance. Full closure of parks impacts physical and mental health.”
- “It is absurd to close parks. Often a park is safer than a house—it is so common that many people live in crowded dwellings—without sun light and air, and without spaces to walk. Do not restrict access to places that helps us to recover our physical and mental health.”

These instances express a demand to access UGS. And, as we will see, these messages capture a different spirit with respect to those messages expressing anger or even outrage for non-compliance in UGS during the pandemic.

4.3.3. Outrage for non-compliance

As part of the denounce of non-compliance view, messages complain about behaviors of visitors to UGS. In some instances, Twitter users would shame people by sharing pictures of crowded places or pictures of people not wearing a mask. Messages express a feeling of outrage for the lack of compliance with protocols and mobility restrictions. Often, Twitter users would express their astonishment with people’s ‘lack of consciousness’:

- “I’m coming from the Health Center. The park near to Av. La Paz is full with people taking a walk, all ages, without masks… it is absurd.”

In touristic Playa del Carmen: “Most hotels and parks have closed down. Starting tomorrow, restaurants and bars will close until further notice. But people is in the streets as if nothing is happening, more worried about economic impacts than the collapse of the health system”.

- “People should be more conscious about the situation. I live in front of a park and people this morning were WITHOUT MASKS, that is unconsciousness and lack of solidarity. Please, help!”

- “Soccer is suspended across the world but people in the park close to my house are playing soccer as if nothing is going on in the world. When they get sick, they blame others, unaware of the consequences of their own actions.”

Complaints do seem similar across all four countries under study. However, these complaints in Spain seem more frequent when softened mobility restrictions where in place, while in Latin America people denounce non-compliance through the entire period under analysis.

4.3.4. Demands of enforcement to politicians

As part of the denounce of non-compliance view, there are messages reaching out to politicians to demand enforcement of protocols—enforcement of lockdown, social distance measures, and/or use of masks:

- “What is Mayor Almeida waiting for to open the big parks of Madrid? Instead, he is inviting Madrid’s residents to crowd out reduced spaces where most people is not using masks and people practicing sports cannot keep distance from each other.”

To a Mexican Mayor: “Parque Lineal is as full as a soccer field. People is very insensitive. Could you do something? Close it down, or make them aware that the health and the economy are on the line”.

To governor of Jalisco, Mexico: “Yesterday, Sunday 30th, the city was surpassed by people without masks, and policemen were only staring at them. There were hundreds of people at the Parque Rojo—youngsters without masks most of them. There could be a [COVID-19] surge. Let’s see curfews come after this surge …”.

While these illustrative messages from Spain and Mexico are similar, there is a noteworthy difference: the message in Spain is questioning the decision to close UGS, and the message in Mexico is expressing concerns that people are using UGS when they are not supposed to. The lack of compliance seems more acute in the Mexican case.

Some messages do not reach out to any specific person, but express policy demands related to green spaces. In Argentina, a message points out to the need for more investment in UGS: “In park Saavedra, jogging is possible only if we are willing to stand one meter away from other person. There are few UGS in the city, and there is a bigger problem in the perurban area. Is this the opportunity to create more UGS in Buenos Aires and its Metropolitan Area?”

