



Local governments' use of social media during the COVID-19 pandemic: The case of Portugal

Miguel Padeiro^{a,*}, Beatriz Bueno-Larraz^b, Ângela Freitas^c

^a Centre of Studies in Geography and Spatial Planning, University of Coimbra, Portugal

^b Independent Consultant, Portugal

^c Centre of Studies in Geography and Spatial Planning, University of Coimbra, Spain

ARTICLE INFO

Keywords:

Social media
Facebook
E-disclosure
Municipalities
Health crisis management
COVID-19

ABSTRACT

While the use of social media by local governments has gained relevance in recent years, crises are critical situations that reinforce the need to reach citizens to disclose information, demonstrate the government's commitment, and increase the citizens' level of preparedness and awareness of resources. This paper examines the factors that influenced local governments' e-disclosure during the first wave of the COVID-19 pandemic. To accomplish this objective, we systematically tracked every post published by the official Facebook page of 304 Portuguese municipalities between March 2 and July 5, 2020. The findings show that financial autonomy is the main predictor of e-disclosure, factors varied on the different phases of the pandemic's first wave, and socio-demographic factors became more prevalent as explanatory factors when the crisis worsened. Our study may help increase the level of preparedness during possible future crises. In particular, establishing communication strategies for prolonged public health crises, making financial resources available for the accomplishment of such strategies, and reducing the digital divide can contribute to more effective disclosure. Future research should explore the dynamics of disclosure during public health crises. This study also highlights the need to incorporate time in research that focuses on the determinants of e-disclosure that could also be tested in normal times.

1. Introduction

In the age of digital communication, social media has become one of the most widely used ways for local governments to reach citizens directly and to disclose a large amount of information. As increasingly more people now have access to the Internet and the average time spent on social media increases (Global Web Index, 2020b), public authorities have seized on this trend and have intensified their presence on social media in the past several years, particularly in the context of many national initiatives to promote e-government (Twizeyimana & Andersson, 2019). E-disclosure allows them to increase transparency and accountability, which are two major dimensions of political action (Bertot, Jaeger, & Grimes, 2010; Guillamón, Ríos, Gesuele, & Metallo, 2016; Pina, Torres, & Royo, 2007), and thereby increase the legitimacy of their actions (Archel, Husillos, Larrinaga, & Spence, 2009) while being more attentive to citizens' reactions.

The use of social media as a crisis management tool is not new. Social media have been used in many public health crises and disasters such as

earthquakes, tsunamis, floods, and hurricanes to monitor evolving situations, release information, provide guidance, observe public opinion and needs, correct misinformation and rumors, and mobilize local resources to extend emergency response (Alexander, 2014; Chen et al., 2020; Kim, Jung, & Chilton, 2016; Tang, Zhang, Xu, & Vo, 2015). However, disclosure took on another dimension in March 2020 as a new challenge arose for public authorities around the world when the World Health Organization (WHO) declared the outbreak of SARS-CoV-2 as a global pandemic. Over the weeks that followed, national governments took important steps to curb the spread of the virus while local authorities relayed available information, applied national-level measures locally, and took specific measures themselves. Local governments rapidly faced a wide variety of situations depending on the severity of outbreaks, the population structure, and their own needs and available resources. Some municipalities were quickly affected by the virus, while others did not report a single case until several weeks or even months after the initial outbreak. This long-lasting and global public health crisis rendered an urgent and significant need to quickly and effectively

* Corresponding author.

E-mail address: jmnp@uc.pt (M. Padeiro).

¹ Permanent address: CEGOT – Universidade de Coimbra, Departamento de Geografia e Turismo, Largo de Dom Dinis, 3000-504 Coimbra, Portugal.

reach citizens, and remote service provision became the only way to maintain the continuity of public services. At the same time, as social influence seems to play a significant role in shaping public values, attitudes and social and health-related behaviors and outcomes during the COVID-19 pandemic (Fuentes & Peterson, 2021; Tunçgenç et al., 2021), increasing citizens engagement can be effective on prevention, disease control and health education (Tsao et al., 2021). As a result, national, regional, and local authorities were not only guided by a threefold need to reduce the number of daily cases, increase the response capability to treat patients, and mitigate the negative effects arising from the containment measures. They also sought to increase e-disclosure and involve citizens in the response to the crisis.

As a consequence, the COVID-19 crisis may have changed the intensity, scale, and nature of disclosure. Common messages to inform citizens about the situation, major measures, recommendations, and guidelines to follow were repeatedly posted as well as information about material aid and social, financial, and psychological support. Furthermore, rational use of personal protective equipment, misinformation corrections, warnings about fraud and deception, messages of praise and encouragement to create a sense of social cohesion, and online events such as concerts, storytelling, and home physical activity training sessions were increasingly organized by local governments. Social media usage thus went beyond the usual crisis management tasks directly linked to health issues.

This study examines the factors that influenced local governments' e-disclosure during the first wave of the COVID-19 pandemic (March–July 2020) and how their influence varied across space and time. While many studies have considered the factors of local government's use of social media (Cárcaba García & García-García, 2010; Guillamón et al., 2016; Lameiras, Silva, & Tavares, 2018; Serrano-Cinca, Rueda-Tomás, & Portillo-Tarragona, 2009; Tavares & da Cruz, 2020), others have observed e-disclosure linked to public health crises (including the COVID-19 crisis) and have focused on the amount and content of social media posts by local governments (Landi, Costantini, Fasan, & Bonazzi, 2021; Mori, Barabaschi, Cantoni, & Virtuani, 2020; Pang, Cai, Jiang, & Chan, 2021; Sesagiri Raamkumar, Tan, & Wee, 2020), social media engagement between public authorities and citizens (Chen et al., 2020; Chen, Min, Zhang, Ma, & Evans, 2021), and social media usage by citizens (Cauberghe, Van Wesenbeeck, De Jans, Hudders, & Ponnet, 2020; Naby-Grover, Cheung, & Thatcher, 2020). However, this is the first study to analyze the factors of local government's use of social media during a public health crisis, and it is the first to integrate a multidimensional analysis of factors, including the geographical (all municipalities in the country) and temporal (different phases of the pandemic) dimensions.

This study seeks to offer a better understanding of the differences between local governments' e-disclosure behavior during the learning curve experienced in the context of the pandemic (Mori et al., 2020). It draws on the existing literature that focuses on the determinants of e-disclosure and applies these findings to the context of the COVID-19 crisis. The study focuses on Portuguese municipalities' Facebook usage during the pandemic. Facebook was selected as it is the most popular social media (Global Web Index, 2020b; Taylor, Wells, Howell, & Raphael, 2012), and it is one of the most commonly used platforms by local governments (Bonsón, Royo, & Ratkai, 2017). Portugal is an interesting case study, for several reasons. Portuguese territorial management and policy competencies are distributed between a centralized state and a strong municipal level, with no intermediate level (with the exception of the Madeira and Azores Autonomous Regions), unlike most European countries. As part of the decentralization of formal competences that has been underway since 2018, the municipalities have significantly increased their scope of action, strengthening their role in the development and implementation of public policies in different sectors, such as education and health. In addition, the country has seen a strong increase in the use of social media by local governments. In 2016, 293 Portuguese municipalities (95.1% of 308) already had an account

on Facebook (Lameiras et al., 2018), and their number rose to 304 by 2020 (authors' count). Although it may not be a strong indicator of actual use, this level of presence contrasts with the existence of a significant digital divide, as the digital divide in Portugal was the third highest in Europe in 2019, with 19% of households without internet connection (Eurostat, 2020).

The paper is structured as follows. Section 2 provides a brief overview of the literature on local governments' e-disclosure and its role during crises as well as on the determinants of e-disclosure among local governments. Section 3 presents the study area and the methodology of the study. Section 4 details the results of the descriptive analysis, and the regression models are discussed in Section 5. Finally, Section 6 concludes this paper.

2. Literature review

2.1. Social media and e-disclosure

The average time spent on social media has increased from 101 min per day in 2014 to 145 min in 2021 (Global Web Index, 2020a, 2020c; WAS, and Hootsuite, 2021). Facebook is the most used social media platform as 85% of global Internet users (outside of China) have a Facebook account (Global Web Index, 2020b). This platform is increasingly a primary source of information for citizens (Bene, 2017). With the advent of Web 2.0, which describes all new technologies that offer the opportunity to increase citizen participation through collective interactions (Bertot, Jaeger, & Hansen, 2012; Mossberger, Wu, & Crawford, 2013), social media has quickly become popular. These media are generally defined as "a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of user-generated content" (Kaplan & Haenlein, 2010). Social media are increasingly replacing the traditional, one-way means of communication of public institutions (Bonsón, Perea, & Bednárová, 2019); these earlier forms of communication offer little or no interaction, and they include public relations offices and websites as well as mass media, such as written press, radio, and television. Through these traditional means, effective disclosure is often limited by cumbersome bureaucratic procedures (Meijer, 2008), significant costs, and language that is often technical and administrative that does not facilitate a full public understanding (Glenny, 2008). Despite several risks and vulnerabilities (Picazo-Vela, Gutiérrez-Martínez, & Luna-Reyes, 2012), particularly related to the digital divide (Friemel, 2016; Reddick, Enriquez, Harris, & Sharma, 2020), the benefits of social media in the context of institutional communication are numerous. In addition to reducing costs compared to the significant maintenance costs and increasing server capacity over time, communication through social media is much less regulated than official communication through institutional websites or print media. This method uses informal, concise, and often visual language (Chen et al., 2020); engages emotions and creates empathy (Stone & Can, 2020); allows the broadcast of a greater diversity of content; announces future activities; and quickly collects reactions through greater engagement (Mossberger et al., 2013) to better adapt the content and required actions (Bonsón, Torres, Royo, & Flores, 2012; Picazo-Vela et al., 2012). Unlike traditional communication channels that citizens must access in a proactive way, social media send information directly to citizens through notifications (Mori et al., 2020).

With the rise of public scrutiny (OECD, 2003; Piotrowski & Van Ryzin, 2007) and the multiplication of open government initiatives in recent years—particularly at the local level, where citizen participation is most effective (Berry, Portney, & Thomson, 2002)—local governments are increasingly opting for the most direct route to reach their citizens (Chen et al., 2020). This shortening of the transmission chain allows local governments to reduce the exclusively top-down nature of institutional communication (Bonsón et al., 2019), reduce information asymmetry, and reach vulnerable populations who are increasingly

using social media (Jaeger & Bertot, 2010; Kavanaugh et al., 2012).

The growing success of social media explains why many studies have focused in recent years on the impact of social media on e-disclosure (Gesuele, Metallo, & Agrifoglio, 2016; Magro, 2012). Among the main lines of research are the adoption of social media and the measurement of the level or intensity of e-disclosure (Bonsón et al., 2017; Bonsón & Ratkai, 2013; Oliveira & Welch, 2013; Reddick & Norris, 2013); the determinants of e-disclosure (Alcaide Muñoz, Rodríguez Bolívar, & López Hernández, 2016; Gandía & Archidona, 2008; Guillamón, Bastida, & Benito, 2011; Guillamón et al., 2016; Lameiras et al., 2018; Serrano-Cinca et al., 2009; Tavares & da Cruz, 2020); the varied content of the information disclosed (Gesuele et al., 2016; Guttormsen & Sæbø, 2013); and the impact of e-disclosure via Web 2.0 on citizen engagement (Bonsón et al., 2019; Lovari & Parisi, 2015; Metallo, Gesuele, Guillamón, & Ríos, 2020). Current research highlights the success and growing impact of social media on e-disclosure, linked to its multiple benefits and the establishment of a stronger trust relationship. Social media tend to respond more easily than other means to the triple challenge (Gandía, Marrahí, & Hugué, 2016) of transparency, which involves the fundamental elements of public governance (Bertot et al., 2010; La Porte, Demchak, & De Jong, 2002; OECD, 2003): availability and timeliness, quality, and enlarged accessibility of information (Detlor, Hupfer, Ruhi, & Zhao, 2013; Gandía et al., 2016; Justice, Melitski, & Smith, 2006). Social media potentially allow citizens to interact more with local governments (Bonsón et al., 2012) and to assess public action more effectively (Ingram & DeJong, 1987; Pina et al., 2007; Zimmerman, 1977). The technical possibility of a two-way dialogue and the open release of government-held data potentially broaden the opportunities for collaboration and the monitoring of institutional action (Veljković, Bogdanović-Dinić, & Stoimenov, 2014), while increasing accountability and propelling citizens' empowerment (Kassen, 2013).

However, greater disclosure does not necessarily imply greater transparency. For example, social media may be used by governments in the form of one-way communication (Brainard & McNutt, 2010; Gandía et al., 2016; Reddick & Norris, 2013). In some cases, openness and transparency may mainly reflect an institutional propaganda stance to distill selected data aimed at legitimizing official discourse and/or actions undertaken (Zavattaro & Sementelli, 2014; Zheng & Zheng, 2014). The low level of effective transparency could result from the difficulties faced by an institutional culture unaccustomed to two-way collaboration as it attempts to adapt to a new format (Criado, Sandoval-Almazan, & Gil-Garcia, 2013), and the dilemma of simultaneously ensuring open and interactive communications, avoiding burdensome constraints on decisions, and not shirking statutory responsibilities (Maxwell, 2003).

Nonetheless, the increase in open data within the framework of e-government and open government policies (Attard, Orlandi, Scerri, & Auer, 2015) can help increase the perception of transparency (Yavuz & Welch, 2014), trust, and responsiveness. Their disclosure in a more systematic and routine manner that is integrated into the flow of information that citizens receive on a daily basis can impact the effectiveness of actions in times of crisis (Arshad & Khurram, 2020). Some authors have noted, for example, that during the COVID-19 pandemic compliance with physical distancing, hygiene, and stay-at-home measures tended to be more respected when the political trust was high (Bargain & Aminjonov, 2020; Nivette et al., 2021). This relationship is why it is important to analyze the use of social media in times of crisis.

2.2. The use of social media in public health crises

Public health crises are major critical events that extend over time and rapidly take on a global scale (Pan & Meng, 2016; Sornette, 2002). Such emergencies are characterized by a high degree of uncertainty, in terms of the day-to-day development of the situation, the responsibilities of everyone involved (public institutions, private sector, citizens), and the recommendations in force. They are also marked by great complexity due to numerous logistical, legislative, political,

institutional, or financial constraints, which require many urgent adaptations and entail an additional difficulty to communicate with the public.

For these reasons, health crises amplify the need for public authorities to disseminate accurate and reliable information effectively, quickly, and widely (Alexander, 2014; Chen et al., 2020; Kavanaugh et al., 2012; Lindsay, 2011; Mori et al., 2020; White, 2011; WHO, 2020). However, several recent studies have shown that in times of major crises people heavily use social media (Alexander, 2014), for example to reassure loved ones (Tobias, 2011), to access information (Alexander, 2014; Taylor et al., 2012), and to share information from the authorities with others (Thelwall & Thelwall, 2020). Facebook is assumed to be the second-most used channel after televised news in the hypothetical case of a disaster (Taylor et al., 2012). For example, a significant increase in the number of followers of the official pages of several municipalities in northern Italy was recorded between February and June 2020, related to the outbreak of COVID-19 and the first lockdown (Mori et al., 2020).

While social media allow for greater speed in the transmission of information (Basch, Basch, Hillyer, & Jaime, 2020), the use of social media by public authorities has also become increasingly widespread in recent years in the management of various general crises (Chatfield & Reddick, 2018) and public health crises in particular (Sharma, Yadav, & Ferdinand, 2017; Signorini, Segre, & Polgreen, 2011). Many roles are assigned to social media related to the management of health crises (Alexander, 2014), and these may vary during the various phases of the crisis (Lindsay, 2011; Mori et al., 2020; Pan & Meng, 2016; Wukich, 2015): social media are used as a means to disclose information and updates on developments; decisions taken by the government and public institutions; general recommendations on measures to be taken at the individual level; and the existence of logistical, psychological, food, social, medical, and financial support (Chatfield & Reddick, 2018; Sharma et al., 2017; Signorini et al., 2011). Social media are also used to observe public opinion and behavior; combat misinformation and clarify information overload (Panagiotopoulos, Barnett, Bigdeli, & Sams, 2016); channel and mobilize human resources, for example through volunteering campaigns (Lovari & Bowen, 2020; White, 2011); and maximize the number of people who are aware of the seriousness of the situation and their responsibilities (Wukich, 2015).

