Effects of local government social media use on citizen compliance during a crisis: Evidence from the COVID-19 crisis in China

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Abstract
Improving citizen compliance is a major goal of public administration, especially during crises. Although social media are widely used by government agencies across the globe, it is still unclear that whether the use of social media can help local governments improve citizen compliance especially during crises. Based on an original daily panel dataset of 189 cities in China during COVID-19, this study provides empirical evidence for the positive effect that crisis-related social media posts published by local government agencies has on citizen compliance. In addition, this effect is mediated by the topic of prevention measures in social media posts, and is stronger in cities with higher GDP per capita, better educated citizens and wider internet coverage. The findings imply that social media is an efficient and low-cost tool to assist local government agencies to achieve public administration objectives during crises, and its efficacy is largely dependent on regional socioeconomic status.

Chinese abstract
提高公民遵从性是公共行政的一个主要目标，并且危机时期显得更为重要。尽管社交媒体已经在全球范围内被政府机构广泛使用，但仍不清楚社交媒体的使用是否能帮助地方政府提高公民遵从性，特别是在危机时期的遵从性。基于新冠疫情期间中国189个城市的日级面板数据集，本研究为地方政府机构发布的危机相关社交媒体帖子对公民遵从性的积极影响提供了实证证据。我们还发现这种效应受到社交媒体帖子中关于预防措施的话题的调节，并且在人均国内生产总值较高、公民受教育程度较高和互联网覆盖范围
Since early 2020, government agencies all over the world have enacted or recommended stay-at-home and social distancing measures to contain the spread of the COVID-19, a global pandemic recognized by the World Health Organization. However, citizen compliance with government mandates has varied significantly across the globe (Bargain & Aminjonov, 2020). Some recent studies have found several factors that influence individuals' compliance behavior during the COVID-19 pandemic, including media viewership (Simonov et al., 2020), possession of scientific knowledge (Algara et al., 2021), party identification (Grossman et al., 2020), elites’ cues (Green et al., 2020), and trust in government (Bargain & Aminjonov, 2020). However, research from the perspective of local public administration is still rare. Specifically, the effect of local government’s use of information and communication technology, such as social media, on citizen compliance behavior during a crisis, has not been empirically investigated.

Social media plays an essential part in people's daily life, and government agencies also find it an effective tool for public administration (Jungblut & Jungblut, 2021; Kavanaugh et al., 2012; Mergel, 2013). Yet few prior research has touched upon the relationship between government use of social media and citizens' compliance of government mandates and no consensus has been reached. One line of research emphasizes that features of social media can enhance the performance of local government by promoting openness, transparency, and collaboration (Bertot et al., 2010; Stamati et al., 2015). Therefore, one might speculate that during the crisis when there are overloaded information online, governments’ posts on social media can promote information openness and transparency, hence increase citizen trust in government and encourage compliance behaviors (Im et al., 2014). Another line of research holds a more prudent view, arguing that the effect varies by different contents of the messages and different organizational and demographic characteristics of local municipalities (Bonsón et al., 2015, 2017). However, little research on the effect of governments’ use of social media on citizen behavior considers the specificity of the crisis context.

The most relevant research is from Chen et al. (2020). Using the social media post data from a national health authority, they have found that information related to the latest news and the governments’ handling measures, as well as the dialogic loop between government and citizens, can positively predict citizen online engagement. Our study further expands the investigation of online citizen engagement during crises to offline citizen compliance, providing more profound implications for policymakers in charge of crises management.

COVID-19 pandemic in China provides a new and historically unparalleled context to empirically examine the effect. Starting from late January 2020, the spread of COVID-19 has become a national health crisis in China. Government agencies at different levels adopted stringent policies and administrative measures to contain its spread (Kraemer et al., 2020; Tian et al., 2020) and have been using social media to disseminate the latest epidemic statistics and prevention policies to citizens (Chen et al., 2020). Specifically, social distancing was required or at least advocated by all local governments. In addition, the inner-city mobility index derived from location-based services (Kraemer et al., 2020; Tian et al., 2020) provides aggregate level mobility data that can be used as a reverse proxy for citizen’s compliance with governments’ mobility-restrictive policies during the pandemic. Based on these data sources, the main objective of this study is to investigate the relationship between government use of social media and citizen compliance during crises. Specifically, this study investigates three questions: (a) Does local governments’ social media use influences citizen compliance during crises? (b) How does different content in governments' social media posts influence citizen compliance during crises?
and (c) Does the relationship between government use of social media and citizen compliance differ by local socio-economic features?