| Topic | Class | Text |
|-------|-------|------|
|        |       | please, [@climatiajulia mientras los trabajadores esperan su camión con tapabocas; los que están en casa se aburren y salen al parque, pensamos en el personal médico que no tiene porque pagar por nuestra inconsciencia, revisen toda esa zona sur por favor [@climatiajulia mientras los trabajadores esperan su camión con tapabocas; los que están en casa se aburren y salen. | |
|        |       | Governor, here at Villa de Alvarez most people like nothing happens, they keep meeting in parks and in their homes, not paying attention to social distancing, without mentioning that most people do not use masks. [@nachoperalta] Lac en Villa de Alvarez la gente en su mayoría sale como si nada, se siguen reuniendo en los parques y en sus casas, haciendo caso omiso de las medidas, sin mencionar que el cubrebocas prácticamente nadie lo usa @nachoperalta]. |
|        |       | Persons should get aware of this situation, in front of my house there is a park and most people in the morning without a MASK. That is unconsciousness and lack of solidarity, reactions please, community help!!! [@VickyDavila] Exactamente que las personas tomen conciencia de esta situación, pero al frente de mi casa hay un parque y la mayoría de personas hoy en la mañana sin TAPABOCAS eso es inconsciencia y falta de solidaridad reacciones porfavor ayuda comunitaria!!! |
|        |       | Football soccer is suspended worldwide due to risk of contagion for Covid 19, but in the park near my house people are playing like nothing happens in the world! Then they go out and point to everybody less their own lack of responsibility. [El futbol estás suspendido a nivel mundial por el riesgo de contagios por Covid 19, pero en el parque cerca de mi casa las personas lo juegan como si nada pasaría en el mundo! Después estos salen a semiarar y a culpar a todos menos a su inconsciencia.]. |
|        |       | “I’m coming from the Health Center. The park near to Av. La Paz is full with people taking a walk, all ages, without masks... it is absurd.” |
|        |       | In touristic Playa del Carmen: “Most hotels and parks have closed down. Starting tomorrow, restaurants and bars will close until further notice. But people is in the streets as if nothing is happening, more worried about economic impacts than the collapse of the health system”. |
|        |       | “People should be more conscious about the situation. I live in front of a park and people this morning were WITHOUT MASKS, that is unconsciousness and lack of solidarity. Please, help!” |
|        |       | “Soccer is suspended across the world but people in the park close to my house are playing soccer as if nothing is going on in the world. When they get sick, they blame others, unaware of the consequences of their own actions.” |
|        |       | Complaints do seem similar across all four countries under study. However, these complaints in Spain seem more frequent when softened mobility restrictions where in place, while in Latin America people denounce non-compliance through the entire period under analysis. |
|        |       | “What is Mayor Almeida waiting for to open the big parks of Madrid? Instead, he is inviting Madrid’s residents to crowd out reduced spaces where most people is not using masks and people practicing sports cannot keep distance from each other.” |
|        |       | To a Mexican Mayor: “Parque Lineal is as full as a soccer field. People is very insensitive. Could you do something? Close it down, or make them aware that the health and the economy are on the line”. |
|        |       | To governor of Jalisco, Mexico: “Yesterday, Sunday 30th, the city was surpassed by people without masks, and policemen were only staring at them. There were hundreds of people at the Parque Rojo—youngsters without masks most of them. There could be a [COVID-19] surge. Let’s see curfews come after this surge …”. |
|        |       | While these illustrative messages from Spain and Mexico are similar, there is a noteworthy difference: the message in Spain is questioning the decision to close UGS, and the message in Mexico is expressing concerns that people are using UGS when they are not supposed to. The lack of compliance seems more acute in the Mexican case. |
|        |       | Some messages do not reach out to any specific person, but express policy demands related to green spaces. In Argentina, a message points out to the need for more investment in UGS: “In park Saavedra, jogging is possible only if we are willing to stand one meter away from other person. There are few UGS in the city, and there is a bigger problem in the perurban area. Is this the opportunity to create more UGS in Buenos Aires and its Metropolitan Area?” |
4.4. Association between stringency of mobility restrictions and percentage of messages denouncing non-compliance

We have also explored country-level conditional association between percentage of tweets denouncing non-compliance and stringency of mobility restrictions. Percentage of tweets denouncing non-compliance has been calculated on a weekly basis. Stringency of mobility restrictions has been approximated based on an index calculated and made available by Hale et al. (2021). This stringency index takes on values from zero to 100 by considering country-level restrictions officially issued in terms of i) closing of schools; ii) closing of workplaces; iii) cancellation of public events; iv) restrictions on size of gathering groups; v) closing of public transportation; vi) stay-at-home requirements; vii) restrictions on internal movement; ix) restrictions on international travel; and ix) public information campaigns.