2.3. Determinants of social media use by local governments during pandemics

Several theories have been mobilized in recent years in the literature on the use of social media by local governments (Alcaide Muñoz et al., 2016; Gao, Shuang, & Liu, 2018; Serrano-Cinca et al., 2009). The first of these is the neoinstitutional theory that focuses on the role of external, institutional pressures and the adoption of innovative methods with the aim of producing an image of modernity (Powell & DiMaggio, 2012). The second, based on legitimacy theory, reflects the need for local governments to build credibility through intense disclosure (Archel et al., 2009; Gao et al., 2018). The third approach—agency theory—argues that citizens apply pressure on the government for better disclosure and monitoring, and governments have a willingness to display their proactivity and performance, whether to foster their reelection (Zimmerman, 1977), to limit conflicts of interest (Ingram & DeJong, 1987; Zimmerman, 1977), or to demonstrate their commitment (Laswad, Fisher, & Oyelere, 2005).

In this study, we started from a set of potential determinants divided into five categories (Fig. 1, Table 1). Several of these potential factors are similar to those studied by other authors (Guillamón et al., 2016; Lameiras et al., 2018; Serrano-Cinca et al., 2009; Tavares & da Cruz, 2020). Other variables were never used in this type of study, as they are specific to public health crises as possible factors of virus transmission that may influence public fears and calls for attention on behalf of public authorities. Other variables (such as density, tourism, transport, material deprivation index, social inequalities within municipal territories,

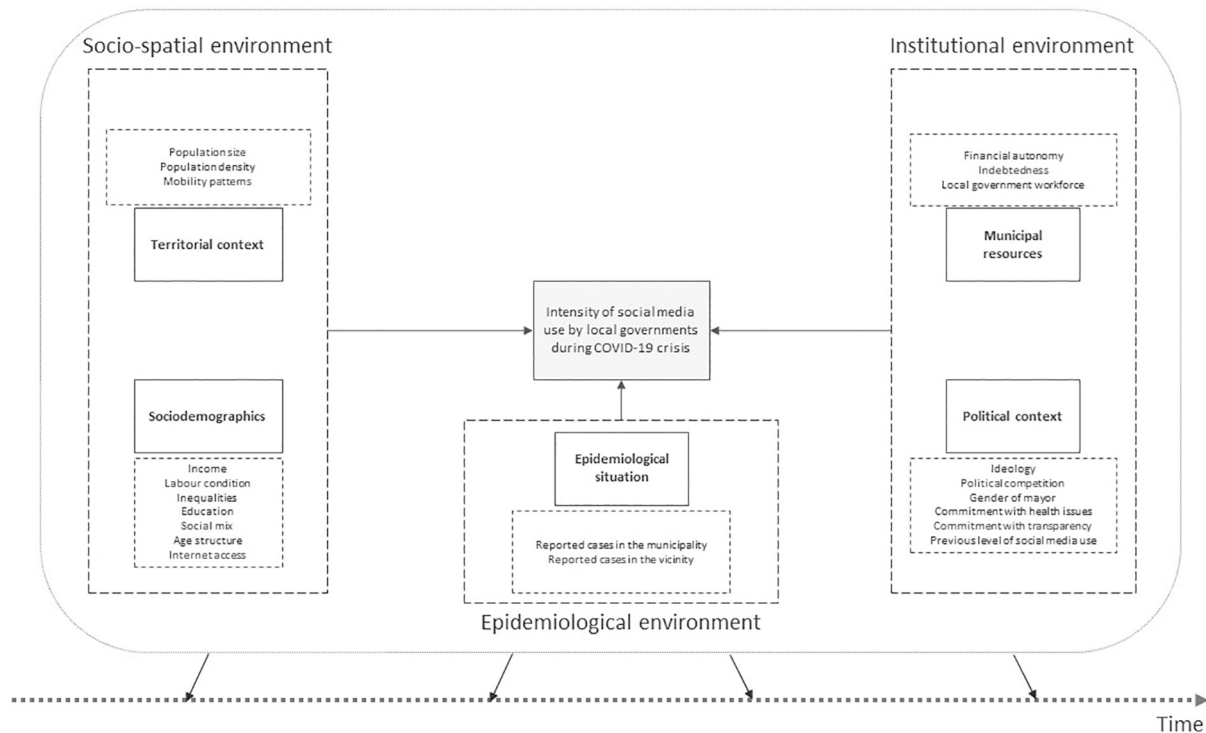


Fig. 1. Conceptual model of social media use by local governments during COVID-19 crisis.

low-qualified workers, commitment to health as a priority in local policies) have never been tested to our knowledge—although social inequalities are sometimes approached using the percentage of unemployment (Tavares & da Cruz, 2020) or of people living below poverty (Lowatcharin & Menifield, 2015).

Among the five categories, two correspond to the socio-spatial environment: territorial context and socio-demographic variables. As suggested by Alcaide Muñoz et al. (2016), these two categories relate to the assumptions of agency and legitimacy to the extent that both describe an environment characterized by a given level of demand and pressure from citizens. They also correspond to the demand-side described by Tavares and da Cruz (2020). Two other categories correspond to the institutional environment and the supply-side of Tavares and da Cruz (2020): municipal resources and political context. Similar to the division proposed by Alcaide Muñoz et al. (2016), these categories are related to agency and legitimacy to the extent that they reveal the need to demonstrate their full commitment vis-à-vis transparency and accountability (Alcaide Muñoz et al., 2016). The last category—epidemiological environment—is crisis-related and reports on the epidemiological situation at a given time.

All the hypotheses are considered to be evolving since a pandemic is a dynamic and continuing event (Sornette, 2002) that constantly requires data updates and a series of adjustments in interventions and communication (Tokakis, Polychroniou, & Boustras, 2019). Mori et al. (2020) have shown, for example, changes in the content of communications published by several Italian municipalities on Facebook between February and June 2020. It is thus possible that the importance of the various factors may have varied over time, depending on the greater or lesser urgency and prioritization of the transmission of information. In this way, the validity and significance of the hypotheses may vary over time. In addition, the concern of local governments to relay information from various sources (national authorities, health authorities, regional offices) and to inform citizens about decisions taken at the local level and the means implemented to help people (social, psychological, food, or financial support as well as the continuity of public services) increases in times of public health crises. More intense and efficiently organized

communication is an essential prerequisite for effective crisis management (Chen et al., 2020).

2.3.1. Territorial context

The relationship between population size and the intensity of social media use is explained by two different reasons. On the one hand, agency theory and legitimacy theory argue that a larger population is characterized by greater asymmetry between leaders and citizens and a higher cost of traditional communication, due to the greater complexity of public action and the multiplicity of stakeholders, more conflicts of interest, and greater public pressure (Serrano-Cinca et al., 2009; Zimmerman, 1977). The use of social media is thus linked both to the reduction in cost it provides (Cárcaba García & García-García, 2010) and the need to reach the multiplicity of citizens and actors at a wide level (Christiaens, 1999; Yavuz & Welch, 2014). This scenario explains why large cities are generally the most innovative in terms of communication (Moon, 2002; Tat-Kei Ho, 2002). Although numerous studies have confirmed the link between population size and disclosure (Christiaens, 1999; Guillamón et al., 2016; Lameiras et al., 2018; Serrano-Cinca et al., 2009; Sol, 2013), others have not found such a link (Tavares & da Cruz, 2020). On the other hand, in the context of a health crisis population density may be a factor of contagion, although its actual role remains controversial (Carozzi, 2020), and municipalities with higher density may feel the greater need to communicate widely to help reduce the threat. Thus, we propose the following hypotheses:

H1-a. There is a positive association between *population size* and the number of Facebook posts.

H1-b. There is a positive association between *population density* and the number of Facebook posts.

The territories most dependent on tourism are frequently vulnerable to economic crises. In the event of a crisis, it is possible that activity may be kept to a minimum and municipalities may need to communicate, for example, to disclose information relating to financial support to companies in the sector. Thus, we propose the following hypothesis:

Table 1
Summary of research hypotheses and operationalization.

Environmental dimension	Category	Hypothesis	Variables names	Measurement
Dependent variable		–	logposts	Log of the number of daily posts published on the Facebook page (2020) ¹ plus 1 (to ensure finite values)
Socio-spatial environment	Territorial context	H1-a. Positive association between population size and the number of Facebook posts.	H1-a. pop	H1-a. Number of inhabitants (2018) ³
		H1-b. Positive association between population density and the number of Facebook posts.	H1-b. denspop	H1-b. Population density (2018) ³
		H2. Positive association between the weight of tourism in the local economy and the number of Facebook posts.	tourism	Number of overnight stays per inhabitant (2019) ²
		H3. Positive association between use of public transport in commuter mobility and the number of Facebook posts	transport	% of daily commuting by public transport (2011) ³
	Sociodemographics	H4. Negative association between socioeconomic status (SES) and the number of Facebook posts.	H4-a. income H4-b. mdi H4-c. ineq	H4-a. Gross income (euros) per inhabitant (2018) ² H4-b. Material deprivation index: composite index based on illiteracy rates, housing conditions, and unemployment (2011) ³ H4-c. Inequality in the distribution of households' gross income (P80/P20) (2017) ²
		H5. Association between the the percentage of low-qualified workers and the number of Facebook posts.	workers	% of workers as: farmers and skilled workers in agriculture, fisheries and of the forest; skilled workers in industry, construction and craftsmen; plant and machine operators and assembly workers; unskilled workers (2011) ²
		H6. Positive association between the level of education of residents and the number of Facebook posts.	education	% of residents with higher education (2018) ²
		H7. Negative association between the percentage of residents aged 65+ and the number of Facebook posts.	age	% of people aged 65 or over (2018) ²
		H8. Positive association between the presence of foreign population and the number of Facebook posts.	foreign	% foreign residents (2011) ³
		H9. Positive association between residents' Internet access and the number of Facebook posts.	internet	% of residents with broadband Internet access (2019) ²
		H10. Positive association between voter turnout and the number of Facebook posts.	turnout	% of voter turnout in the 2019 legislative election ⁵
Institutional environment	Municipal resources	H11. Positive association between financial autonomy and the number of Facebook posts.	autonomy	% of tax revenues in the total revenue (2018) ⁴
		H12. Positive association between the level of debt and the number of Facebook posts.	debt	Total debt (euros) per capita (2018) ⁴
		H13. Positive association between the size of a municipal government and the number of Facebook posts.	admin	Local public administration employees per 1000 residents (2018) ²
	Political context	H14. Association between the dominant ideology of the city council representatives and the number of publications by the municipalities.	ideology	% of local government members affiliated to left-wing parties (BE, PCP-PEV, PS) (2017) ⁵
		H15. Positive association between the gender of the mayor and the number of Facebook posts.	gender	Gender of mayor (2017) ⁵
		H16. Positive association between the level of political competition and the number of Facebook posts.	H16-a. competition H16-b. terms	H16-a. 100 - percentage points difference between left-wing and right-wing parties in the 2017 municipal election ⁵ H16-b Total number of terms by the mayor ⁵
		H17. Positive association between the level of commitment to transparency and the number of Facebook posts.	transparency	Municipal Transparency Index (2017) ⁶
		H18. Positive association between the commitment to health issues and the number of Facebook posts.	health	Membership Portuguese Healthy Cities Network (1 if yes, 0 otherwise) (2020) ⁷
Epidemiological environment	Epidemiological situation	H19. Positive association between the number of COVID-19 cases reported in the municipal territory during a given period and the number of publications	cases	Average number of reported cases per thousand inhabitants (2020) ^{1, 9}
		H20. Positive association between epidemiological situation of the enlarged territory around municipalities and the number of publications.	proximity	20-a. Maximum value of the proximity to the virus index (2020) ^{1, 9} 20-b. Mean value of the proximity to the virus index (2020) ^{1, 9}

¹ Facebook search.² INE – Statistics Portugal.³ 2011 national population census (INE – Statistics Portugal).⁴ DGAL/MMEAP - Balanço Social - Sistema Integrado de Informação da Administração Local (SIIAL) and DGO/MF - Base de Dados DOMUS (2009) | Contas de Gerência do SIIAL - Sistema Integrado de Informação da Administração Local.⁵ Portuguese Ministry of Interior (2017 municipal election results).⁶ 2017 Municipal Transparency Index, a publicly available database developed by Transparência e Integridade, Associação Cívica (TIAC), the national representative of TI, and four Portuguese academic institutions (da Cruz et al., 2016; Lameiras et al., 2018; Tavares & da Cruz, 2020).⁷ Portuguese Healthy Cities Network.⁹ Directorate-General of Health (DGS).

H2. There is a positive association between the *weight of tourism in the local economy* and the number of Facebook posts.

Another contagion factor frequently mentioned in the press and in the literature is mobility, in particular modal shares, defined as the percentage of different modes of transport (e.g., automobile, public transport, walking) used for commuting to work. While the role of the use of public transport (metro, buses, trains) in the risk of infection is still widely discussed (van Holm, Wyczalkowski, & Dantzler, 2020), changes in mobility behavior during the pandemic have revealed negative perceptions and avoidance strategies; instead, people prefer to walk or cycle (Wilbur et al., 2020) or, in particular, to use private cars and paratransit (e.g., private and application-based taxis) (Abdullah, Dias, Muley, & Shahin, 2020). For example, municipalities that are more dependent on public transport for daily travel may have had a greater concern for their citizens. Thus, we propose the following hypothesis, which to our knowledge has never been tested:

H3. There is a positive association between the use of *public transport* in commuter mobility and the number of Facebook posts.

2.3.2. Socio-demographics

The link between deprivation levels and Facebook usage remains controversial. Much of the literature has long considered that higher incomes increased the likelihood of people using social media (Gandía & Archidona, 2008; Laswad et al., 2005; Serrano-Cinca et al., 2009), which would lead public authorities to use this means of communication more widely, especially since high income groups are typically more politically active (Rosenstone & Hansen, 1993), they interact more with local governments online (Tat-Kei Ho, 2002), and they use Facebook more frequently than other groups (Duggan & Brenner, 2013). As a result, some researchers have proposed that this group's demand for disclosure is likely to be higher (Baber, 1983; Ingram, 1984; Lameiras et al., 2018; Serrano-Cinca et al., 2009), especially in times of crisis. However, other authors have found a negative association between income and disclosure (Guillamón et al., 2016). More recent work has also shown that the use of social media is now cross-cutting (Guadagno, Muscanell, & Pollio, 2013). In addition, it is possible that a high level of deprivation may be associated with greater incompatibility with telework (Gould & Shierholz, 2020), which generates greater job-related mobility, often through public transport (van Holm et al., 2020) and a greater precariousness of labor and housing conditions (Tai, Shah, Doubeni, Sia, & Wieland, 2020). This outcome would justify a greater intensity of communication on social media to reach these vulnerable groups more easily. Tavares and da Cruz (2020), for example, found a strong link between the percentage of unemployment and lower transparency. Thus, we propose the following hypothesis:

H4. There is a negative association between *socioeconomic status (SES)* and the number of Facebook posts.