Our research contributes both empirically and theoretically to the understanding of the effect of government use of social media on citizen compliance by examining the relation in the setting of crises. Based on a daily panel dataset of government social media posts, epidemic statistics, meteorological conditions, lock down policies and inner-city human mobility from 189 cities in China, we first adopt a two-way fixed effects model and an instrumental variable strategy to identify a positive causal effect of government use of social media on citizen compliance behavior during the COVID-19 pandemic. We then turn to a mediation analysis that identifies the mediation role of the content of these posts. We finally complement the analysis by examining the effect heterogeneity across cities using a moderation analysis, which finds that this effect is stronger in cities with higher GDP per capita, better-educated citizens, and wider internet coverage. These findings make an important contribution to existing academic debates on how government social media use influences citizen behavior, especially compliance behaviors during a crisis.

2 | THEORY AND HYPOTHESES

2.1 | Citizen compliance and contributing factors

Citizen compliance is one of the most important factors in evaluating the efficacy of policy implementation (Pressman & Wildavsky, 1984). Mastrofski et al. (1996) define citizen compliance as “conforming behavior to a standard of conduct that is set by normative or political means.” Braithwaite and Makkai (1994) classify the concept of citizen compliance into two categories, including self-interestedness and citizenship. Self-interestedness is based on the theory of rational choice and argues that individuals will only respond to policies or rules when there is an incentive to maximize personal benefits and minimize personal losses (Braithwaite & Makkai, 1994). In response to self-interested compliance, a competing or complementary explanation is the concept of citizenship, which emphasizes that citizens’ attitudes, reputations, moral obligations, and civic responsibilities can also lead to compliance behavior (Wenzel, 2002). In this perspective, citizens regard policies and rules as an obligation of citizenship to be fulfilled, despite it might contradict their own interests (Braithwaite & Makkai, 1994). Hence, citizens are willing to maintain their responsibility to the society if they believe that the society is developing in the right direction (Scholz, 1998).

Further research has investigated key factors that give rise to citizen compliance, and these factors can be broadly classified into three categories (Braithwaite & Makkai, 1994; McCluskey et al., 1999). The first category includes citizens’ demographic and attitudinal features, which influence the perceived efficacy of government policies. Individual-level factors like gender, education, income (Im et al., 2014), trust in government (Braithwaite & Makkai, 1994; Lee, 2003), risk perceptions (Allcott et al., 2020), and level of scientific knowledge (Algara et al., 2021) affect individuals’ compliance with government policies. Aggregate-level socio-economic features such as regional economic condition, education level, and the infrastructure of network facilities can also explain citizen compliance of those who live in the region (Bali, 2003; Chiou & Tucker, 2020).

The second category emphasizes the importance of government as the actor who launches policies and takes monitoring and enforcement measures to promote citizen compliance. Governments proactively encourage citizen compliance through incentives and sanctions, allocation of resources, and provision of information (Weaver, 2014). In addition, governments’ political characteristics, such as legitimacy (McMann, 2016), ideology (Sedgwick et al., 2021), and incumbent partisanship (Grossman et al., 2020), can also explain compliance.

The third category focuses on the role of media, ranging from print media to social media, which are used by government agencies to publish policies and communicate with citizens (Porumbescu et al., 2017). Research has shown that a more fluent and adequate presentation of policy can foster greater voluntary compliance through a better communicating of benefits and costs of government policies (Porumbescu et al., 2017). Specifically, policy accessibility, fluency of policy information, and policy domain can affect citizen compliance (Porumbescu
et al., 2017). Some research has also provided microlevel evidence for the effect of government use of internet technology on citizen compliance (Im et al., 2014).