Fig. 7 illustrates the evolution, by country, of both stringency of restrictions (straight lines) and percentage of denounce tweets (dashed lines). We highlight three features from Fig. 7. First, for all four countries, stringency index jumps from low stringency (from zero to below 20) to high stringency (80 to 100) around week ten. Second, during the rest of the period under analysis, stringency remains high (between 70 and 90) in all three Latin American countries—and in Spain, it went down to 40 around week 27, and then to 60 through the rest of the period. Third, percentage of tweets denouncing non-compliance do not seem to have a clear trend—with exception of Argentina, where there seems to be a positive trend.

We have implemented, for each country under study, a rolling window strategy on an ordinary least squares (OLS) specification that models percentage of tweets denouncing non-compliance as a function of stringency index and a trend term. That is, the functional form of our specification is \[ d_t = \alpha_t + \delta_s t + \epsilon_{it} \] where \( d_t \) stands for percentage of tweets denouncing non-compliance during week \( t \) in country \( i \); \( s_t \) stands for stringency index during week \( t \) in country \( i \); \( \epsilon_{it} \) is an error term in the statistical model; \( \alpha_t \) reflects the trend in percentage of tweets; and \( \delta_s \) reflects the partial correlation between percentage of tweets denouncing non-compliance and stringency of restrictions—this is the parameter of interest in this conditional analysis as it explores a potential association between percentage of tweets denouncing non-compliance and stringency of mobility restrictions.

A rolling window strategy—also called sliding or moving window strategy—consists in executing a specification—in this case, an OLS specification as described above—on each set of observations defined by a window period—in our case, we have chosen a window of 20 weeks.\(^5\) Given the functional form of our OLS specification, a rolling strategy allows us to test whether percentage of denouncing tweets decrease or increase with time—as reflected by \( \alpha_t \)—and whether there is a consistent association between percentage of denouncing tweets and stringency of restrictions—as measured by the partial correlation \( \delta_s \).

Fig. 8 reports, for each country and window period, estimates of trend for percentage of denouncing tweets. The main message from Fig. 8 is that tweets denouncing non-compliance had a tendency to increase at lower rates over the first 30 weeks. That is, during the first window period (week one to week 20), denouncing tweets had a positive trend of around 6 % (Spain), 4 % (Argentina), 7 % (Colombia), and 6 % (Mexico), but this trend was smaller in all four countries by the window period finalizing in week 30—around 2 % (Spain), zero (Argentina), 2 % (Colombia), and 1 % (Mexico). Then, trend in denouncing parameters stabilized in all countries but Argentina—in Spain, it stabilized around 2 %; and in Colombia and Mexico, at zero. Consistent with the visual message of Fig. 7, denouncing tweets in Argentina had a tendency to increase at higher rates by the end of the period under analysis.

Once trend is controlled for, a partial correlation parameter reflects the conditional association between variables of interest. Fig. 9 reports, for each country and window period, estimates of partial correlation between stringency in mobility restrictions and percentage of denouncing tweets. When focusing our attention in Spain, we observe that point estimates of partial correlation parameter take values over a range that goes from −0.5 to 1.0 but 95 % confidence intervals imply that the null hypothesis that partial correlation is zero cannot be rejected. Thus, the message is straightforward—relative frequency of denouncing tweets in Spain is not associated with stringency of mobility restrictions during the period under study.

When focusing on the panel referring to Argentina in Fig. 9, we observe a pattern similar to Spain’s—most of the period, partial correlation parameter cannot be rejected to be zero, with exception of two couple of windows.