Territories differ, among other things, in regard to the structure of jobs. Not all people experience the same labor conditions, as some could shift to telework during the COVID-19 pandemic more easily than others. For example, industrial territories were particularly affected during the pandemic (Marquès, Rovira, Nadal, & Domingo, 2021), because, on the one hand, the secondary sector is less conducive to telework and to physical distance, and on the other hand, the sector is generally associated with lower income levels and higher levels of exposure to pollutants (Miranda, Edwards, Keating, & Paul, 2011), which contributes to higher COVID-19-related mortality rates (Copat et al., 2020). Alternatively, the social vulnerability often associated with territories where industrial, manual, and/or precarious jobs prevail (Pacione, 2013) may be associated with a greater need for communication about the various social support mechanisms carried out by local governments. In a non-pandemic context, this variable has rarely been tested, with the exception of Cheng (1992). Accordingly, we propose the following hypothesis:

H5. There is a positive association between the *percentage of low-qualified workers* and the number of Facebook posts.

Similarly, the level of education is associated with different levels of disclosure. The arguments are relatively similar to those concerning income levels. For some authors, people with a higher level of education use the Internet more frequently (Duggan & Brenner, 2013). This greater use may be explained by the level of knowledge and skills that are necessary to use Facebook as a source of institutional information as well as because a more educated population participates more (Low-atcharin & Menifield, 2015; Yang & Callahan, 2007) and applies more pressure on local governments to monitor public action (Piotrowski & Van Ryzin, 2007; Rodríguez Domínguez, García Sánchez, & Gallego Alvarez, 2011; Tolbert, Mossberger, & McNeal, 2008). On the contrary, cross-cutting use—the use of Facebook being widely disseminated across different levels of education attainment—and fears of social vulnerabilities in times of a pandemic justify greater disclosure on the part of local governments. Here, we propose the following hypothesis:

H6. There is a positive association between the *level of education* of residents and the number of Facebook posts.

The use of social media is strongly marked by age: users are mostly young (Duggan & Brenner, 2013), and the age-related digital divide remains strong in some countries (Friemel, 2016; Reddick et al., 2020). Municipalities with large elderly populations are likely to be less likely to communicate through social media (Tavares & da Cruz, 2020) for two reasons: (i) the pressure to adopt these means is less strong because there are fewer young people, and (ii) the preference for more traditional means makes it easier to reach an older audience and avoid situations of exclusion (Khan, Swar, & Lee, 2014). Thus, we propose the following hypothesis:

H7. There is a negative association between the *percentage of residents aged 65+* and the number of Facebook posts.

The presence of foreign populations should be tested as a potential factor in disclosure for two reasons. The first is the ubiquity and ease of access of social media, which facilitate their use by the most vulnerable populations (Paganoni, 2012), including migrants. Therefore, social media are frequently considered a support for social inclusion and a means of getting information directly to people from vulnerable groups. Municipalities with a larger foreign population, particularly those with low-income country origins, could try to reach these people more intensely (Van der Meer & Van Winden, 2003). However, this strategy may be counterbalanced by linguistic barriers (Bertot et al., 2012; Lovari & Bowen, 2020). The second reason is related to the pandemic context. The strong presence of a foreign population (not only from low-income countries) may indicate greater international mobility due to strong links with the country of origin. In the age of globalization and air transport, viruses may spread internationally at high speeds (Sokadjo & Atchadé, 2020), which potentially causes fears for municipalities with a large foreign population. In addition, migrants, especially those from low-income countries, frequently work in precarious jobs that are less conducive to telework (Gould & Shierholz, 2020). Furthermore, several studies have shown that migrants have a higher rate of contamination due to their more precarious working and housing conditions (Ralli, Cedola, Urbano, Morrone, & Ercoli, 2020) as well as because of a more fragile social support network. Thus, we propose the following hypothesis:

H8. There is a positive association between the *presence of a foreign population* and the number of Facebook posts.

Where more of the population has access to the Internet, the likelihood increases that people will use it on a daily basis for information and that public services will more heavily use social media to communicate (Bertot et al., 2010; Jaeger & Bertot, 2010; Tolbert et al., 2008). Relatedly, low Internet penetration encourages local governments to

turn to more traditional means of dissemination. Thus, we propose the following hypothesis:

H9. There is a positive association between *residents' Internet access* and the number of Facebook posts.

The possibility of a link between electoral participation and the intensity of communication through social media is based on the idea that citizens who are more participatory and interested in political life tend to be more demanding and attentive to institutional communication and public action (Oliver, 2001; Piotrowski & Van Ryzin, 2007; Sol, 2013; Tavares & da Cruz, 2020). For other authors, communication through social media is used to attract the attention of those who are less interested and those who do not participate in order to increase their confidence in the institutions (Warren, Sulaiman, & Jaafar, 2014). Other studies have found no significant link (Serrano-Cinca et al., 2009; Tavares & da Cruz, 2020). Therefore, we propose the following hypothesis:

H10. There is a positive association between *voter turnout* and the number of Facebook posts.

2.3.3. Municipal resources

The human and financial resources of municipalities are an indispensable condition for the implementation of an effective communication strategy. Municipalities with more resources, particularly from their own incomes, are not only better able to disseminate information than other municipalities (Cárcaba García & García-García, 2010; Debreceeny, Gray, & Rahman, 2002; Geys, Heinemann, & Kalb, 2010; La Porte et al., 2002; Laswad et al., 2005; Moon, 2002; Tavares & da Cruz, 2020), but they are also more willing and committed to demonstrate their accountability and responsibility towards their citizens (Tavares & da Cruz, 2020). However, it is also possible that a lack of resources may be a reason to opt for communication through social media due to the low cost (Baruah, 2012). Alternatively, some authors argue that financial self-sufficiency may not be a strong indicator of the economic capacity of municipalities (Lameiras et al., 2018) and that this ability may not be associated with greater diffusion (Guillamón et al., 2016) but rather with the quality of it (Lameiras et al., 2018). We propose the following hypothesis:

H11. There is a positive association between financial *autonomy* and the number of Facebook posts.

Low debt levels may reinforce the positive role of financial self-sufficiency: less indebted municipalities with more financial resources communicate more to ensure their credibility and show their results (Alcaide Muñoz et al., 2016) to increase attractiveness for investors (Daniels & Daniels, 1991) and to increase their legitimacy in the eyes of the citizens (Curtin & Jacob, 2006). A high level of debt is associated with lower transparency and minimal publication of poor financial results (Guillamón et al., 2016). Nevertheless, a high level of debt may also contribute to a greater trend of communicating through social media with the aim of reducing the costs of the communication strategy while demonstrating to citizens their ability to manage public money (Ingram, 1984; Zimmerman, 1977). Here, we propose the following hypothesis:

H12. There is a positive association between the *level of debt* and the number of Facebook posts.

An administration with a larger number of employees has, in principle, a greater capacity for action. According to this common assumption, it has more human resources and more technical knowledge that allows it to implement various policies, increase possible topics of disclosure, initiate activities taking place in the municipal territory, and develop a proactive and innovative communication strategy, which

leads to a more massive disclosure through social media (Alcaide Muñoz et al., 2016; Giroux & McLelland, 2003; Moon, 2002; Serrano-Cinca et al., 2009; Yavuz & Welch, 2014). In the context of a health crisis, it is also possible that a larger administration may be better able to divide and organize tasks and to conduct the emergency missions related to the reduction of contamination, interventions to mitigate the adverse effects of the flatten-the-curve strategy, and the communication and relaying of information from a variety of sources (Chen et al., 2020; Mori et al., 2020). Thus, we propose the following hypothesis:

H13. There is a positive association between the *size of a municipal government* and the number of Facebook posts.

2.3.4. Political context

The idea that the political orientation of the ruling party may influence the disclosure of information is one of the most prominent and studied (Bonsón et al., 2012; García-Sánchez, Frías-Aceituno, & Rodríguez-Domínguez, 2013; Lameiras et al., 2018; Serrano-Cinca et al., 2009; Tavares & da Cruz, 2020; Tolbert et al., 2008; Yang & Callahan, 2007); however, the results are rather controversial. Some authors believe that right-wing parties are the most likely to communicate through social media because of the cost reduction that this strategy implies and their greater reluctance to spend publicly (Tolbert et al., 2008). Other authors consider left-wing parties to be more transparent (Cárcaba García & García-García, 2010; García-Sánchez et al., 2013; Lameiras et al., 2018; Piotrowski & Van Ryzin, 2007; Sol, 2013) and to be greater advocates of encouraging public confidence in political action and public spending. Alternatively, others have not found a clear result (Guillamón et al., 2016; Rodríguez Domínguez et al., 2011; Sáez Martín, Haro de Rosario, Pérez, & M. d. C., 2015; Serrano-Cinca et al., 2009; Tavares & da Cruz, 2020). Thus, we propose the following hypothesis:

H14. There is an association between the *dominant ideology* of the city council representatives and the number of publications by the municipalities.

The literature suggests a number of differences between the actions of men and women in power (Guillamón et al., 2011). Some authors argue that men are politically more active and are more likely to ask for information (Piotrowski & Van Ryzin, 2007). Others consider that women are more likely to seek consensus and external partnerships (Eagly & Johnson, 1990; La Porte et al., 2002; Tavares & da Cruz, 2020) and therefore would be more likely to carry out more intensive communication strategies. Other authors have not found a significant result (Guillamón et al., 2016; Sjöberg, 2010). Thus, we propose the following hypothesis:

H15. There is a positive association between the *gender* of the mayor and the number of Facebook posts.

The local political climate and the existence of strong opposition and political competition may contribute to a greater or lower tendency to disclose information. According to some authors, political competition encourages governments to develop a better communication strategy to assert their legitimacy, demonstrate their commitment to public action, and ensure future electoral victories (Alcaide Muñoz et al., 2016; Baber, 1983; Cárcaba García & García-García, 2010; Gandía & Archidona, 2008; Giroux & McLelland, 2003; Laswad et al., 2005; Oliver, 2001; Tavares & da Cruz, 2020). In the case of low political competition, which may result in either a large difference in votes or several consecutive terms, mayors may not feel the need to report their results as much. Tavares and da Cruz (2020) as well as Lameiras et al. (2018) have shown that the cumulation of offices is associated with a lower level of disclosure. If, in addition to low competition, the mayor is right-wing, the disclosure falls even more (Lameiras et al., 2018). Alternatively,

others believe that greater political stability marked by weak local opposition allows for a more comprehensive communication strategy (Rodríguez Domínguez et al., 2011; Sáez Martín et al., 2015) while greater competition may lead some elected officials to avoid using tools capable of generating greater instability (Tavares & da Cruz, 2020). Thus, we propose the following hypotheses:

H16-a. There is a positive association between the *level of political competition* and the number of Facebook posts.

H16-b. There is a positive association between the number of terms previously held by the mayor and the number of Facebook posts.

Furthermore, the use of social media in institutional communication may be based on a desire for greater transparency that is viewed more comprehensively (Bonsón et al., 2012; Guillamón et al., 2016; Lameiras et al., 2018). Thus, we propose the following hypothesis:

H17. There is a positive association between the *level of commitment to transparency* and the number of Facebook posts.

Local health strategies have multiplied around the world in recent years, largely due to the growing recognition of the role of the environment in health outcomes and behaviors (Almendrea, Santana, & Vasconcelos, 2017; Santana & Nogueira, 2016). A municipality that has demonstrated a strong compromise with population health promotion through the development of a municipal health strategy or the connection to a community, association, or network of institutions (e.g., Healthy Cities Network) may have a greater impetus to disclose information widely, based on the following factors (Baum et al., 2020): (i) less segmentation between the different departments of the town hall, where health is an interdepartmental concern and intersectoral action is put on practice (e.g., Health in all Policies framework) (Tsouros, 2013; WHO, 2012); (ii) greater sensitivity and preparedness in the face of public health crises; and (iii) a municipal desire to prevent disease and promote population health through the reduction of preventable mortality and co-morbidities, which are criteria and objectives for a medium to long-term horizon that are increasingly dependent on local environments (Barton & Grant, 2013). Thus, we propose the following hypothesis:

H18. There is a positive association between the *commitment to health issues* and the number of Facebook posts.

2.3.5. Epidemiological situation

As a virus spreads in one country, it particularly affects certain parts of the territory, sometimes intensely, while other areas remain relatively unspoiled. This spatial difference may fade or increase depending on a variety of factors. In terms of disclosure, this may result in two opposite paths. The first possible path is that municipalities most affected need to communicate strongly and to prioritize emergency measures. Meanwhile, other municipalities may not increase their communication and instead may prepare local responses with more available time. In this case, the intensity of the communication is directly related to the presence or proximity of the virus. The second trajectory corresponds to an opposite idea that the affected territories lose some of their resources by focusing more heavily on measures to contain the spread of the virus, and thus, they communicate less while others have more time to act and take the opportunity to inform the population and increase the level of preparedness. In this case, it is not the local intensity that influences communication but rather the perception of an inevitable danger in the long term. In either case, this perception may be based on two different datasets: the epidemiological evolution of the municipality or, more generally, that of the region in which the municipality is inserted. Thus, we propose the following hypotheses:

H19. There is a positive association between the *number of COVID-19 cases reported in the municipal territory* during a given period and the number of publications of the municipality.

H20. There is a positive association between the *epidemiological situation of the enlarged territory around municipalities* and the number of publications.

3. Study area and data

3.1. Study area

Portugal covers about 92,000 km² and includes a mainland territory and two autonomous regions (Madeira and Azores). The population (10.3 million inhabitants) is mainly concentrated on a large coastal fringe, particularly in the two metropolitan areas of Lisbon (2.85 million) and Porto (1.73 million). The country includes a total of 308 municipalities (including 12 in the Azores and Madeira archipelagos).

The first case of COVID-19 in Portugal was reported on March 2, 2020. The first death occurred 15 days later. At the end of the month, the country had reported 7443 cases of infection and 160 deaths. The number of infections increased to 32,500 by May 31 and to 44,097 by July 5, corresponding to an infection rate of 4.251 cases per thousand inhabitants (Fig. 2). The Portuguese national government declared a state of emergency on March 18, eight days after the World Health Organization (WHO) declared the COVID-19 outbreak a pandemic. The state of emergency was renewed twice and was replaced as of May 3 by a state of calamity. A progressive three-stage deconfinement plan lasted until June 14 with three main dates. The state of calamity was revoked on July 1 with the exception of a few civil parishes in the Lisbon Metropolitan Area. Locally, one municipality, Ovar with 54,120 residents, experienced the first major outbreak with 35 confirmed cases on March 18 and was imposed a localized lockdown between that day and April 17, during which the number of cases rose to 595 according to the municipality (but 498 according to the Directorate-General of Health-DGS).

3.2. Data collection

For this study, we systematically tracked every post published on the official Facebook pages of 304 (out of 308) Portuguese municipalities² between March 2 and July 5, 2020. The captured information includes text content, links, and images and videos. All Facebook posts were included, even those that were not related to the COVID-19 situation. Two reasons guided this choice. First, our objective was to examine local governments' e-disclosure during the pandemic rather than their crisis management e-disclosure. E-disclosure, even in pandemic times, includes dissemination of information on a large variety of topics and is supposed to ensure that public action is not interrupted. Second, distinguishing between posts that were related to the COVID-19 situation and those that were not related would be difficult to manage as the boundaries are rather blurred. This is the case, for example, when local governments use social media to post or share photographs or videos of local landscapes; organize and announce online events (not necessarily related to the COVID-19 crisis) and highlight the importance of the online format for the continuity of the cultural agenda; organize online events; celebrate Mother's Day and mention that this year the context is harder; and release information on the support to local business that may or may not include COVID-related support actions. In all these cases, e-disclosure does not focus on the public health crisis, but it plays a role in offering moral support and enhancing a sense of social cohesion.

Additional data were collected from a variety of sources (Table 2). The number of reported cases of infection in each municipality was

² Out of the 308 Portuguese municipalities, four do not have a Facebook page (Barreiro, Corvo, Palmela, and Penalva do Castelo), and one (Sever do Vouga) previously did not have a page but specifically created a new page on March 23 in the context of the pandemic.