Among these perspectives, there is a growing body of literature that focuses on factors that influence citizen compliance during crises (Algara et al., 2021; Sedgwick et al., 2021). A crisis often creates a complex situation, where government responses cannot be managed in a linear, step-by-step, and holistic way from a single center (Boin & Hart, 2007). As citizen compliance is one of the key axes in evaluating the effectiveness of government response to crises (Cairney & Wellstead, 2021), a better understanding of its contributing factor is important. Specifically, the global COVID-19 pandemic has encouraged scholars to conduct relevant studies. Algara et al. (2021) investigate the relationship between individual demographic characteristics and compliance during the pandemic. Sedgwick et al. (2021) compare citizen compliance behaviors in countries with different political systems during the pandemic. Barrios et al. (2021) identify the impact of civic capital on citizen compliance with stay-at-home orders during the pandemic. Surprisingly, although many studies have found that social media were widely used by government agencies during the COVID-19 crisis (Chen et al., 2020; Huang et al., 2020), few of them shed light on identifying the impact of government use of social media on citizen compliance during crises. This gap in the literature inspires our research.

2.2 Government use of social media in crisis management

Nowadays governments around the world are increasingly using social media during crises for communication and management (Reuter & Kaufhold, 2018). Social media platforms provide government agencies with a channel to reach citizens immediately, inform citizens of the crisis conditions, contain the spread of false information, respond to stakeholder requests, monitor the situation, and help victims. Previous studies have reported many cases of government use of social media in different kinds of crises such as earthquakes (Zhang et al., 2020), floods (Villodre & Criado, 2020), nuclear disasters (Utz et al., 2013), water pollution (Yuan & Gascó, 2018), smog (Lin et al., 2016), and riots (Panagiotopoulos et al., 2014). These studies mainly focused on the timeliness (Spence et al., 2015; Wukich, 2016; Yuan & Gascó, 2018), the content (Chen et al., 2020; Wang et al., 2021), and the dissemination features (Kim & Hastak, 2018; Wukich et al., 2019) of government social media use during crises.

It is commonly recognized that social media has changed the relationship between the public and the government during crises (Hughes & Palen, 2012). Nonetheless, how government use of social media influences the public behavior during a crisis is complex. Wukich and Mergel (2015) argue that governments’ online messaging strategies can affect citizen engagement. Specifically, those messages delivered with more interactive tactics can increase citizen engagement. Based on observed social media data, Luo et al. (2021) find that information related to emotional support and social mobilization can promote citizens to share government social media posts during a crisis. Chen et al. (2020) argue that the information related to the latest news and the government’s handling measures positively affects citizen engagement online. Hong et al. (2018) find that government use of social media during crises increases the public awareness of which government to communicate regarding certain issues. The complexity of crisis situation depicted in these studies is necessary to be taken into consideration when discussing the effect of government use of social media on citizen. However, all the research mentioned above focused exclusively on citizen online behaviors. The effect of government use of social media on citizen compliance offline during crises is still unclear.

Existing research on the relationship between government use of social media and citizen compliance does not focus on the specific context of crises. Some studies propose that with social media, government agencies can boost citizen compliance during the normal period by improving policy readability, citizen–government interactions, and the timeliness of government feedback (Mergel, 2013; Porumbescu et al., 2017). The first one functions through reaching citizens in a more rapid and vivid way, and enhancing policy information’s accessibility and readability (Porumbescu et al., 2017). The interaction theory suggests that by using social media, governments can invite citizens to co-create and share contents in different forms, inducing a sense of participation (Mazerolle et al., 2013). Finally, the feedback theory focuses on that social media platforms provide governments a tentative channel through
which governments can build a more harmonious relationship with citizens by becoming more responsive (Chatfield & Reddick, 2018; Panagiotopoulos et al., 2014; Schmidhuber et al., 2021). However, there are very few studies on investigating the effect of government use of social media on citizen compliance during crises. Therefore, it is crucial to put more emphasis on the crisis context, and empirically test the causal mechanism.