When focusing on the panel referring to Colombia in Fig. 9, we observe that partial correlation between denouncing tweets and stringency of restrictions increases as time passes. This correlation starts at −0.8 to take a value of 0.5 by the end of the period under analysis. That is, while during the first 20 weeks a 1.0% increase in stringency is associated with a 0.8% decrease in denouncing, during the last 20 weeks this association implies that a 1.0% increase in stringency is associated with a 0.5% increase in denouncing.

When focusing on the panel referring to Mexico in Fig. 9, we observe a pattern strikingly similar to the Colombian case—while during the first 20 weeks a 1.0% increase in stringency is associated with a 0.6% decrease in denouncing, during the last 20 weeks this association implies that a 1.0% increase in stringency is associated with a 0.6% increase in denouncing.

4.5. Summary and interpretation of findings

The following is a summary and interpretation of findings arising from the four analytical approaches undertaken in this paper.

Views in all four countries evolved in such a way that, through the period under analysis, there were two views to mobility restrictions in UGS. Every day, a subset of messages demanded access to UGS; at the same time, a number of messages denounced non-compliance with mobility restrictions, and demanded more regulation in accessing UGS. By itself, the simultaneous presence of these two views does not imply a contentious debate. For instance, people may demand access to UGS and at the same time denounce non-compliance that requires more regulation. Indeed, such scenario seems to have happened in Spain during the period under analysis—views in Spain evolve closely following the issuing-strengthening-softening of restrictions, with the demand view dominating during issuing-strengthening periods; and denounce view taking over once restrictions are softened.

Verbatim quotation of tweets illustrates the contentious nature of views with respect to mobility restrictions in UGS—particularly, in Latin American countries. On one hand, a subset of Twitter users expressed concerns with lack of compliance with restrictions and put forward the suggestion that UGS facilities should not be used during the pandemic—e.g. by suggesting that if soccer events were suspended across the world, people should also not play soccer in the neighborhood’s UGS. On the other hand, a different subset of Twitter users expressed a demand for access to UGS and put forward the mental and physical benefits of UGS—e.g. by suggesting that UGS are safer than small, crowded houses, and that if other public spaces are not closed then neither UGS should be closed.

Frequencies by topic and view reveal that, in all four countries, mental health is the least mentioned topic, and children and sports are together the most mentioned. This general finding may be interpreted as reflecting that demanding or denouncing views are not grounded in a need for mental health—which would be somehow counterintuitive in light of the abundant evidence pointing out to the contribution of UGS to mental health, particularly during the pandemic. However, verbatim quotations suggest that health—mental and physical—is a topic that

\(^5\) We have made use of Stata’s command rolling. See StataCorp (2013) for details.
people prefer to subsume into other topics. That is, people prefer to avoid direct references to mental or physical health, and instead justify the need of UGS for children’s sake—in terms that reflect concerns about children’s physical and mental health. A similar story-line arises when motivating the opening of UGS to practice sports—it benefits children’s health.

In general, we interpret the evolution of tweets and their content as reflecting a contentious debate with respect to mobility restrictions in UGS. However, we see nuances: Spain and Argentina seem to reflect a less contentious debate, but the reasons behind this pattern differ across countries. On one hand, views in Spain seem to follow the evolution of mobility restrictions and, in this respect, views were less contentious because some agreement was reached. In Argentina, however, the debate is less contentious because the demand view dominates most of the conversation through the entire period under analysis.

This general interpretation and the nuance we have identified are supported by the partial correlation between stringency of restrictions and percentage of denouncing tweets. On one hand, this correlation is practically zero in Spain and Argentina over the entire period under analysis. This zero-correlation reflects a lack of increase (or decrease) in denounce of non-compliance as the restrictions were strengthened—either because there was some periodical agreement (Spain) or because there was mostly a demand point of view (Argentina). On the other hand, percentage of denouncing tweets is positively associated with stringency of restrictions in Colombia and Mexico. This association reflects an increase in denounce of non-compliance as restrictions became stronger—implying that use of UGS became a more contentious topic as restrictions on mobility increased, a finding that is consistent with challenges of implementing mobility restrictions that managers of UGS in Latin America have reported (Sainz-Santamaria & Martínez-Cruz, 2022).