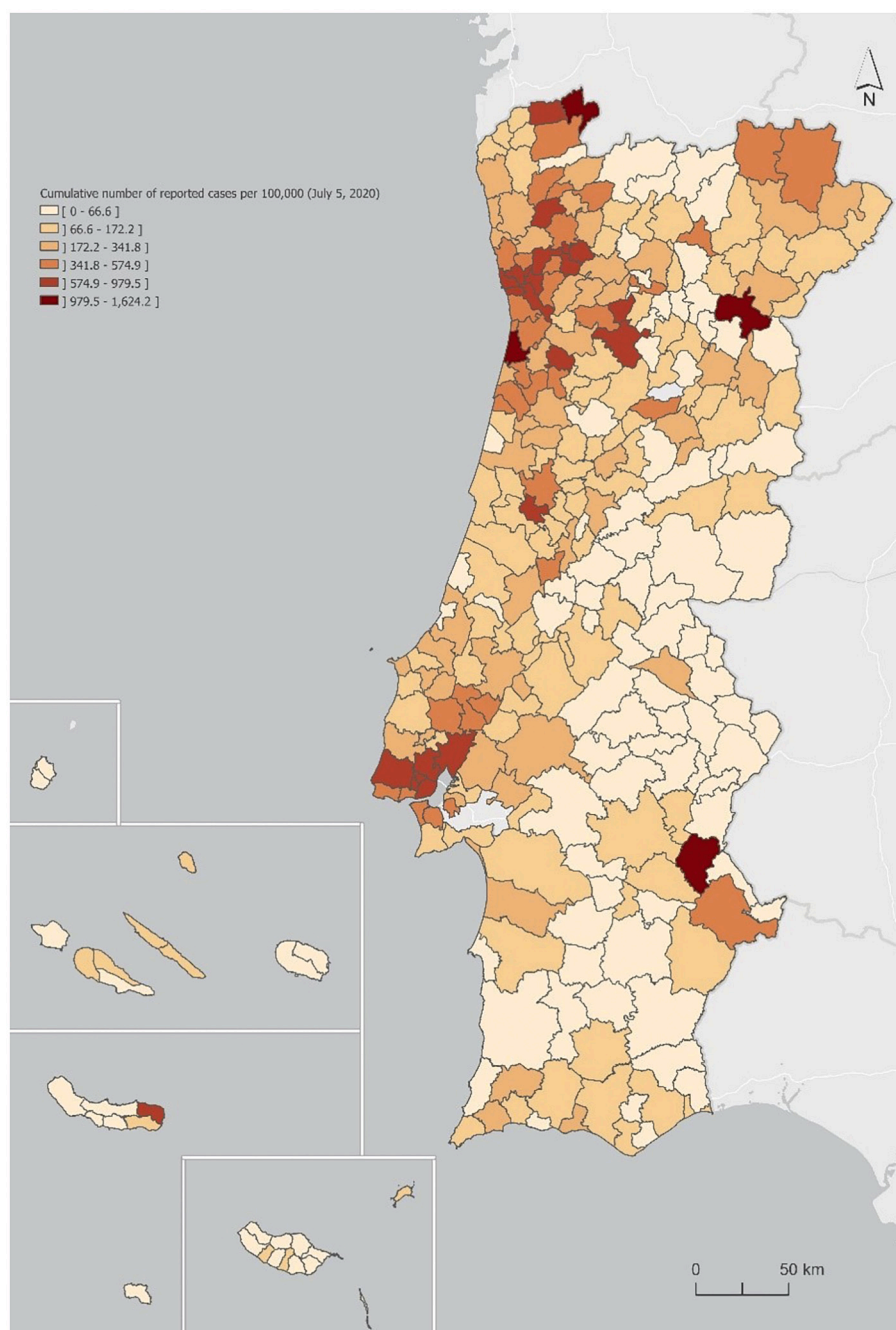


Fig. 2. Cumulative number of reported cases per 100,000 (July 5, 2020).

based on two different sources. The daily reports of the Directorate-General of Health (DGS) provided municipal-level numbers since March 24. Due to confidentiality issues, the number was not reported in municipalities where the number of cases was below 3. Many municipalities' Facebook pages also provided numbers. These were sometimes the mere disclosure of DGS reports, but in many cases the municipalities provided different numbers based on a different source of information (frequently, the local health unit or the field hospital). Before March 24, some municipalities had already provided numbers while DGS reports did not include any local information. This situation resulted in some discrepancies that raised several debates about the reliability of official data, particularly because the numbers reported by the municipalities were higher in most cases than the numbers provided by the national authorities. In this study, we created specific variables for each source (DGS or municipalities' Facebook pages). When the numbers diverged,

the numbers provided by the municipality were retained for the study, considering that this information was disclosed to the local population and that it informed local decisions.

4. Methods

After collecting the data, the study involved three major steps. First, a succinct descriptive analysis was undertaken to measure temporal and spatial variations in the use of Facebook by local governments throughout the COVID-19 crisis.

Second, Facebook posts numbers were related to the epidemiological situation at different times to analyze how the increasing risk and proximity of the virus affected or prompted increases in information disclosure. Drawing on a single indicator of reported cases within municipalities is likely to be insufficient, because the perception of risks are

Table 2
Descriptive statistics.

Group	Hypothesis	Variable name	If distinction between periods	Mean (or % of value 1 when applicable)	Std
DV	–	logposts.1	in period 1 (March 2 to March 12)	1.12	0.44
	–	logposts.2	in period 2 (March 13 to March 22)	1.18	0.45
	–	logposts.3	in period 3 (March 23 to April 3)	1.33	0.49
	–	logposts.4	in period 4 (April 4 to April 16)	1.22	0.55
	–	logposts.5	in period 5 (April 17 to May 15)	1.29	0.53
	–	logposts.6	in period 6 (May 16 to July 5)	1.09	0.47
	–	logposts.7	in the entire period	1.20	0.45
TC	H1-a	pop	–	33,320.21	55,303.19
	H1-b	denspop	–	288.45	803.55
	H2	tourism	–	6.26	16
	H3	transport	–	16.17	6.13
SD	H4-a	income	–	7561.17	1735.49
	H4-b	mdi	–	0.0	0.59
	H4-c	ineq	–	3.33	0.41
	H5	workers	–	45.2	8.76
	H6	education	–	12.52	5.15
	H7	age	–	23.36	7
	H8	foreign	–	2.66	2.83
	H9	internet	–	33.08	7.91
	H10	turnout	–	51.74	6.62
	H11	autonomy	–	24.49	16.58
RES	H12	debt	–	583.09	677.61
	H13	admin	–	19.55	11.84
POL	H14	ideology	–	54.66	28.12
	H15	gender	–	10.53%	n.a.
	H16-a	competition	–	53.43	29.1
	H16-b	mandates	–	1.97	0.86
	H17	transparency	–	50.9	16.88
	H18	health	–	18.10%	n.a.
ES	H19	cases.1	in period 1 (March 2 to March 12)	0.00001	0.0002
	H19	cases.2	in period 2 (March 13 to March 22)	0.0002	0.03
	H19	cases.3	in period 3 (March 23 to April 3)	0.22	0.47
	H19	cases.4	in period 4 (April 4 to April 16)	0.71	1.27
	H19	cases.5	in period 5 (April 17 to May 15)	1.25	1.82
	H19	cases.6	in period 6 (May 16 to July 5)	1.73	2.16
	H19	cases.7	in the entire period	1.08	1.43
	H20-a	proximity.max.1	in period 1 (March 2 to March 12)	0.0001	0.001
	H20-a	proximity.max.2	in period 2 (March 13 to March 22)	0.04	0.09
	H20-a	proximity.max.3	in period 3 (March 23 to April 3)	1.71	1.45
	H20-a	proximity.max.4	in period 4 (April 4 to April 16)	3.60	2.67
	H20-a	proximity.max.5	in period 5 (April 17 to May 15)	5.56	3.84
	H20-a	proximity.max.6	in period 6 (May 16 to July 5)	7.60	4.51
	H20-a	proximity.max.7	in the entire period	7.61	4.49
	H20-b	proximity.mean.1	in period 1 (March 2 to March 12)	0.00002	0.0002
	H20-b	proximity.mean.2	in period 2 (March 13 to March 22)	0.01	0.04
	H20-b	proximity.mean.3	in period 3 (March 23 to April 3)	0.84	0.71
	H20-b	proximity.mean.4	in period 4 (April 4 to April 16)	2.68	2.05
	H20-b	proximity.mean.5	in period 5 (April 17 to May 15)	4.77	3.41
	H20-b	proximity.mean.6	in period 6 (May 16 to July 5)	6.52	4.12
	H20-b	proximity.mean.7	in the entire period	4.09	2.69

influenced by the situation in neighboring areas and by the existence of functional relations with these areas. To consider the existence of such links, we constructed the following index of virus proximity largely inspired on accessibility indexes used in transport studies (Hansen, 1959) and based on the aforementioned distance matrix and on the reported cases data:

$$A_{i,d} = \sum \frac{c_{j,d}}{D_{ij}^{-\beta}} + c_{i,d}$$

where: i represents each municipality ($n = 304$), d is a given day (from March 2 to June 21), $A_{i,d}$ is the accessibility index from municipality i at day d , $c_{i,d}$ and $c_{j,d}$ express the number of reported cases in municipalities i and j on the same day, D_{ij} is the road distance (expressed in km) between i and j , and β is a friction coefficient (a value of -1 is applied here).

Finally, to analyze the structural determinants of varying numbers of Facebook publications, we undertook an ordinary least squares (OLS) regression model at different times. The model takes the following form:

$$\text{Logposts} = \log(F_{i,t} + 1)$$

$$= \alpha + \beta_1 \text{TC}_i + \beta_2 \text{SD}_i + \beta_3 \text{RES}_i + \beta_4 \text{POL}_i + \beta_5 \text{ES}_{i,t} + \varepsilon_i$$

where $F_{i,t}$ represents the average of the number of publications in the municipalities' Facebook pages over a period of time; α is the constant of the equation; β_1 , β_2 , β_3 , β_4 , and β_5 are the parameters of vectors TC (territorial context), SD (socio-demographics), RES (municipal resources), POL (political arena), and ES (epidemiological situation); and ε_i is the error term. The logarithmic transformation applied to the dependent variable is required to ensure that the model hypotheses are satisfied. Table 2 provides a detailed account of the variables tested in each vector. Moreover, to compare coefficients between different variables and models, all regressor variables were standardized before applying the model to have a zero mean and a variance equal to one. Therefore, the model intercept α would be equal to zero in all cases.

As we demonstrated in Table 2, a significant number of regressors was considered compared to the number of municipalities in the sample.

For linear models, a large number of regressors increases the variability of coefficients, which negatively impacts precision in the predictions. Moreover, when using all regressors it is more challenging to identify which variables are relevant for the prediction, since underlying relationships between regressors ruin the coefficient significance tests. Therefore, a variable selection approach should be applied. We used a forward stepwise selection: in each step we included in the model the regressor that has larger partial correlation (i.e., correlation between model residuals and residuals when replacing the dependent variable with the regressor under consideration). We added variables while their regression coefficients remained significant (p -value under 0.05).

The model was used for several sub-periods of analysis which corresponded to different phases of the first pandemic wave. The phases were not specifically based on those of the public authorities (e.g., the state of alert, emergency, or public calamity), as the phases defined by public authorities may have a time delay with respect to the actual changes in the infection curve, and reactions in the news and on social media are almost instantaneous. Instead, the phases were inspired in part by the study of Mori et al. (2020) who defined seven phases in the Italian case. The phases are data-driven and can be directly deduced from the evolution of the smoothed 7-day rolling average of COVID-19 reported cases (Fig. 3) and correspond to specific inflection points in time that indicate the different phases. They are as follows: pre-alert phase (March 2–12), alert phase (March 13–22), peak crisis phase (March 23–April 3), plateau phase (April 4–April 16), descent phase (April 17–May 15), and rebound phase (May 16–July 5).

5. Results

5.1. Descriptive analysis

Between March 2 and July 5, a total of 104,653 Facebook posts were published by the municipalities. General data show a significant increase in the quantity of posts as of March 2 (Fig. 4). During the first six weeks, the daily average of posts each week rose from 700 to 938 posts.

Then, it stabilized at slightly above 900 during the next five weeks. One exception is that municipalities cumulatively published 2990 posts on April 24 and 25; this increase is likely tied to the celebration of the 1974 Carnation Revolution on April 25. Another exception is on June 1 at the beginning of the third stage of the deconfinement plan. The number finally decreased to averages of 607 and 515 daily posts in the last two weeks of the period (Fig. 3).

An initial consideration of the aggregated data suggests that the publications trend was less related to the evolution of the number of confirmed cases, as the first increases were more pronounced than the increase in local infection rates and more related to national-level events. During the first increase phase of publications (March 13–April 8), no statistical relationship was found between the number of publications and the number of cases at the municipal level. The highest five peaks in the daily number of publications occurred on specific days: June 1 (first day of the last stage of the deconfinement plan), April 24 and 25 (online tributes and celebration of the Carnation Revolution anniversary), May 15 (decision of the Council of Ministers to extend the state of emergency), and April 30 (the Prime Minister's speech announcing the transition from a state of emergency to a state of calamity).

The spatial distribution of the 104,653 posts was rather uneven and right-skewed (an average of 344.3 posts per municipality and 3.07 daily posts per municipality; see Fig. 4). One municipality, Alcanena, published 2031 posts despite ranking at the 148th position with only 19 infection cases (147.7 cases per 100,000 residents) at the end of the period. Therefore, this municipality was eliminated from the study since linear models are sensitive to outliers.

5.2. Model results

The regression coefficients of the models are presented in Table 3. We checked whether the data for the different date ranges satisfy the following hypotheses of multivariate linear models:

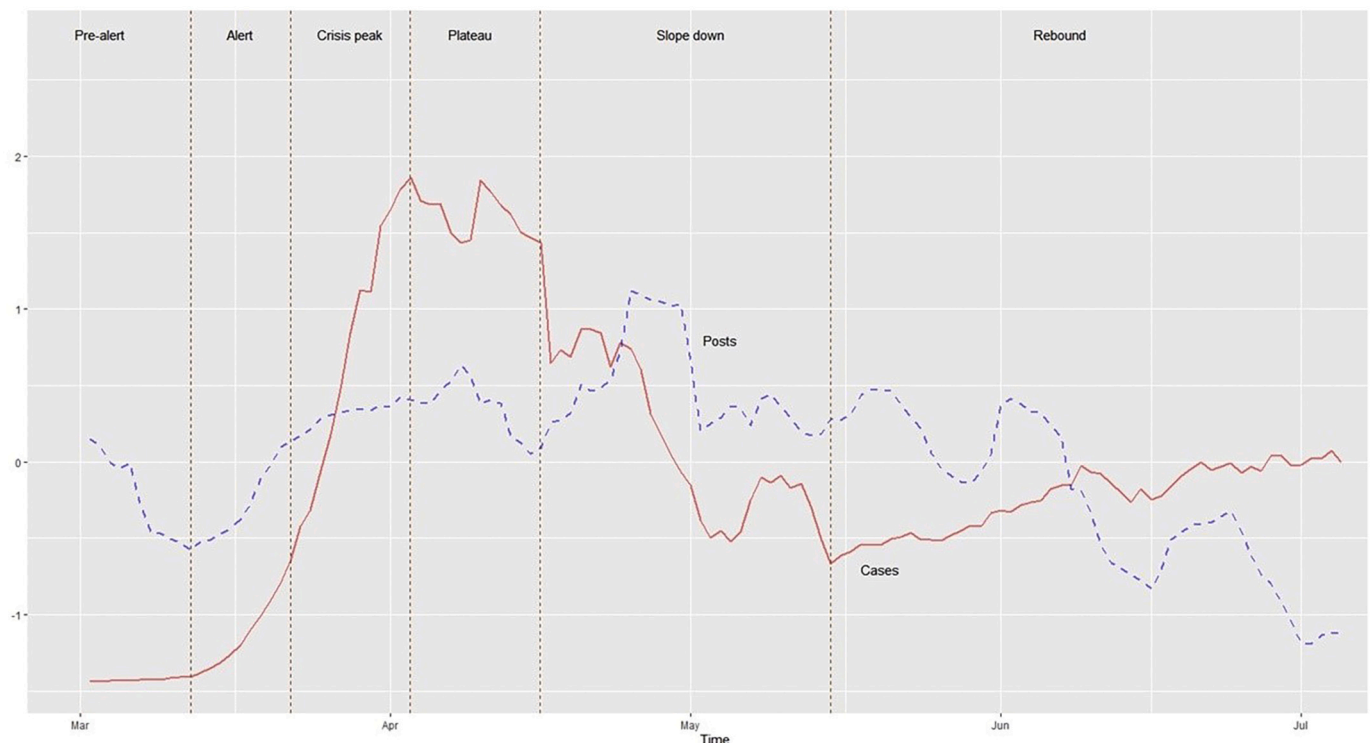


Fig. 3. Smoothed 7-day rolling average of COVID-19 reported cases versus the number of Facebook posts published by the municipalities—standardized numbers (March 2–July 5, 2020).