2.3 | Government use of social media and citizen compliance in crises

As indicated above, citizen compliance is primarily motivated by self-interestedness and citizenship (Braithwaite & Makkai, 1994). Both can be amplified through government use of social media, especially during crises. From the perspective of self-interestedness, citizens would only be willing to comply with regulations if they realize the benefit to do so (Porumbescu et al., 2017). By using social media, government agencies can transmit large amounts of information promptly at a low cost, making citizens always informed of the latest situation, potential risks, and knowledge relevant to the crisis (Reuter & Kaufhold, 2018). In this way, citizens are better informed to rationally evaluate the cost and benefits in complying with the policies or regulations. The motivation of citizenship highlights the compliance behavior as a result of citizens’ sense of identity. When crises happened, people are more likely to rely on the government to get information (Wang et al., 2012), but traditional forms of media environment is biased toward the authority as the government unilaterally produces the content (Woodly, 2008). Social media has reduced the power asymmetry between the government and citizens by allowing ordinary people to generate content freely and communicate with the authority directly (Hong, 2013). The rapid feedback from government social media, in turn, could provide citizen with a sense of participation. Indeed, previous studies provide abundant evidence that government use of social media during a crisis can promote citizens’ online engagement and coproduction (Chatfield & Reddick, 2018; Chen et al., 2020). This may make citizens believe that the situation is developing in the right direction (Scholz, 1998), and bolster further compliance (Bali, 2003). To sum up, it is reasonable to infer that government use of social media promotes citizen compliance behavior in crises. Therefore, we proposed Hypothesis 1.

Hypothesis 1. Local government social media posts about a crisis increase the level of citizen compliance during the crisis.

Existing research has already pointed out that topics in government social media posts can have different impacts on citizens’ online engagement behavior, as reflected in the number of likes, comments and shares (Chen et al., 2020; Luo et al., 2021). During a crisis, the most demanded information is the latest situation of the crisis and the information about the policies or measures that can guide the public (Chen et al., 2020; Xie et al., 2017). Both of the two topics can trigger citizen compliance offline through the above-mentioned motivations. First, the information of the newest crisis situation can stimulate citizens’ perception of risks, and the information of prevention measures or policies can make citizens more aware of potential punishment. Hence, they will be more likely to comply with government mandates due to self-interestedness. Second, both of the information of the newest crisis situation and detailed prevention measures or policies can improve citizens’ perception of government transparency, legitimacy and credibility (Grimmelikhuijsen & Meijer, 2015), strengthening the sense of citizenship and subsequently promoting compliance. Consequently, we propose the following hypotheses.

Hypothesis 2a. The effect of local government social media posts on citizen compliance is mediated by the topic of local crisis situations.

Hypothesis 2b. The effect of local government social media posts on citizen compliance is mediated by the topic of prevention measures or policies.
A final point here is that we should consider the audience of government social media posts and the process of how citizen compliance is achieved. Citizens should first read the post before their behaviors are influenced. Hence, factors influencing who can read the post could moderate the effect of our interest. In this sense, several local socio-economic features, including the internet coverage, education level, and income level can be important moderators, as they could influence whether citizens can go online and read the government social media posts (Manoharan, 2013). First, if the city has wider internet coverage, government social media posts can have larger potential audiences (Tolbert et al., 2008), and therefore should have a stronger effect in promoting citizen compliance behavior. Second, more educated people are more likely to have a better understanding of the meaning of government’s mandates, and consequently are more likely to be persuaded by government social media posts (Algara et al., 2021; Im et al., 2014; Miller, 1998), leading to a higher level of compliance. Third, richer cities usually have a better performance of government social media operation (Ma, 2014), which can have a deeper influence to their citizens. In addition, richer people tend to be more risk-averse, and hence will be more responsive to the government’s voice about crises (Sun et al., 2017). Hence, we propose the following hypotheses.

**Hypothesis 3a.** The effect of local government social media posts on citizen compliance is stronger in cities that are more penetrated by the internet.

**Hypothesis 3b.** The effect of local government social media posts on citizen compliance is stronger in cities that are more educated.

**Hypothesis 3c.** The effect of local government social media posts on citizen compliance is stronger in cities that are richer.