5. Discussion and public policy implications

Understanding contesting views arising during a pandemic may help us to understand behavior and opinions during social crisis episodes, and it also represents an input for policy formulation. In particular, we refer to the existence of contesting views on mobility restrictions in UGS during COVID-19. These views reflect residents’ stands with respect to how UGS should be used during a pandemic event. Overall, these views mirror trade-offs that managers have faced through the pandemic—what are the services that should be provided, and when? A subset of Twitter messages has focused on the downsides from restricting mobility in UGS, and another subset has focused on the risks of allowing access to UGS. For instance, in reaction to a package of policies—for instance, opening of bars and restaurants, a subset of residents have pointed out the contradications of a policy that is supposed to reduce spread of COVID-19 but creates incentives for crowding out in reduced and badly aired spaces.

5.1. Contesting views

The most salient finding in this paper is the contentious nature of views on mobility restrictions applicable to UGS. While the literature documenting sentiments towards UGS has documented an unequivocal increase in positive sentiments towards UGS, this information cannot inform policies or managers’ strategies. COVID-19 has provoked that UGS become a ‘social hazard’ due to the risk of contagion (Shackleton et al., 2016; von Dohren & Haase, 2015). Due to the corresponding restrictions imposed on mobility, UGS have also become a scarcer good in urban setting. Documenting a general increase in positive sentiments towards UGS cannot inform how to design policies that deal with this trade-off in the administration of UGS.

Contesting views, on the other hand, are more informative for
purposes of administration of scarce resources. COVID-19 has exacerbated both positive and negative views on the relevance of services provided by UGS. Online social media has made residents’ views publicly available, without the need to directly elicit such views. Indeed, the unstructured nature of views expressed in social media imposes a challenge in terms of meaningfully making sense out of online posts, so that they can be understood by policy makers and managers in real-time—this paper’s algorithm illustrates how this meaningful interpretation can be implemented.

Understanding and addressing negative views about mobility restrictions applicable to UGS is relevant for public policy because urban residents may decide to invest in private UGS—e.g. gardens or private playgrounds and green areas in gated communities—instead of public UGS. Also, a deficient reaction to such negative views may redistribute green space users from urban to natural parks beyond capacity of charge, which may create additional pressure on natural protected areas—as documented by McGinlay et al. (2020) for the European case.

The fundamental issue in the management of UGS is the trade-off between allowing access and increasing risk of contagion. In Colombia and Mexico, denounce views have dominated the conversation not only through the period of mobility restrictions but also before and after formal restrictions were issued. This pattern is likely associated with the perception of a low level of compliance across Latin America—evidence of which is offered by (Sainz-Santamaria & Martinez-Cruz, 2022).

We posit that the existence of contesting views are prevalent and entail different responses from decision-makers: trade-offs should be acknowledged and communicated. Compliance with protocols may be improved with targeted and clearer communication on what can be done and where. An improved compliance could allow extended access while keeping the same risk of contagion (this could be understood as a ‘Pareto improvement’ and should be actively sought after).

5.2. The issue is non-compliance

We document, on one hand, a number of messages denouncing non-compliance regarding protocols—expressed often with anger and even outrage towards other people and also directed to public officials, requesting enforcement. On the other hand, there were petitions of granting safe access and demands of more green spaces to allow safer distances. This situation can be characterized as a social installment of non-compliance, deficient rules, insufficient public spaces, and unresponsive politicians—a description that is consistent with findings documented with different methods by research focused in Latin America (Cortinez-O’Ryan et al., 2020; Sainz-Santamaria & Martinez-Cruz, 2022) and with mobility patterns in Latin America during the pandemic (Zhu et al., 2020).