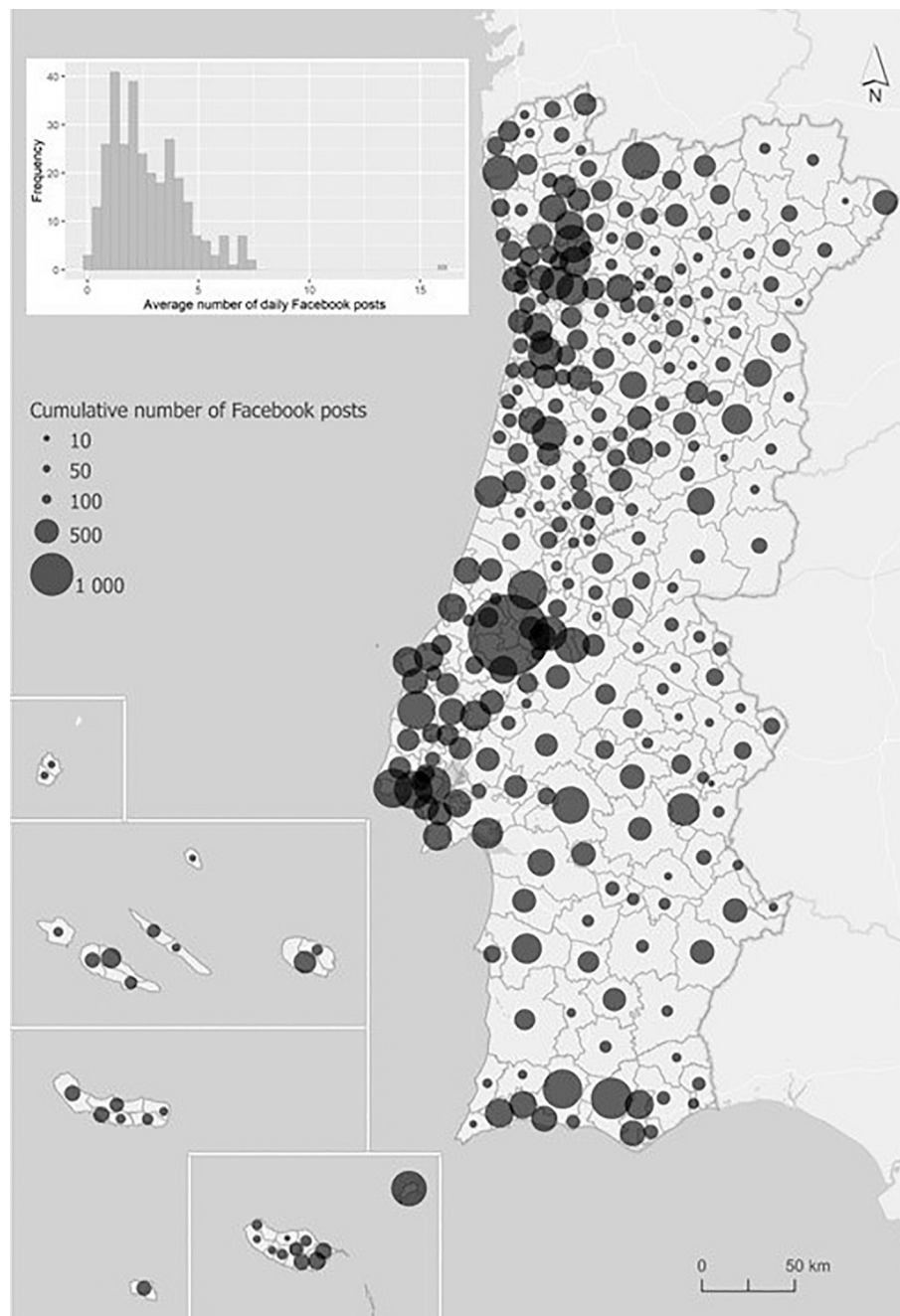


Fig. 4. Cumulative number of Facebook posts by municipalities between March 2 and July 5, 2020.

- (i) the relationship between the dependent variable and the regressors is linear. We checked the plots of residuals against fitted values (i.e., the predicted values for the dependent variable) from the supplemental file in Fig. 1;
- (ii) the model is linear if the adjusted (red) line is more or less horizontal. Model errors (residuals) have zero mean and constant variance. We checked the same plot as that of hypothesis 1. Residuals' variance is constant if the vertical width of the dot cloud is approximately constant along the x-axis;
- (iii) model errors are uncorrelated and follow a normal distribution. We used the Kolmogorov-Smirnov test on the standardized residuals to confirm this hypothesis, whose results are found in the supplemental file in Table 1. We also checked the Q-Q plots of the supplemental file in Fig. 1.

Although for some periods we could have discarded other municipalities that may be considered as outliers, we retained them to use the same data set for all models. Nonetheless, the model assumptions seem to be fulfilled for all the analyzed time ranges.

The adjusted coefficient of determination ($\text{adj. } R^2$) is relatively low, varying between 0.108 and 0.231, and tending to increase over time. An essential part of the disclosure through Facebook is not captured by the models, which may be explained by the gravity of the situation resulting in a partially more random distribution of communication strategies in a context of crisis. The three highest R^2 s are in the later phases of the study period, as a more cohesive organization, communication, and response strategy arguably emerges in cities' departments.

Four results deserve to be highlighted. The first is that financial autonomy is the only variable whose statistically significant influence is maintained throughout the period. Second, the maximum value per

Table 3
Regression results.

		Model 1: March 2–March 12		Model 2: March 13–March 22		Model 3: March 23–April 3		Model 4: April 4–April 16		Model 5: April 17 – May 15		Model 6: May 16 – July 5		Model 7: global	
		Pre-alert		Alert		Crisis peak		Plateau		Slope down		Rebound		Global	
Average number of daily posts		723.2		791.0		991.9		904.6		980.7		722.9		830.6	
Hypotheses		β coef	t-value	β coef	t-value	β coef	t-value	β coef	t-value	β coef	t-value	β coef	t-value	β coef	t-value
Socio-spatial environment															
Territorial context															
pop	1-a														
denspop	1-b														
tourism	3									−0.135*	−2.483	−0.119*	−2.150		
transport	4											−0.157**	−3.060	−0.147**	−2.717
Sociodemographics															
income	5					0.345***	3.691	0.450***	4.713						
mdi	5														
ineq	5							−0.198**	−2.596						
workers	2					0.264**	3.067	0.265**	2.833						
education	6														
age	7														
foreign	8	−0.215***	−3.397												
internet	9					−0.261**	−2.916	−0.296***	−3.422						
turnout	10							−0.196**	−2.682						
Institutional environment															
Municipal resources															
autonomy	11	0.447***	7.020	0.275***	5.028	0.478***	5.748	0.448***	4.935	0.449***	8.257	0.419***	6.654	0.363***	6.642
debt	12														
admin	13											−0.127*	−2.081		
Political															
ideology	14														
gender	15	0.119*	2.235												
competition	16-a			0.114*	2.097										
mandates	16-b														
transparency	17														
health	18														
Epidemiological situation															
cases	19-a													−0.198*	−2.281
proximity.max	19-b			0.126*	2.306									0.354***	3.797
proximity.mean	19-c	−0.122*	−2.259												
Adj R-Squared		0.148***		0.108***		0.168***		0.220***		0.179***		0.231***		0.219***	
F statistic		14.24		13.29		16.37		15.30		34.1		23.81		22.36	
N		303		303		303		303		303		303		303	

P-values *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Empty cells indicate non significant factors.

period of the virus proximity index is found at the start of the period (alert phase) and on the overall model. This means that in general and particularly at a time when the number of cases was increasing significantly, the communication of municipalities experienced a peak increase compared to municipalities where the proximity index remained low.

Based on the global model including the entire period considered (model 7), the third salient result is that financial autonomy and the maximum value of the virus proximity index are the only variables whose positive role is statistically significant, and two other variables (the share of public transport in commuting and the average infection rate) play a statistically significant negative role. Considering the surrounding municipalities (positive coefficient), the different role played by the infection rate of the municipalities (negative coefficient) and by the virus proximity index seems to indicate that an emergency situation within the municipal territory is likely to substantially reduce communication capacities. This is because services are occupied with managing other forms of crisis management while a threatening situation in the surroundings—at a short distance but not yet on the municipal territory itself—encourages greater communication, which is partly preventive.

Finally, three main periods were identified. During the first period, which includes the pre-alert and alert phases, the variables of the institutional environment are predominant as well as the proximity to the virus. The role of the mayor's gender (positive coefficient in the pre-alert phase) indicates a greater tendency to disclosure when the mayor is a woman, and the level of political competition (negative coefficient in the alert phase) shows that while the number of cases increased, municipalities with a larger difference of votes between parties communicated more. The percentage of foreigners in the population is the only variable belonging to the socio-spatial environment that plays a significant role. However, it is only (negatively) significant in the pre-alert phase; since this was when most of the communication did not concern the COVID-19 pandemic, this finding confirms the hypothesis that in non-pandemic times disclosure is less intense where the presence of foreigners is greater. As the number of infected cases increased, the impact of the variable was not confirmed again.

During the second period, which includes the peak and plateau phases, the variables belonging to the institutional environment ceased to play a role, and the variables of the socio-spatial environment dominated, having a more explanatory role in the intensity of publications. On the one hand, the level of income and the percentage of low-qualified workers play a positive role in disclosure during both phases: the number of posts rose when both the percentage of low-qualified workers and the income increased. In the case of the average income level, the idea that the existence of demand is an incentive for greater disclosure finds support. On the other hand, the role of the percentage of low-skilled workers reveals the need to quickly reach populations considered to be more at risk of becoming vectors of contagion because of their working conditions, thus reflecting fears specific to this population group. During these two phases, three variables play a negative role in e-disclosure; e-disclosure increases where Internet penetration is lower, where income inequalities within the municipal territory are lower (only during the plateau phase), and where electoral participation is lower (only during the peak of the crisis). The third period includes the decline and rebound phases. As the pressure slightly eased and a potentially less severe summer was anticipated in comparison to spring, three new variables appeared, and all had negative associations with the number of publications: tourism, the share of public transport (territorial context), and the size of the local administration (municipal resources).

6. Discussion

Rather than globally confirming the importance of certain factors in e-disclosure, the results obtained through the regression models all confirm the existence of a strong temporal variability of institutional

communication and its determinants. The evolution of the number of publications shows an initial increase, a more accentuated increase at the peak of the crisis, and then a slow decrease. This observation contrasts with that made by Mori et al. (2020) who found that in several Italian municipalities, over a relatively comparable period, the quantity of publications did not show a clear trend of increasing or decreasing.

Regarding the explanatory factors, the hypothesis that is confirmed most consistently over time is that regarding financial autonomy (H12). This factor is found to be positive and statistically significant in each phase. This result is consistent with several previous studies (Cárcaba García & García-García, 2010; Debreceny et al., 2002; Geys et al., 2010; La Porte et al., 2002; Laswad et al., 2005; Moon, 2002; Tavares & da Cruz, 2020). Less transfer-dependent municipalities need to better justify municipal spending in the eyes of their citizens, in the context of a strong scrutiny of the involvement-efficiency relation (Geys et al., 2010; Jorge, Sa, Pattaro, & Lourenço, 2011). These municipalities thus have an increased communication capacity that allows them to react faster and more consistently as well as to reach more people in times of a protracted crisis.

Two hypotheses belonging to the socio-spatial environment are only supported during the pre-alert period: gender (H15) and foreign population (H8). This first stage constitutes an echo of the non-crisis periods, although it cannot be generalized due to its small temporal extension. In the case of the gender variable, the result is similar to that of several previous studies (Eagly & Johnson, 1990; Sjöberg, 2010; Tavares & da Cruz, 2020), thus supporting the notion that women are more likely to implement communication strategies. However, it is difficult to explain why this variable disappears as a significant one in later periods of the crisis. One possibility is that the existence of a communication strategy, not necessarily linked to an increase in the respective human and organizational capacity, becomes less important as the crisis progresses. Another possibility is that men become more efficient in times of crisis, to the point of closing the pre-existing gap, due to the fact that they are more politically active (Piotrowski & Van Ryzin, 2007), and that they potentially have more connections and resources. Regarding the finding associated with the presence of foreigners, while the statistically negative relationship indicates greater communication in municipalities where fewer foreigners reside, the erasure of this negative relationship may be linked to rising fears concerning the possibilities of contagion as well as to the need to grant a certain level of social support to counter the adverse effects of containment measures.

Regarding the remainder of the hypotheses, those referring to the socio-spatial environment—the population, regardless of the indicator used (H1-a, H1-b); educational level (H6); and age structure (H7)—are not confirmed at any time during the first wave of the pandemic. In the case of population, the finding is consistent with the study by Tavares and da Cruz (2020), but it contrasts with other studies (Christiaens, 1999; Guillamón et al., 2016; Serrano-Cinca et al., 2009). This could be due to the fairly small size of Portuguese cities, as only six municipalities have a population larger than 200,000 residents. Regarding educational level, the variable is likely gradually becoming less important in terms of Facebook usage. The absence of an effect of age structure can be linked to two mechanisms that cancel each other out. On the one hand, the presence of older people can translate into less use of Facebook and, therefore, less disclosure. This result was found by Tavares and da Cruz (2020) in a study on Portuguese municipalities. The cancellation of this negative relationship during the pandemic may mean that part of the municipalities (but not enough for the direction of the relationship to be totally reversed) tended to communicate more due to a greater presence of elderly people and a perception of the associated risks.

As indicated above, the socio-spatial environment takes on a greater importance when the number of reported cases increases: this is the case of the hypothesis concerning the percentage of low-qualified workers (H5), which is confirmed during the peak of the crisis and the plateau phase. The absence of a relationship is not surprising in normal times. Moreover, low-qualified workers are also rarely analyzed because it is

not expected as a disclosure factor. However, the existence of a relationship at the peak of the crisis and in the plateau phase is important insofar as this is a population that needs social support and works in companies that have often been in need of economic support. These workers are well represented in the industrial region productive spaces of northwestern Portugal, where cases of COVID-19 were numerous during the first wave of the pandemic.

In contrast, the hypothesis of the role of Internet penetration (H9) takes an unexpected turn during the two acute phases: contrary to what we predicted, municipalities with fewer households with Internet access tended to communicate more than others. The notion that accessing the Internet with mobile phones outweighs home-based Internet usage may partly explain this finding. This point requires further examination, in particular based on the underlying relationships between the variables. The hypothesis of electoral participation (H10) is also refuted: it is not confirmed at the general level (for the entire period), which is consistent with other studies (Lameiras et al., 2018; Serrano-Cinca et al., 2009; Tavares & da Cruz, 2020) and is even associated with a lower level of municipalities' e-disclosure during the plateau phase. The general absence of a relationship is rather expected in Portugal, where rates of abstention are relatively homogenous across the country (with a very low standard deviation) and where political distrust is high. Nonetheless, the negative relationship during the plateau phase is difficult to explain.