### 3 | DATA AND METHODS

#### 3.1 | Context

The rapid spread of COVID-19 causes a global health crisis. The first infection case was reported in Wuhan, China in December 2019, and quickly spread throughout China and then the whole world (Tian et al., 2020). On January 1, 2020, the National Health Commission of China set up a leading group to respond to the epidemic. By the end of February 2020, the National Health Commission of China has reported 79,824 confirmed cases and 2870 deaths of COVID-19 infection in the 31 province-level administrative districts of mainland China (China National Health Commission, 2020). Chinese government agencies at different levels started to respond to the spread of COVID-19 in late January. The containment policies at the national level and province level were mainly instructive, whereas detailed non-pharmaceutical regulations were mainly enacted by municipal governments. These regulations involve three types of measures, including (a) prohibition of unnecessary commercial activities; (b) prohibition of gathering; and (c) traffic restrictions of both private cars and public transportation (He et al., 2020).

On January 23, 2020, Wuhan, the capital of the Hubei Province and the earliest epicenter of the COVID-19 disease, was strictly locked down based on the three measures above. Within hours of the Wuhan lockdown, similar regulations were also implemented in nearby cities and were eventually implemented in all cities in Hubei. Starting from early February 2020, cities outside Hubei also adopted one or several of the above measures. In most cases, the containment measures were mainly implemented by residential committees or village committees at the community level (Wei et al., 2021). During the strongest moments of the lockdowns, police officers were endowed with discretionary power to assess the citizens’ compliance behaviors. Anecdotal evidence showed that non-compliant actors were dissuaded, warned, or even arrested by the police officers according to the severity of their activities (JingChu Web, 2020).
Meanwhile, the social media accounts of local government agencies in China also became active to inform the public of the local epidemic situation and prevention policies. These crisis management efforts including social media usage were important in containing the spread of the COVID-19 disease (Chen et al., 2020; Huang et al., 2020). Since March 2020, the COVID-19 disease in China has been gradually contained. Hence, we set our study period from January 1 to March 15, 2020.

3.2 | Data collection

We collected data from multiple sources. First, data of local governments' social media posts were collected from Weibo, the largest social media platforms in China with over 550 million monthly active users (Weibo Corporation, 2020). Numerous government agencies in China use Weibo to communicate with the public (Ma, 2014). According to the statistics of China Internet Network Information Center (2019), as of June 2019, there were 139,270 certificated government accounts on Weibo. We manually searched the official account of all the 334 prefecture-level city governments and included in our sample of those that are: (a) certified as a government organization by Weibo; (b) owned by the city's Publicity Department of Party Committee or Government Press Office; and (c) named in a unified format as “XX Release” (XX is the city).

Based on the three criteria, we found official accounts of 199 prefecture-level cities on Weibo. We then removed the 10 cities in Hubei Province from the sample for the following reason. The first COVID-19 case was reported in Wuhan, the capital of Hubei province, and soon the central government dispatched a vice premier to the

FIGURE 1 Distribution of cities in our sample
province to deal with the epidemic. In addition, by March 15, 2020, 84% of the cases in China were reported from Hubei Province. This may lead to different patterns of government behaviors and citizen compliance in cities of Hubei Province from the rest. Therefore, our final sample includes 189 prefecture-level cities, as shown in Figure 1. These 189 cities in our sample had a total population of 843 million people (60% of mainland China) and a collective GDP of 62 trillion Chinese Yuan (62% of mainland China) by the end of 2019. Hence, the GDP per capita in our sample is very close to the national average level of China. In addition, our sample includes 22 capitals of the 24 provincial-level administrative regions, and the rest are general prefecture-level cities, ensuring the diversity of our sample. The official Weibo accounts of these 189 cities had 102.80 million followers in total. As a result, we think that the sample has a relatively strong representativeness of Chinese cities as a whole.

We crawled all the posts published by the 189 official accounts on Weibo during the period from January 1, 2020, to March 15, 2020. Based on Hu et al. (2020), we built a word list to identify whether a post was related to the COVID-19 disease. Details of the 133 words in the list are presented in the Table S1. A post containing any of the keywords in Table S1 is considered a COVID-19 related post. Figure 2 shows the trends of Weibo posts published by the 189 official accounts during the study period. Starting from late January, the numbers of all posts, original posts, and original COVID-19 related posts have significantly increased, indicating that the spread of the COVID-19 disease significantly stimulated government use of social media. The proportion of original COVID-19 related posts in all original posts also increased dramatically after January 19, 2020, indicating that epidemic containment has become the major task for local government agencies in China.