A difference between Spain and Latin American countries in this study is that, in Spain, longing for UGS dominated the conversation during lockdown time; and denouncing views surged when mobility restrictions were relaxed. Even though there were complaints about non-compliance in Spain during lockdown times, there seems to be a less problematic relation with rule of law as compared to Latin American countries. In Argentina, and Colombia, the mobility restrictions seem to have been observed, but after a few months, compliance dropped and with that the outrage surged. While denounce messages clearly predominated in Argentina, in Colombia and Mexico demand and denounce views were present over the entire period under analysis. In Spain, denounce views were moderately low and there was a peak of outrage towards other people and also directed to public officials, requesting enforcement. On the other hand, there were petitions of granting safe access and demands of more green spaces to allow safer distances. This situation can be characterized as a social installment of non-compliance, deficient rules, insufficient public spaces, and unresponsive politicians—a description that is consistent with findings documented with different methods by research focused in Latin America (Cortinez-O’Ryan et al., 2020; Sainz-Santamaria & Martinez-Cruz, 2022) and with mobility patterns in Latin America during the pandemic (Zhu et al., 2020).

These findings are relevant because i) they provide evidence of
Partial correlation between stringency index and % of tweets denouncing non-compliance

![Graphs showing correlation between stringency index and % of tweets denouncing non-compliance for Spain, Argentina, Colombia, and Mexico.](https://example.com/graphs)

**Fig. 9.** Evolution of partial correlation between stringency in mobility restrictions and percentage of tweets denouncing non-compliance on a weekly basis—estimates have resulted from fitting 20-period rolling window OLS specifications for percentage of tweets denouncing non-compliance as a function of stringency of mobility restriction and a trend term.

Differences among populations of developed countries and emerging economies with respect to their opinion towards usage of UGS during COVID-19, and ii) they are consistent with what other studies have documented with respect to enforcement of mobility restrictions in UGS across Latin America. In this respect, Sainz-Santamaria and Martinez-Cruz (2022) document that managers of UGS in 16 cities across Latin America report overcrowding conditions and lack of resources to enforce mobility restrictions or restricted access. In this context, it makes sense that demand for the opening of UGS is less salient—as UGS were effectively not closed—than complaining about non-compliance—as it seems that non-compliance has been a constant and continuous pattern during the COVID-19 pandemic.

From the public policy perspective, non-compliance has been a key concern, and governments have been overwhelmed by the demands posed by the virus in many aspects of public services, making very difficult to monitor compliance in most areas of the city. Citizens sounding alarms in specific areas could be used as an informal public problem-monitoring scheme to disseminate information in a targeted way. Analysis of trends for specific areas of the cities or specific urban parks may supply information for cities authorities and park managers on what are the specific issues in each location and establish a communication with citizens, answering concerns, documenting decisions, informing about efforts, and providing simple information about rules and schedules.

### 5.3. Twitter as a window to understanding people’s opinion and behavior during COVID-19

Social media supplies a large amount of data for social science research. Twitter in particular, with 187 million active users globally in 2021, is an extraordinary repository of citizens’ opinions, attitudes, sentiments, and demands related to COVID-19 policies—as social media is also used as an instrument of communication with politicians and public officials. These repositories of information are a valuable input for understanding opinions and generating hypotheses on behavior—particularly, in emerging countries where opinions and behaviors have not been studied as systematically as in developed countries, where surveys and other data collection efforts are commonly used.

In particular, Twitter is a platform where citizens, representatives and public officials participate. As such, it is often used to submit requests to politicians, expressing opinions, demanding actions or blaming them for an action or a result.

This paper contributes to the analysis of information deposited in social media by illustrating how unstructured views can be gathered and organized to meaningfully understand public opinions that try to influence decision-making through reaching out politicians, shaming, and reporting their situation due to the existing protocols or lack of enforcement. In this sense, public officials may want to use social media as a communication platform to improve the information on protocols, identify conducts that deserve attention, and send messages aiming at a better coordination with citizens.