Regarding the institutional environment, most of the assumptions are not confirmed: the level of indebtedness (H12), the dominant ideology (H14), the number of terms held by the mayor (H16-b), the commitment to transparency (H17), nor the commitment to health (H18) do not have an impact at any time. In the case of debt, ideology, and the number of terms of the mayor, it is possible that a rebalancing effect similar to the case of the age structure is the cause of the lack of a visible relationship in the models. The pandemic partially erases the positive or negative effects of certain variables due to the urgency of action and communication. For example, while Lameiras et al. (2018) showed the positive influence of a left-wing ideology on the use of social media, many right-wing municipalities faced the proximity of the virus and communicated more than usual, rebalancing this relationship and causing it to disappear in statistical terms. We can say the same for the number of terms of the mayor, which Tavares and da Cruz (2020) related negatively to transparency. In this specific case, it is possible that the mayors who have accumulated more successive terms have more connections and support, and in an emergency situation they communicate a little more. However, in the case of the commitment to health, it is likely that the variable itself is not sufficiently representative of a real compromise with health, insofar as belonging to a network of cities may not translate into the existence of a formal strategy. Political competition, expressed by the difference between the parties (H16-a), is only confirmed during the alert phase: the more competitive municipalities have more intense e-disclosure. However, this relation disappears in the later phases, which means that municipalities where competition is lower became more communicative as the crisis worsened. The hypothesis regarding the size of the local government is also almost never confirmed, with an exception in the rebound phase, but it is hard to explain and would require further investigation.

Finally, concerning the hypotheses linked to the epidemiological situation, it is especially notable that the infection rate has a significant negative influence (but only in the global model covering the entire period), while the virus proximity index has a more significantly positive influence on disclosure. This may be because municipalities (i) felt the need to communicate when the epidemiological situation in the municipalities belonging to the same region became worse and (ii) were focused to engage in more urgent tasks when infection rates were high in their territory.

6.1. Theoretical implications

This study extends the literature on the factors that influence e-disclosure. Our model is based on a conceptual framework which has been proven in the past (Cárcaba García & García-García, 2010; Guillamón et al., 2016; Lameiras et al., 2018; Serrano-Cinca et al., 2009; Tavares & da Cruz, 2020), through the incorporation of several environmental dimensions that reflect the institutional characteristics of local governments and the socio-demographic attributes of the population. The study expands on the previous research in that, first, the model is applied to a pandemic context, and specific variables linked to the epidemiological situation were added. Second, the model incorporates a temporal dimension and proposes that the different determinants be analyzed over time, recognizing that some factors may be more important at certain times than at others. It is possible that the temporal dimension introduces, even outside periods of crisis, important variations, for example between the beginning, middle, and end of a political term, since political action is frequently influenced by the election cycle and by constraints related to budget execution (Benito, Bastida, & Vicente, 2013; Kohno & Nishizawa, 1990; Köppl Turyna, Kula, Balmas, & Wacławski, 2016). Finally, the model includes variables usually not considered (i.e., tourism, transport, industrial employment, social inequalities, deprivation index). These variables are important not only in the context of a public health crisis because of the health, social, and economic vulnerabilities they reflect, but they could also be tested outside of the pandemic. The case of the variable *ineq* (social inequalities), for example, evidences the importance of distinguishing between income, which only describes the territories on the basis of an imprecise average, and the reality of income inequalities.

The results provide evidence that the COVID-19 crisis has affected e-disclosure in several ways. First, in quantitative terms, the increase in disclosure is significant, at least during the acute phases, and it provides support that periods of crisis lead to an increase in disclosure (Chen et al., 2020; Mori et al., 2020). With the possibility of an increasing frequency of extreme episodes such as cold or heat waves (Smid, Russo, Costa, Granell, & Pebesma, 2019), disasters (Bevacqua et al., 2019; Madsen, Lawrence, Lang, Martinkova, & Kjeldsen, 2014), and epidemics (IPBES, 2020), these communication peaks are estimated to repeat more and more in the future. Second, the COVID-19 crisis probably affected disclosure by disrupting the explanatory factors, given the disappearance of some of them and the importance of responding to stimuli of the epidemiological situation. This means that disclosure in an emergency situation is above all subject to the vagaries of the situation rather than to a previously established and predictable action plan based on the characteristics of the territory and the local institution. Finally, setting aside the financial autonomy which remains the primary factor explaining municipalities disclosure through digital channels, there is an important contrast in the initial phase where the institutional environment, on the supply side, predominates, and the critical phase where the socio-spatial environment, on the demand side, is preponderant. This contrast suggests that municipalities still have the ability to adapt their communication flexibly to different contexts, and that there is room to maneuver to increase disclosure where territorial and socio-demographic characteristics require it. The empowerment of local governments is undoubtedly a decisive element in the concretization of this objective in the medium and long term.

In general, it is nevertheless too early to predict that the impact on disclosure will be lasting and relevant, particularly in periods without a pandemic. The use of social networks by municipalities remains considerably uneven, and the increase in the number of posts on Facebook gave way, in a second phase, to a gradual decrease to a level comparable to the initial phase. However, it is likely that the number of followers of municipal pages has increased during the pandemic, due to an increasing demand for information, as has been the case in municipalities in northern Italy (Mori et al., 2020). Our study does not confirm this hypothesis in the Portuguese case, but if this increase turns out to be

real, and if the communication was effective and reliable, it is possible that a relationship of greater trust was established between the citizens and the municipalities. The confidence of citizens in local governments is an essential condition for the success of communication strategies and the effectiveness of disclosure in times of crisis (Bonsón & Ratkai, 2013; Kim & Lee, 2012; Liu, Lin, Wang, Chen, & Zhang, 2020). This development could thus affect the effectiveness of disclosure in the future thanks to the maintenance of the number of followers, the confidence generated, and the consequent commitment. Finally, the evolution of content is notable in terms of greater citizen engagement. For example, many municipalities have offered activities such as story time, concerts, online exhibitions, and online physical activity sessions. This programming could lead to an increase in concrete interactions between citizens and governments, with an effect of nourishing the governments' will to communicate more and in a different manner, so as to build new shared actions with citizens. Increased engagement and interactions, however, do not necessarily mean increased transparency.

Our study does not determine how disclosure in times of a pandemic may or may not have impacted transparency in the future. We can nevertheless formulate some hypotheses based on the existing literature and on our general knowledge—which is not systematized at this stage—of the posts published by the Portuguese municipalities. The first hypothesis is that a renewed demand was sparked on the part of the citizens and even of the municipalities in a neoinstitutional framework. On the one hand, citizens may have realized the importance of local governments to combat the virus and minimize the adverse effects of containment measures, and may therefore increase their expectations in the future. On the other hand, local governments have repeatedly wanted to assert themselves as actors in problem solving, particularly in the context of skills transfer currently underway in Portugal, and frequently also in other countries, in the face of the state power and national measures. In both cases, such a trend could lead to increased transparency. A more unfavorable hypothesis could be invoked to justify the idea that transparency will not increase as a result of the pandemic. Indeed, a disclosure considered too detailed can sometimes lead to an increase in panic, especially where there is limited trust between citizens and the government (Liu et al., 2020). For instance, a recent survey conducted in Japan showed that respondents had strong concerns about information disclosure and reliability (Zhang, 2021). In addition, during the critical pandemic some local elected officials have severely differentiated national measures according to the epidemiological situation of the territories. They argued that their territory and its people risked being stigmatized. Finally, when confidence is low and diffuse content not conducive to fear, the content can give rise to a negative interpretation accusing the government of promoting propaganda. In this case, a decrease in transparency during the next crises could occur, even where disclosure is important.

6.2. Practical implications

The results of this study further contribute to the current knowledge about local government communication in times of a public health crisis, which may help increase the level of preparedness during possible future crises (Boyce & Katz, 2020; WHO, 2020). In particular, we identified the factors that lead some municipalities to communicate more actively than others on social media. These findings may help policymakers and practitioners to better respond to future crises, as a number of practical and policy recommendations can be derived from the data. As Mori et al. (2020) state, the crisis has been a learning period for both local governments and citizens in what regards community engagement and communication, and it will be necessary in the future to learn from this experience.

Thus, as the disclosure response capacity of municipalities increases with financial autonomy, it is important to strengthen the means of fiscal decentralization. Alternatively, municipalities with less autonomy should be provided additional means to better disclose information in

times of crisis—means that should be effectively directed to communication purposes. This objective could be achieved through special aid in times of crisis but should also be the subject of a number of publications and training courses intended for local governments to increase the adoption of more homogeneous communication policies across the territories. The establishment of a communication strategy adapted to times of crisis could also be considered, in particular within the most transfer-dependent municipalities.

In addition, it is fundamental to reduce the digital divide to ensure better access to information for populations. Our results suggest, on the one hand, that disclosure decreases with the increase in social inequalities in the plateau phase and with the proportion of low-skilled workers. The results also indicate, on the other hand, that disclosure is unrelated to the proportion of elderly people, which may reduce the access to information for the most vulnerable. Reducing the divide is generally more a matter of measures undertaken at the national level, but it can also come from local policies through aid for equipment and a training policy intended for the most vulnerable populations (e.g., older adults, migrants). These training actions should include teaching units on institutional communication and on the engagement and use of social networks to encourage citizens to follow the pages of local institutions.

6.3. Limitations and further directions

This study has some limitations. First, it is only a quantitative study of the number of Facebook posts by municipalities. The content, speeches, and announced interventions were not analyzed—they are the subject of an in-depth analysis that is currently underway. Second, communication by municipalities is only addressed through Facebook, which raises two problems: (i) other platforms exist and are often used in times of crisis, such as Twitter and Whatsapp (WHO, 2020); (ii) communication is also facilitated through other channels (newspapers, posters, direct communication), especially in areas where Internet penetration is low and ageing is accentuated. Third, the results of this study are difficult to generalize, as they relate to the case of a single country. Comparative approaches including contrasting contexts would therefore be useful. Fourth, this study covers a relatively short period of time, since we did not have the necessary data to assess the number of publications prior to the pandemic. These data would make it possible to establish a control variable reflecting the usual intensity of e-disclosure in normal times, as a baseline to be compared to a period of a public health crisis. It is likely that local governments already accustomed to communicating through Facebook are also the ones that more easily adjust their communication strategy in times of a pandemic.

Further research should thus extend this approach to a broader time period that includes all waves of the pandemic to reflect the evolution of communication and learning in this area. It is possible, for example, that an evolution will be felt during the second and third waves of COVID-19. Comparisons with other contexts in various parts of the world are also necessary to generalize the findings. A second major direction to follow relates to content and interactions with users. It would be fruitful to deepen the knowledge of disclosure in pandemic times based on the contents of the publications without limiting it to their quantitative analysis and to analyze user engagement in evolution. Another possible avenue is to incorporate time into models to quantify the role of various factors in disclosure and transparency, both in pandemic times and in normal times. As we have highlighted above, time plays an important role in the relationship between the local (territorial and socio-demographic) and institutional (political and institutional) environment. This was demonstrated by this study during the first pandemic wave, but it is likely that this is also the case outside a context of crisis: electoral and/or budgetary deadlines or the existence of regular or ad hoc events can boost communication in certain municipalities, and these are examples that the current models do not capture. Finally, research is needed on the citizen dimension and public attitudes towards COVID-19 pandemic. This was not the focus of this study, however it is clear that

investigating citizens' perceptions and reactions in the face of a public health crisis, as well as engagement with governments through social media during public health crises, would allow to draw a more complete picture of the role and efficiency of e-disclosure in pandemic times.

7. Conclusion

This study examined the factors influencing local governments e-disclosure during the first wave of the COVID-19 pandemic. To accomplish this, we performed several regression models on the number of posts published on Facebook by 304 Portuguese municipalities from March 2 to July 5, 2020. The results particularly demonstrate the predominance of the institutional environment during the initial phases of the crisis, and the scenario of a worse epidemiological situation remains relatively abstract. This results of this study match the results of [Tavares and da Cruz \(2020\)](#) applied to normal times, which indicate the importance of the endogenous factors of local governments in the levels of transparency and openness. Our results also show the predominance of the socio-spatial environment when the crisis grew, which required broad measures and intense communication, regardless of the institutional capacities of the municipalities.

At a time when the COVID-19 crisis is still unfolding as we write these lines and, above all, when the social and economic consequences have taken on immense proportions, further increasing the uncertainty and fears of citizens—especially the most vulnerable—it is important to understand the extent to which municipalities have seized upon one of the most widely used communication tools. At this stage, few studies on the subject have been conducted. To our knowledge, this study is the first to analyze the factors of e-disclosure in the context of a public health crisis. In this sense, it contributes to the literature on the determinants of local government communication and transparency, extending it to a particular context that may significantly alter the capacities and possibilities of public authorities by putting them under great pressure. This knowledge contributes to a better anticipation of the difficulties of local governments at different times and, consequently, to a better management of 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.

Acknowledgements

This study received support from the Centre of Studies in Geography and Spatial Planning (CEGOT, Portugal), funded by national funds through the Foundation for Science and Technology (FCT, Portugal) under the reference UIDB/04084/2020. Ângela Freitas is a recipient of Individual Doctoral Fellowship funded by national funds through the FCT, under the reference SFRH/BD/123091/2016. Beatriz Bueno-Larraz is a member of the collaboration group of the research project granted by the Spanish Ministry of Science and Innovation with code PID2019-109387GB-I00. The authors acknowledge the help of Crowdfight (<https://crowdfight.org>, funded by grant 831644 of EOSCsecretariat.eu and the European Commission) to establish the collaboration between Miguel Padeiro and Beatriz Bueno-Larraz.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.giq.2021.101620>.