To analyze the effect of different content topics in government social media posts, we use keyword matching to determine whether a post contains certain topics. We focus on two topics, crisis situation and prevention measures. For each of the two topics, we create a dummy variable to mark whether the post contains the topic. That is, if a post contains any of the keywords for the topic in Table 1 (corresponding Chinese words are given in Table S2). We set the value of the corresponding dummy variable for the post to be one, otherwise zero. Then, the government social media data are aggregated into a daily panel of 189 prefecture cities. We also collected the number of followings of cities’ social media accounts at the beginning of the study period as an instrumental variable.
Second, we collected the inner-city human mobility index from the Baidu Qianxi platform (https://qianxi.baidu.com/), which captures daily human movement within a city based on location-based services (Kraemer et al., 2020; Tian et al., 2020). The index is defined as the proportion of people who left their homes on a given day (Fisman et al., 2021). During the COVID-19 pandemic in China, due to the city lockdown and other social distancing policies, the inner-city human mobility data can reflect citizen compliance with policies or regulations at the city level. Inner-city mobility index is an aggregate indicator at the city level. However, citizen compliance can have aggregate as well as individual dimensions. Aggregate compliance can be regarded as the sum of all actions of compliance (or non-compliance) by individuals who might engage in relevant behavior (Weaver, 2014). In fact, aggregate compliance may be more important to policymakers than individual compliance, as public administration performance is usually measured at the regional level (Weaver, 2014). With regard to the specific context, the Chinese government adopted strict policies in the first wave of the pandemic (the study period of our research), and the goal of these policies was to make people minimize movement. However, during the time, including the Spring festival holidays in China, inner-city movement was necessary for the Chinese people due to the custom. Therefore, the decrease in mobility can represent the extent to which Chinese people comply with the policy. This mobility data has been widely used in recent empirical studies to measure citizen compliance during the COVID-19 pandemic (Barrios et al., 2021; Dincer & Gillanders, 2021; Painter & Qiu, 2020). The corresponding index of the same date in the latest Chinese lunar year was also collected for a placebo test. In addition, we also collected search indexes of two popular web mapping applications in China as alternative measures of citizens' outdoor activities from Baidui, the largest search engine in China.

Third, as the local epidemic situation can influence both the dependent variable (inner-city human mobility) and the independent variable (government social media posts), it should be controlled in our empirical setting. Starting from January 22, 2020, the central government of China required that local health commissions should release the epidemic statistics of the previous day on their official websites before 3:00 am every day. Therefore, we collected the official epidemic statistic data, including the number of new confirmed cases and cumulative confirmed cases each day at the prefecture city level from the official websites of cities' health commissions.

Fourth, as weather conditions could influence citizen out-door activities (Nalau et al., 2017), we collected meteorologic data, including air quality index (AQI), average temperature, wind speed and rainfall for the 189 cities at the daily level from Weather.com.cn as control variables.

Finally, as lockdown policies across cities could influence citizen our-door activities, we referred to the data of city lockdown policies from He et al. (2020) and added a control variable indicating whether a city was under a full lockdown at each day in our analysis. A full lockdown means a city government was enforcing the three measures, including (a) prohibition of unnecessary commercial activities; (b) prohibition of gathering; and (c) traffic restrictions on both private cars and public transportation (He et al., 2020).

Based on the collected data, we established a city-day panel dataset of government social media posts, inner-city mobility index, daily epidemic statistics, meteorologic data and lockdown policies of the 189 cities from January 1, 2020, to March 15, 2020. We merged the data of city features, including gross domestic product per capita (2019), internet coverage rate (2019), and average education year (2020), into the panel data for heterogeneity analysis. Table 2 shows the definitions and descriptive statistics of all variables used in this study.
3.3 Model specifications

A two-way fixed effects model, as shown in Equation (1), is used to assess the effect of local government social media posts about the COVID-19 on the inner-city mobility index, which is a reverse proxy of citizen compliance behavior.

\[
\text{Move}_{it} = \beta_1 \times \text{GSMP}_{it-1} + \beta_2 \times \text{Totalcases}_{it} + \beta_3 \times \text{Dailycases}_{it} + \theta \times \mathbf{X}_{it} + \mu_i + \lambda_t + \epsilon_{it}
\]  