The usefulness of analysis of Twitter posts to understand unstructured public debates should not leave aside an important limitation for decision-making: Twitter (and other social media) users are not a representative sample of the population of residents of a city. For instance, Twitter users have been found to be predominantly male, with a better than average income, left-leaning (this might be different from country to country), and with a higher percentage of urban users compared to the overall percentage of people living in urban areas (Barbera & Rivero, 2015). In the case of Twitter users in Mexico, for example:...
instance, the percentage of women and men users are 61 % and 39 %, respectively. According to Gomez et al. (2021), the 82.5 % of users on Twitter have a superior academic degree versus the 17.5 with a lower academic degree.

The existence of bias regarding demographic, gender, income and other variables in Twitter, does not eliminate the usefulness of monitoring views on policy matters, but limits its capacity to “listen the voice of citizens” (Alizadeh et al., 2019).

6. Conclusions

COVID-19 pandemic and governments’ efforts to control its spread captured the global public and private conversations since March 2020. In this context, Twitter has emerged as a unique source of information to document opinions, sentiments and debates. This broadcasting has proved particularly useful for debates about COVID-19 policy-making and behavior that is not necessarily covered in conventional media. Issues of interests to organized groups have more prevalence in news reports—e.g. the debate on when and how to open restaurants—but other topics have been barely discussed in conventional media—e.g. issues related to urban green spaces.

This paper’s findings are consistent with previous studies documenting that non-compliance has been a constant issue during the COVID-19 pandemic in Latin America. In particular, this study documents the trajectory of denounces for non-compliance—which include complaints about careless crowding in the UGS, and lack of observation to the basic protocols (using masks) or anger about the decisions of authorities to allow the use of green spaces or not enforce the restrictions. Demand for access to UGS were not less impassioned, with bold criticisms of closing areas where safe distance could be kept (as compared to other spaces where access was allowed and that were closed and smaller), and making an account of the damages of keeping lockdown for too long—including development of cognitive capacities in children.

Information posted in social media represents a powerful tool to monitor the evolution of contested views during a social crisis. City planners and UGS managers may want to monitor these views. Notwithstanding, it is important to keep in mind limitations of our study: as it is the case in all countries, people using Twitter are not a representative sample of a city’s population, and this might be a more acute issue in developing countries—where users are biased towards people with higher incomes and more vocal than the general population. This bias does not impede that monitoring of views is useful as it is a useful approach to make sense out of unstructured debates.

While the extant literature has addressed the positive aspects and (to a much lesser degree) the dissonance dimension of UGS, we stress that COVID-19 exacerbates both positive and negative opinions about how to use UGS—as mobility restrictions make visits scarcer and also bad behavior becomes much costlier. From the public policy point of view, the contesting views synthesize the dilemma faced by managers of UGS: how to balance the need for UGS and their positive effects on physical and mental health with the imperative need to control the spread of the virus. Understanding the public debate and acknowledging the trade-offs that every decision entail is key for the improvement of cities planning and decision making, during and beyond COVID-19.

Collection, filtering, and classification algorithms implemented in this paper allow practitioners to unveil views on a topic of relevance across countries. In this sense, the algorithms develop in this paper are general enough to be implemented on practically any country a practitioner may want to. Importantly, searching and classification algorithms in this paper have been trained only in Spanish because this is the official language in the four countries under analysis. Thus, language- and culture-specific considerations must be taken into consideration if these algorithms are used in other contexts.

CRediT authorship contribution statement

Jaime Sainz-Santamaria: Writing – original draft, Conceptualization, Investigation, Visualization, Project administration. Daniela Moctezuma: Writing – review & editing, Investigation, Visualization, Software, Resources. Adam L. Martinez-Cruz: Investigation, Visualization, Conceptualization, Formal analysis, Methodology, Writing - original draft, Writing - review & editing. Eric S. Tellez: Software, Resources. Mario Graff: Software, Resources. Sabino Miranda-Jiménez: Software, Resources.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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