References

- Abdullah, M., Dias, C., Muley, D., & Shahin, M. (2020). Exploring the impacts of COVID-19 on travel behavior and mode preferences. *Transportation Research Interdisciplinary Perspectives*, 8, 100255. <https://doi.org/10.1016/j.trip.2020.100255>.
- Alcaide Muñoz, L., Rodríguez Bolívar, M. P., & López Hernández, A. M. (2016). Transparency in governments: A meta-analytic review of incentives for digital versus hard-copy public financial disclosures. *The American Review of Public Administration*, 47(5), 550–573. <https://doi.org/10.1177/0275074016629008>.
- Alexander, D. E. (2014). Social media in disaster risk reduction and crisis management. *Science and Engineering Ethics*, 20(3), 717–733. <https://doi.org/10.1007/s11948-013-9502-z>.
- Almendra, R., Santana, P., & Vasconcelos, J. (2017). Evidence of social deprivation on the spatial patterns of excess winter mortality. *International Journal of Public Health*, 62(8), 849–856.
- Archel, P., Husillos, J., Larrinaga, C., & Spence, C. (2009). Social disclosure, legitimacy theory and the role of the state. *Accounting, Auditing & Accountability Journal*, 22(8), 1284–1307.
- Arshad, S., & Khurram, S. (2020). Can government's presence on social media stimulate citizens' online political participation? Investigating the influence of transparency, trust, and responsiveness. *Government Information Quarterly*, 37(3), Article 101486. <https://doi.org/10.1016/j.giq.2020.101486>.
- Attard, J., Orlandi, F., Scerri, S., & Auer, S. (2015). A systematic review of open government data initiatives. *Government Information Quarterly*, 32(4), 399–418.
- Baber, W. R. (1983). Toward understanding the role of auditing in the public sector. *Journal of Accounting and Economics*, 5, 213–227.
- Bargain, O., & Aminjonov, U. (2020). Trust and compliance to public health policies in times of COVID-19. *Journal of Public Economics*, 192, Article 104316. <https://doi.org/10.1016/j.jpubeco.2020.104316>.
- Barton, H., & Grant, M. (2013). Urban planning for healthy cities. *Journal of Urban Health*, 90(1), 129–141.
- Baruah, T. D. (2012). Effectiveness of social media as a tool of communication and its potential for technology enabled connections: A micro-level study. *International Journal of Scientific and Research Publications*, 2(5), 1–10.
- Basch, C. E., Basch, C. H., Hillyer, G. C., & Jaime, C. (2020). The role of YouTube and the entertainment industry in saving lives by educating and mobilizing the public to adopt behaviors for community mitigation of COVID-19: Successive sampling design study. *JMIR Public Health and Surveillance*, 6(2), Article e19145.
- Baum, F., Townsend, B., Fisher, M., Browne-Yung, K., Freeman, T., Ziersch, A., ... Friel, S. (2020). Creating political will for action on health equity: Practical lessons for public health policy actors. *International Journal of Health Policy and Management*, 1–14.
- Bene, M. (2017). Influenced by peers: Facebook as an information source for young people. *Social Media + Society*, 3(2). <https://doi.org/10.1177/2056305117716273>.
- Benito, B., Bastida, F., & Vicente, C. (2013). Municipal elections and cultural expenditure. *Journal of Cultural Economics*, 37(1), 3–32.
- Berry, J. M., Portney, K. E., & Thomson, K. (2002). *The rebirth of urban democracy*. Brookings Institution Press.
- Bertot, J. C., Jaeger, P. T., & Grimes, J. M. (2010). Using ICTs to create a culture of transparency: E-government and social media as openness and anti-corruption tools for societies. *Government Information Quarterly*, 27(3), 264–271. <https://doi.org/10.1016/j.giq.2010.03.001>.
- Bertot, J. C., Jaeger, P. T., & Hansen, D. (2012). The impact of policies on government social media usage: Issues, challenges, and recommendations. *Government Information Quarterly*, 29(1), 30–40.
- Bevacqua, E., Maraun, D., Voudoukas, M. I., Voukoulavas, E., Vrac, M., Mentaschi, L., & Widmann, M. (2019). Higher probability of compound flooding from precipitation and storm surge in Europe under anthropogenic climate change. *Science Advances*, 5(9), Article eaaw5531.
- Bonsón, E., Perea, D., & Bednárová, M. (2019). Twitter as a tool for citizen engagement: An empirical study of the Andalusian municipalities. *Government Information Quarterly*, 36(3), 480–489.
- Bonsón, E., & Ratkai, M. (2013). A set of metrics to assess stakeholder engagement and social legitimacy on a corporate Facebook page. *Online Information Review*.
- Bonsón, E., Royo, S., & Ratkai, M. (2017). Facebook practices in Western European municipalities: An empirical analysis of activity and citizens' engagement. *Administration & Society*, 49(3), 320–347.
- Bonsón, E., Torres, L., Royo, S., & Flores, F. (2012). Local e-government 2.0: Social media and corporate transparency in municipalities. *Government Information Quarterly*, 29(2), 123–132.
- Boyce, M. R., & Katz, R. (2020). Rapid urban health security assessment tool: A new resource for evaluating local-level public health preparedness. *BMJ Global Health*, 5(6), Article e002606. <https://doi.org/10.1136/bmjgh-2020-002606>.
- Brainard, L. A., & McNutt, J. G. (2010). Virtual government–citizen relations: Informational, transactional, or collaborative? *Administration & Society*, 42(7), 836–858.
- Cárcaba García, A., & García-García, J. (2010). Determinants of online reporting of accounting information by Spanish local government authorities. *Local Government Studies*, 36(5), 679–695. <https://doi.org/10.1080/03003930.2010.506980>.
- Carozzi, F. (2020). *Urban density and COVID-19*.
- Cauberghe, V., Van Wesenbeeck, I., De Jans, S., Hudders, L., & Ponnet, K. (2020). How adolescents use social media to cope with feelings of loneliness and anxiety during COVID-19 lockdown. *Cyberpsychology, Behavior and Social Networking*, 24(4), 250–257. <https://doi.org/10.1089/cyber.2020.0478>.

- Chatfield, A. T., & Reddick, C. G. (2018). All hands on deck to tweet# sandy: Networked governance of citizen coproduction in turbulent times. *Government Information Quarterly*, 35(2), 259–272.
- Chen, Q., Min, C., Zhang, W., Ma, X., & Evans, R. (2021). Factors driving citizen engagement with government TikTok accounts during the COVID-19 pandemic: Model development and analysis. *Journal of Medical Internet Research*, 23(2), Article e21463. <https://doi.org/10.2196/21463>.
- Chen, Q., Min, C., Zhang, W., Wang, G., Ma, X., & Evans, R. (2020). Unpacking the black box: How to promote citizen engagement through government social media during the COVID-19 crisis. *Computers in Human Behavior*, 110, Article 106380. <https://doi.org/10.1016/j.chb.2020.106380>.
- Cheng, R. H. (1992). An empirical analysis of theories on factors influencing state government accounting disclosure. *Journal of Accounting and Public Policy*, 11(1), 1–42.
- Christiaens, J. (1999). Financial accounting reform in Flemish municipalities: An empirical investigation. *Financial Accountability & Management*, 15(1), 21–40.
- Copat, C., Cristaldi, A., Fiore, M., Grasso, A., Zuccarello, P., Santo Signorelli, S., ... Ferrante, M. (2020). The role of air pollution (PM and NO₂) in COVID-19 spread and lethality: A systematic review. *Environmental Research*, 191, Article 110129.
- Criado, J. I., Sandoval-Almazan, R., & Gil-Garcia, J. R. (2013). Government innovation through social media. *Government Information Quarterly*, 30(4), 319–326. <https://doi.org/10.1016/j.giq.2013.10.003>.
- Curtin, D., & Jacob, M. A. (2006). Does transparency strengthen legitimacy? A critical analysis of European Union policy documents. *Information Policy*, 11, 109–122.
- da Cruz, N. F., Tavares, A. F., Marques, R. C., Jorge, S., & de Sousa, L. (2016). Measuring Local Government Transparency. *Public Management Review*, 18(6), 866–893.
- Daniels, J. D., & Daniels, C. E. (1991). Municipal financial reports: What users want. *Journal of Accounting and Public Policy*, 10(1), 15–38.
- Debreceeny, R., Gray, G. L., & Rahman, A. (2002). The determinants of Internet financial reporting. *Journal of Accounting and Public Policy*, 21(4–5), 371–394.
- Detlor, B., Hupfer, M. E., Ruhi, U., & Zhao, L. (2013). Information quality and community municipal portal use. *Government Information Quarterly*, 30(1), 23–32. <https://doi.org/10.1016/j.giq.2012.08.004>.
- Duggan, M., & Brenner, J. (2013). *The demographics of social media users, 2012* (Vol. 14). Washington, DC: Pew Research Center's Internet & American Life Project.
- Eagly, A. H., & Johnson, B. T. (1990). Gender and leadership style: A meta-analysis. *Psychological Bulletin*, 108(2), 233.
- Eurostat. (2020). Households - Level of internet access. Retrieved from: https://ec.europa.eu/eurostat/statistics-explained/index.php/Digital_economy_and_society_statistics_-_households_and_individuals https://ec.europa.eu/eurostat/databrowser/view/w/isoc_ci_in_h/default/table?lang=en.
- Friemel, T. N. (2016). The digital divide has grown old: Determinants of a digital divide among seniors. *New Media & Society*, 18(2), 313–331.
- Fuentes, A., & Peterson, J. V. (2021). Social media and public perception as core aspect of public health: The cautionary case of @realDonaldTrump and COVID-19. *PLoS One*, 16(5), Article e0251179. <https://doi.org/10.1371/journal.pone.0251179>.
- Gandia, J. L., & Archidona, M. C. (2008). *Determinants of web site information by Spanish city councils* (Online Information Review).
- Gandia, J. L., Marrahi, L., & Huguet, D. (2016). Digital transparency and Web 2.0 in Spanish city councils. *Government Information Quarterly*, 33(1), 28–39. <https://doi.org/10.1016/j.giq.2015.12.004>.
- Gao, S., Shuang, L., & Liu, W. (2018). The role of social media in promoting information disclosure on environmental incidents: An evolutionary game theory perspective. *Sustainability*, 10, 4372. <https://doi.org/10.3390/su10124372>.
- García-Sánchez, I.-M., Frías-Aceituno, J.-V., & Rodríguez-Domínguez, L. (2013). Determinants of corporate social disclosure in Spanish local governments. *Journal of Cleaner Production*, 39, 60–72.
- Gesuele, B., Metallo, C., & Agrifoglio, R. (2016). What do local governments discuss in social media? An empirical analysis of the Italian municipalities. In *Paper presented at the blurring the boundaries through digital innovation, Cham*.
- Geys, B., Heinemann, F., & Kalb, A. (2010). Voter involvement, fiscal autonomy and public sector efficiency: Evidence from German municipalities. *European Journal of Political Economy*, 26(2), 265–278.
- Giroux, G., & McLelland, A. J. (2003). Governance structures and accounting at large municipalities. *Journal of Accounting and Public Policy*, 22(3), 203–230.
- Glenny, L. (2008). Perspectives of communication in the Australian public sector. *Journal of Communication Management*, 12(2), 152–168.
- Global Web Index. (2020a). *The global social media landscape* (Retrieved from London).
- Global Web Index. (2020b). *Global Web Index's flagship report on the latest trends in social media* (Retrieved from London).
- Global Web Index. (2020c). *Social media by generation infographic Q318* (Retrieved from London).
- Gould, E., & Shierholz, H. (2020). Not everybody can work from home Black and Hispanic workers are much less likely to be able to telework. Retrieved from <https://www.epi.org/blog/black-and-hispanic-workers-are-much-less-likely-to-be-able-to-work-from-home/>.
- Guadagno, R. E., Muscanell, N. L., & Pollio, D. E. (2013). The homeless use Facebook?! Similarities of social network use between college students and homeless young adults. *Computers in Human Behavior*, 29(1), 86–89. <https://doi.org/10.1016/j.chb.2012.07.019>.
- Guillamón, M.-D., Bastida, F., & Benito, B. (2011). The determinants of local government's financial transparency. *Local Government Studies*, 37(4), 391–406.
- Guillamón, M.-D., Ríos, A.-M., Gesuele, B., & Metallo, C. (2016). Factors influencing social media use in local governments: The case of Italy and Spain. *Government Information Quarterly*, 33(3), 460–471. <https://doi.org/10.1016/j.giq.2016.06.005>.
- Guttormsen, C., & Sæbø, Ø. (2013). Municipalities “like” facebook: The use of social media in local municipalities. In *Organizational change and information systems* (pp. 157–166). Springer.
- Hansen, W. G. (1959). How accessibility shapes land use. *Journal of the American Institute of Planners*, 25(2), 73–76.
- van Holm, E. J., Wyczalkowski, C. K., & Dantzler, P. A. (2020). Neighborhood conditions and the initial outbreak of COVID-19: The case of Louisiana. *Journal of Public Health (Oxford, England)*, Article fdad147. <https://doi.org/10.1093/pubmed/fdad147>.
- Ingram, R. W. (1984). Economic incentives and the choice of state government accounting practices. *Journal of Accounting Research*, 126–144.
- Ingram, R. W., & DeJong, D. V. (1987). The effect of regulation on local government disclosure practices. *Journal of Accounting and Public Policy*, 6(4), 245–270.
- IPBES. (2020). *Workshop report on biodiversity and pandemics of the intergovernmental platform on biodiversity and ecosystem services* (Retrieved from Bonn).
- Jaeger, P. T., & Bertot, J. C. (2010). Transparency and technological change: Ensuring equal and sustained public access to government information. *Government Information Quarterly*, 27(4), 371–376.
- Jorge, S., Sa, P. M., Pattaro, A. F., & Lourenço, R. P. (2011). Local government financial transparency in Portugal and Italy: A comparative exploratory study on its determinants. In *Paper presented at the 13th Biennial CIGAR conference, bridging public sector and non-profit sector accounting*.
- Justice, J. B., Melitski, J., & Smith, D. L. (2006). E-government as an instrument of fiscal accountability and responsiveness: Do the best practitioners employ the best practices? *The American Review of Public Administration*, 36(3), 301–322. <https://doi.org/10.1177/0275074005283797>.
- Kaplan, A. M., & Haenlein, M. (2010). Users of the world, unite! The challenges and opportunities of Social Media. *Business Horizons*, 53(1), 59–68.
- Kassen, M. (2013). A promising phenomenon of open data: A case study of the Chicago open data project. *Government Information Quarterly*, 30(4), 508–513. <https://doi.org/10.1016/j.giq.2013.05.012>.
- Kavanaugh, A. L., Fox, E. A., Sheetz, S. D., Yang, S., Li, L. T., Shoemaker, D. J., ... Xie, L. (2012). Social media use by government: From the routine to the critical. *Government Information Quarterly*, 29(4), 480–491. <https://doi.org/10.1016/j.giq.2012.06.002>.
- Khan, G. F., Swar, B., & Lee, S. K. (2014). Social media risks and benefits: A public sector perspective. *Social Science Computer Review*, 32(5), 606–627.
- Kim, K., Jung, K., & Chilton, K. (2016). Strategies of social media use in disaster management. *International Journal of Emergency Services*, 5(2), 110–125. <https://doi.org/10.1108/IJES-02-2016-0005>.
- Kim, S., & Lee, J. (2012). E-participation, transparency, and trust in local government. *Public Administration Review*, 72(6), 819–828.
- Kohno, M., & Nishizawa, Y. (1990). A study of the electoral business cycle in Japan: Elections and government spending on public construction. *Comparative Politics*, 22(2), 151–166.
- Köppel Turyna, M., Kula, G., Balmas, A., & Wacławski, K. (2016). The effects of fiscal decentralisation on the strength of political budget cycles in local expenditure. *Local Government Studies*, 42(5), 785–820. <https://doi.org/10.1080/03003930.2016.1181620>.
- La Porte, T. M., Demchak, C. C., & De Jong, M. (2002). Democracy and bureaucracy in the age of the Web: Empirical findings and theoretical speculations. *Administration & Society*, 34(4), 411–446.
- Lameiras, M., Silva, T., & Tavares, A. (2018). An empirical analysis of social media usage by local governments in Portugal. In *Paper presented at the proceedings of the 11th international conference on theory and practice of electronic governance*.
- Landi, S., Costantini, A., Fasan, M., & Bonazzi, M. (2021). Public engagement and dialogic accounting through social media during COVID-19 crisis: A missed opportunity? *Accounting, Auditing & Accountability Journal*. <https://doi.org/10.1108/AAAJ-08-2020-4884>. ahead-of-print (ahead-of-print).
- Laswad, F., Fisher, R., & Oyeler, P. (2005). Determinants of voluntary Internet financial reporting by local government authorities. *Journal of Accounting and Public Policy*, 24(2), 101–121.
- Lindsay, B. R. (2011). *Social media and disasters: Current uses, future options, and policy considerations*.
- Liu, B., Lin, S., Wang, Q., Chen, Y., & Zhang, J. (2020). Can local governments' disclosure of pandemic information decrease residents' panic when facing COVID-19 in China? *International Public Management Journal*, 1–19.
- Lovari, A., & Bowen, S. A. (2020). Social media in disaster communication: A case study of strategies, barriers, and ethical implications. *Journal of Public Affairs*, 20(1), Article e1967.
- Lovari, A., & Parisi, L. (2015). Listening to digital publics. Investigating citizens' voices and engagement within Italian municipalities' Facebook Pages. *Public Relations Review*, 41(2), 205–213.
- Lowtharin, G., & Menfield, C. E. (2015). Determinants of Internet-enabled transparency at the local level: A study of Midwestern county web sites. *State and Local Government Review*, 47(2), 102–115.
- Madsen, H., Lawrence, D., Lang, M., Martinkova, M., & Kjeldsen, T. R. (2014). Review of trend analysis and climate change projections of extreme precipitation and floods in Europe. *Journal of Hydrology*, 519, 3634–3650. Retrieved from <http://www.sciencedirect.com/science/article/pii/S0022169414008889>.
- Magro, M. J. (2012). A review of social media use in e-government. *Administrative Sciences*, 2(2), 148–161.
- Marquès, M., Rovira, J., Nadal, M., & Domingo, J. L. (2021). Effects of air pollution on the potential transmission and mortality of COVID-19: A preliminary case-study in Tarragona Province (Catalonia, Spain). *Environmental Research*, 192, Article 110315. <https://doi.org/10.1016/j.envres.2020.110315>.