(1)

In Equation (1), \(\text{Move}_{it}\) means the inner-city mobility index of city \(i\) on day \(t\), and \(\text{GSMP}_{it-1}\) means the number of original social media posts related to the COVID-19 published by the official social media account of the city \(i\) on day \(t - 1\) (1-day lag design to avoid reverse causality). \(\text{Totalcases}_{it}\) and \(\text{Dailycases}_{it}\) indicate the number of cumulative confirmed cases and the number of daily new confirmed cases of the city \(i\) on day \(t\) released by the city's health commission, respectively. \(\mathbf{X}_{it}\) is the vector of control variables, including Air quality index (AQI), Temperature (Temp), Indicator for rain (Israin), Wind speed (Wind), and Lock down policy (LockDown). \(\mu_i\) and \(\lambda_t\) are the vectors of city and date dummy variables that account for city and date fixed effects, and \(\epsilon_{it}\) is the error term. The coefficient, \(\beta_1\), captures the effect of government social media posts on citizen compliance behavior. Hence, if \(\beta_1\) is significantly negative, Hypothesis 1 is
supported. Then, by adding the terms of Situation and Prevention into Equation (1), we can test Hypotheses 2a and 2b. Finally, by adding the interaction term of each city feature with GSMP into Equation (1), we can test Hypotheses 3a–3c.

4 | RESULTS

4.1 | Effect of GSMP on citizen compliance behavior

Table 3 presents the estimated effect of local government social media posts about the COVID-19 on citizens’ compliance behavior. Model 1 presents the result of regressing $Move_{t}$ on $GSMP_{t-1}$, plus city and date fixed effects. Models 2–4 further control for weather conditions, local epidemic statistics and lockdown policies. As shown in Model 1, the estimated coefficient of $GSMP_{t-1}$ is significantly negative ($-0.0064$, $p < 0.01$). When control variables enter, the coefficients of $GSMP_{t-1}$ remain consistent as shown in Models 2–4. The values of the coefficient indicate that if the local government agency publishes one post about the COVID-19 on the prior day, the inner-city mobility index will significantly decrease by $0.0056$–$0.0064$ on the current day. Hence, Hypothesis 1 is supported. Then, we use alternative measures to proxy citizen compliance behavior as robustness checks. The results are shown in Table 4. Model 1 and Model 2 use the search indexes of “Baidumap” and “Gaodemap” (in logarithm form) to measure the intensity of citizen out-door activities, and the estimated coefficients of $GSMP_{t-1}$ are still negative and statistically significant ($-0.0022$, $p < 0.01$; $-0.0017$, $p < 0.05$). This suggests that our results are reliable and robust. In addition, a placebo test is reported in Model 3, where we change the dependent variable to the inner-city mobility index of the same date in the last Chinese lunar year. The coefficient of $GSMP_{t-1}$ is insignificant, further suggesting that the effect is valid.

4.2 | Instrumental variable estimation

Our fixed-effects models and rich control variables have controlled for many potential confounders and the lagged independent variable has addressed the issue of reverse causality. However, omitted variables such as the variance

| TABLE 3 Effect of government social media posts on citizen compliance behavior |
|-----------------------------------------------|---------------------|---------------------|---------------------|---------------------|
|                                | Model 1 $Move_{t}$  | Model 2 $Move_{t}$  | Model 3 $Move_{t}$  | Model 4 $Move_{t}$  |
|-----------------------------------------------|---------------------|---------------------|---------------------|---------------------|
| $GSMP_{t-1}$                           | $-0.0064^{**} (0.0022)$ | $-0.0063^{**} (0.0020)$ | $-0.0056^{**} (0.0018)$ | $-0.0057^{**} (0.0018)$ |
| $AQL_{t}$                           | $0.0021^{***} (0.0003)$ | $0.0021^{***} (0.0003)$ | $0.0021^{***} (0.0003)$ |
| $Temp_{t}$                           | $-0.0696^{***} (0.0136)$ | $-0.0681^{***} (0.0133)$ | $-0.0679^{***} (0.0133)$ |
| $Israin_{t}$                          | $-0.0230^{**} (0.0085)$ | $-0.0254^{**} (0.0083)$ | $-0.0245^{**} (0.0082)$ |
| $Wind_{t}$                           | $-0.0025 (0.0047)$ | $-0.0035 (0.0046)$ | $-0.0035 (0.0046)$ |
| $Totalcases_{t}$                      | $-0.0013^{*} (0.0006)$ | $-0.0012 (0.0006)$ |
| $Dailycases_{t}$                      | $-0.0209^{*} (0.0097)$ | $-0.0210^{*} (0.0097)$ |
| $LockDown_{t}$                        | $-0.0650 (0.0621)$ |