- Maxwell, T. A. (2003). The public need to know: Emergencies, government organizations, and public information policies. *Government Information Quarterly*, 20(3), 233–258. [https://doi.org/10.1016/S0740-624X\(03\)00039-X](https://doi.org/10.1016/S0740-624X(03)00039-X).
- Meijer, A. J. (2008). E-mail in government: Not post-bureaucratic but late-bureaucratic organizations. *Government Information Quarterly*, 25(3), 429–447. <https://doi.org/10.1016/j.giq.2007.05.004>.
- Metallo, C., Gesuele, B., Guillamón, M.-D., & Ríos, A.-M. (2020). Determinants of public engagement on municipal Facebook pages. *The Information Society*, 36(3), 147–159. <https://doi.org/10.1080/01972243.2020.1737605>.
- Miranda, M. L., Edwards, S. E., Keating, M. H., & Paul, C. J. (2011). Making the environmental justice grade: The relative burden of air pollution exposure in the United States. *International Journal of Environmental Research and Public Health*, 8(6), 1755–1771.
- Moon, M. J. (2002). The evolution of e-government among municipalities: Rhetoric or reality? *Public Administration Review*, 62(4), 424–433.
- Mori, E., Barabaschi, B., Cantoni, F., & Virtuani, R. (2020). Local governments' communication through Facebook. Evidence from COVID-19 pandemic in Italy. *Journal of Public Affairs*, Article e2551.
- Mossberger, K., Wu, Y., & Crawford, J. (2013). Connecting citizens and local governments? Social media and interactivity in major U.S. cities. *Government Information Quarterly*, 30(4), 351–358. <https://doi.org/10.1016/j.giq.2013.05.016>.
- Nabity-Grover, T., Cheung, C. M. K., & Thatcher, J. B. (2020). Inside out and outside in: How the COVID-19 pandemic affects self-disclosure on social media. *International Journal of Information Management*, 55, Article 102188. <https://doi.org/10.1016/j.ijinfomgt.2020.102188>.
- Nivette, A., Ribeaud, D., Murray, A., Steinhoff, A., Bechtiger, L., Hepp, U., ... Eisner, M. (2021). Non-compliance with COVID-19-related public health measures among young adults in Switzerland: Insights from a longitudinal cohort study. *Social Science & Medicine*, 268, Article 113370. <https://doi.org/10.1016/j.socscimed.2020.113370>.
- OECD. M. (2003). *The e-government imperative: Main findings*. OECD Observer.
- Oliveira, G. H. M., & Welch, E. W. (2013). Social media use in local government: Linkage of technology, task, and organizational context. *Government Information Quarterly*, 30(4), 397–405. <https://doi.org/10.1016/j.giq.2013.05.019>.
- Oliver, J. (2001). *Democracy in suburbia*. Princeton, NJ: Princeton Univ. Press.
- Pacione, M. (2013). *Urban geography: A global perspective*. Routledge.
- Paganoni, M. C. (2012). City branding and social inclusion in the global city. *Mobilities*, 7(1), 13–31.
- Pan, P.-L., & Meng, J. (2016). Media frames across stages of health crisis: A crisis management approach to news coverage of flu pandemic. *Journal of Contingencies and Crisis Management*, 24(2), 95–106. <https://doi.org/10.1111/1468-5973.12105>.
- Panagiotopoulos, P., Barnett, J., Bigdeli, A. Z., & Sams, S. (2016). Social media in emergency management: Twitter as a tool for communicating risks to the public. *Technological Forecasting and Social Change*, 111, 86–96. <https://doi.org/10.1016/j.techfore.2016.06.010>.
- Pang, P. C., Cai, Q., Jiang, W., & Chan, K. S. (2021). Engagement of government social media on Facebook during the COVID-19 pandemic in Macao. *International Journal of Environmental Research and Public Health*, 18(7). <https://doi.org/10.3390/ijerph18073508>.
- Picazo-Vela, S., Gutiérrez-Martínez, I., & Luna-Reyes, L. F. (2012). Understanding risks, benefits, and strategic alternatives of social media applications in the public sector. *Government Information Quarterly*, 29(4), 504–511.
- Pina, V., Torres, L., & Royo, S. (2007). Are ICTs improving transparency and accountability in the EU regional and local governments? An empirical study. *Public Administration*, 85(2), 449–472.
- Piotrowski, S. J., & Van Ryzin, G. G. (2007). Citizen attitudes toward transparency in local government. *The American Review of Public Administration*, 37(3), 306–323.
- Powell, W. W., & DiMaggio, P. J. (2012). *The new institutionalism in organizational analysis*. University of Chicago Press.
- Ralli, M., Cedola, C., Urbano, S., Morrone, A., & Ercoli, L. (2020). Homeless persons and migrants in precarious housing conditions and COVID-19 pandemic: Peculiarities and prevention strategies. *European Review for Medical and Pharmacological Sciences*, 24(18), 9765–9767.
- Reddick, C. G., Enriquez, R., Harris, R. J., & Sharma, B. (2020). Determinants of broadband access and affordability: An analysis of a community survey on the digital divide. *Cities*, 106, Article 102904. <https://doi.org/10.1016/j.cities.2020.102904>.
- Reddick, C. G., & Norris, D. F. (2013). Social media adoption at the American grass roots: Web 2.0 or 1.5? *Government Information Quarterly*, 30(4), 498–507. <https://doi.org/10.1016/j.giq.2013.05.011>.
- Rodríguez Domínguez, L., García Sánchez, I. M., & Gallego Álvarez, I. (2011). Determining factors of e-government development: A worldwide national approach. *International Public Management Journal*, 14(2), 218–248.
- Rosenstone, S. J., & Hansen, J. M. (1993). *Mobilization, participation, and democracy in America*. Longman Publishing Group.
- Sáez Martín, A., Haro de Rosario, A., Pérez, C., & M. d. C. (2015). Using Twitter for dialogic communication: Local government strategies in the European Union. *Local Government Studies*, 41(3), 421–444.
- Santana, P., & Nogueira, H. (2016). Environment and health: Place, sense of place and weight gain in urban areas. In A. Williams, & J. Eyles (Eds.), *Sense of place, health and quality of life* (pp. 173–188). Routledge.
- Serrano-Cinca, C., Rueda-Tomás, M., & Portillo-Tarragona, P. (2009). Factors influencing e-disclosure in local public administrations. *Environment and Planning C: Government and Policy*, 27(2), 355–378. <https://doi.org/10.1068/c07116r>.
- Sesagiri Raamkumar, A., Tan, S. G., & Wee, H. L. (2020). Measuring the outreach efforts of public health authorities and the public response on Facebook during the COVID-19 pandemic in early 2020: Cross-country comparison. *Journal of Medical Internet Research*, 22(5), Article e19334. <https://doi.org/10.2196/19334>.
- Sharma, M., Yadav, K., Yadav, N., & Ferdinand, K. C. (2017). Zika virus pandemic—Analysis of Facebook as a social media health information platform. *American Journal of Infection Control*, 45(3), 301–302.
- Signorini, A., Segre, A. M., & Polgreen, P. M. (2011). The use of Twitter to track levels of disease activity and public concern in the US during the influenza A H1N1 pandemic. *PLoS One*, 6(5), Article e19467.
- Sjöberg, C. (2010). *Factors influencing transparency in public institutions. An analysis of Chilean municipalities*.
- Smid, M., Russo, S., Costa, A. C., Granell, C., & Pebesma, E. (2019). Ranking European capitals by exposure to heat waves and cold waves. *Urban Climate*, 27, 388–402. Retrieved from <http://www.sciencedirect.com/science/article/pii/S2212095518302700>.
- Sokadjo, Y. M., & Atchadé, M. N. (2020). The influence of passenger air traffic on the spread of COVID-19 in the world. *Transportation Research Interdisciplinary Perspectives*, 8, Article 100213. <https://doi.org/10.1016/j.trip.2020.100213>.
- Sol, D. A. D. (2013). The institutional, economic and social determinants of local government transparency. *Journal of Economic Policy Reform*, 16(1), 90–107. <https://doi.org/10.1080/17487870.2012.759422>.
- Sornette, D. (2002). Predictability of catastrophic events: Material rupture, earthquakes, turbulence, financial crashes, and human birth. *Proceedings of the National Academy of Sciences*, 99(Suppl. 1), 2522–2529.
- Stone, J. A., & Can, S. H. (2020). Linguistic analysis of municipal twitter feeds: Factors influencing frequency and engagement. *Government Information Quarterly*, 101468.
- Tai, D. B. G., Shah, A., Doubeni, C. A., Sia, I. G., & Wieland, M. L. (2020). The disproportionate impact of COVID-19 on racial and ethnic minorities in the United States. *Clinical Infectious Diseases*. <https://doi.org/10.1093/cid/ciaa815>.
- Tang, Z., Zhang, L., Xu, F., & Vo, H. (2015). Examining the role of social media in California's drought risk management in 2014. *Natural Hazards*, 79(1), 171–193. <https://doi.org/10.1007/s11069-015-1835-2>.
- Tat-Kei Ho, A. (2002). Reinventing local governments and the e-government initiative. *Public Administration Review*, 62(4), 434–444.
- Tavares, A. F., & da Cruz, N. F. (2020). Explaining the transparency of local government websites through a political market framework. *Government Information Quarterly*, 37(3), Article 101249. <https://doi.org/10.1016/j.giq.2017.08.005>.
- Taylor, M., Wells, G., Howell, G., & Raphael, B. (2012). The role of social media as psychological first aid as a support to community resilience building. *Australian Journal of Emergency Management*, 27(1), 20.
- Thelwall, M., & Thelwall, S. (2020). Retweeting for COVID-19: Consensus building, information sharing, dissent, and lockdown life. (2020). arXiv preprint arXiv:2004.02793.
- Tobias, E. (2011). Using Twitter and other social media platforms to provide situational awareness during an incident. *Journal of Business Continuity & Emergency Planning*, 5(3), 208–223.
- Tokakis, V., Polychroniou, P., & Boustras, G. (2019). Crisis management in public administration: The three phases model for safety incidents. *Safety Science*, 113, 37–43.
- Tolbert, C. J., Mossberger, K., & McNeal, R. (2008). Institutions, policy innovation, and E-government in the American States. *Public Administration Review*, 68(3), 549–563.
- Tsao, S.-F., Chen, H., Tisseverasinghe, T., Yang, Y., Li, L., & Butt, Z. A. (2021). What social media told us in the time of COVID-19: A scoping review. *The Lancet Digital Health*, 3(3), e175–e194. [https://doi.org/10.1016/S2589-7500\(20\)30315-0](https://doi.org/10.1016/S2589-7500(20)30315-0).
- Tsouros, A. (2013). City leadership for health and well-being: Back to the future. *Journal of Urban Health*, 90(1), 4–13.
- Tunçgenç, B., El Zein, M., Sulik, J., Newson, M., Zhao, Y., Dezecache, G., & Derooy, O. (2021). Social influence matters: We follow pandemic guidelines most when our close circle does. *British Journal of Psychology*, 112(3), 763–780. <https://doi.org/10.1111/bjop.12491>.
- Twizeyimana, J. D., & Andersson, A. (2019). The public value of E-government – A literature review. *Government Information Quarterly*, 36(2), 167–178. <https://doi.org/10.1016/j.giq.2019.01.001>.
- Van der Meer, A., & Van Winden, W. (2003). E-governance in cities: A comparison of urban information and communication technology policies. *Regional Studies*, 37(4), 407–419.
- Veljković, N., Bogdanović-Dinić, S., & Stoimenov, L. (2014). Benchmarking open government: An open data perspective. *Government Information Quarterly*, 31(2), 278–290. <https://doi.org/10.1016/j.giq.2013.10.011>.
- Warren, A. M., Sulaiman, A., & Jaafar, N. I. (2014). Social media effects on fostering online civic engagement and building citizen trust and trust in institutions. *Government Information Quarterly*, 31(2), 291–301.
- WAS, & Hootsuite. (2021). Digital 2021 global overview report. Retrieved from <https://datareportal.com/reports/digital-2021-global-overview-report>.
- White, C. M. (2011). *Social media, crisis communication, and emergency management: Leveraging Web 2.0 technologies*. CRC Press.
- WHO. (2012). *Addressing the social determinants of health: The urban dimension and the role of local government*. World Health Organization. Regional Office for Europe.
- WHO. (2020). *Strengthening preparedness for COVID-19 in cities and urban settings: Interim guidance for local authorities* (Retrieved from).
- Wilbur, M., Ayman, A., Ouyang, A., Poon, V., Kabir, R., Vadali, A., ... Dubey, A.. Impact of COVID-19 on public transit accessibility and ridership. (2020). arXiv preprint arXiv:2008.02413.
- Wukich, C. (2015). Social media use in emergency management. *Journal of Emergency Management*, 13(4), 281–294.
- Yang, K., & Callahan, K. (2007). Citizen involvement efforts and bureaucratic responsiveness: Participatory values, stakeholder pressures, and administrative practicality. *Public Administration Review*, 67(2), 249–264.

- Yavuz, N., & Welch, E. W. (2014). Factors affecting openness of local government websites: Examining the differences across planning, finance and police departments. *Government Information Quarterly*, 31(4), 574–583.
- Zavattaro, S. M., & Sementelli, A. J. (2014). A critical examination of social media adoption in government: Introducing omnipresence. *Government Information Quarterly*, 31(2), 257–264. <https://doi.org/10.1016/j.giq.2013.10.007>.
- Zhang, J. (2021). People's responses to the COVID-19 pandemic during its early stages and factors affecting those responses. *Humanities and Social Sciences Communications*, 8(1), 37. <https://doi.org/10.1057/s41599-021-00720-1>.
- Zheng, L., & Zheng, T. (2014). Innovation through social media in the public sector: Information and interactions. *Government Information Quarterly*, 31, S106–S117.
- Zimmerman, J. L. (1977). The municipal accounting maze: An analysis of political incentives. *Journal of Accounting Research*, 107–144.

Miguel Padeiro holds a PhD in Spatial Planning from the University of Paris-East, France. He is currently Assistant Professor at the University of Coimbra, and member of the Centre of Studies in Geography and Spatial Planning (CEGOT). His main fields of research include

ageing, urban planning, and local policies directed to residents' health and well-being. He currently coordinates the Gramcity project dedicated to the mobility of older adults in four Portuguese urban areas.

Beatriz Bueno-Larraz holds a PhD in mathematics from the Autonomous University of Madrid (UAM). Her research is mainly focused on developing statistical techniques and algorithms specially designed for time-dependent data. She currently works as senior Data Scientist for a private company, while being part of the statistics research group of the mathematics department of UAM.

Ângela Freitas is currently a Doctoral Research Fellow in Human Geography at the University of Coimbra and member of the Centre of Studies in Geography and Spatial Planning (CEGOT). Her dissertation explores the impact of urban policies on health equity and the role that local government can play in promoting population health. Her research interests lie on the relationship between local environment and health, urban planning, policy health impact assessment and participatory research.