City FE: Yes, Date FE: Yes, Observations: 13,986, Number of cities: 189, $R^2$: 0.859

Note: Robust standard errors in parentheses are clustered by cities; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$. 
in other forms of government communications may still lead to bias in our estimation. To address this issue, we use the instrumental variable (IV) method to alleviate potential endogeneity problems. We use the interaction term of the number of followings (rather than followers) of a city’s social media account at the beginning of the study period and a dummy indicating whether the date is after Wuhan lockdown as the instrumental variable. The number of followings of a government social media account is positively related to the number of posts it publishes, as the account manager can see more posts if the account follows more other accounts. In addition, the number of followings of a government social media account at the beginning of the study period is exogenously given, as it mainly depends on the manager’s preference and is not directly related to citizen compliance. Table 5 shows that the number of followings of a city’s social media account is not correlated with the city’s economic level, internet coverage and education level. As the endogenous variable, GSMP, is time-variant, we interact the number of followings of a government social media account with the dummy indicating whether the date is after Wuhan lockdown as the instrumental variable. That is, after Wuhan lockdown the account following more users would see more posts about the COVID-19 and subsequently publish more posts about the COVID-19.

### TABLE 4  Robustness checks with alternative measures and a placebo test

| Model 1          | Model 2          | Model 3          |
|------------------|------------------|------------------|
| Baidumapi<sub>t</sub> | Gaodemap<sub>t</sub> | Move2019<sub>t</sub> |
| GSMP<sub>t-1</sub>      | −0.0022** (0.0008) | −0.0017* (0.0008) | −0.0019 (0.0013) |
| AQI<sub>t</sub>           | 0.0001 (0.0001)   | 0.0001 (0.0001)   |
| Temp<sub>t</sub>           | −0.0043 (0.0043)  | 0.0090* (0.0041)  |
| Israin<sub>t</sub>         | −0.0038 (0.0023)  | −0.0012 (0.0032)  |
| Wind<sub>t</sub>           | 0.0023* (0.0011)  | 0.0017 (0.0011)   |
| Totalcases<sub>t</sub>     | −0.0004* (0.0002) | −0.0003* (0.0001) |
| Dailycases<sub>t</sub>     | −0.0087 (0.0058)  | −0.0089 (0.0053)  |
| LockDown<sub>t</sub>       | −0.0427** (0.0149) | −0.0512*** (0.0137) |
| City FE          | Yes              | Yes              | Yes              |
| Date FE          | Yes              | Yes              | Yes              |
| Observations    | 13,986           | 13,986           | 13,986           |
| Number of cities | 189              | 189              | 189              |
| R²              | 0.954            | 0.900            | 0.516            |

Note: Robust standard errors in parentheses are clustered by cities; *p < 0.05; **p < 0.01; ***p < 0.001.

### TABLE 5  Correlation between the number of followings of a city’s social media account and other city features

| Model 1          | Model 2          | Model 3          | Model 4          |
|------------------|------------------|------------------|------------------|
| Followings<sub>i</sub>       | Followings<sub>i</sub>       | Followings<sub>i</sub>       | Followings<sub>i</sub>       |
| GDPP<sub>i</sub>              | 0.0392 (0.0330)   | −0.0028 (0.0450)  |
| WEB<sub>i</sub>                 | 0.8833 (0.5693)   | 0.4636 (0.6034)   |
| EDU<sub>i</sub>                | 0.2132 (0.1304)   | 0.1502 (0.1329)   |
| Province dummies | Yes              | Yes              | Yes              |
| Observations    | 189              | 189              | 189              |
| R²              | 0.146            | 0.150            | 0.153            | 0.155            |

Note: Robust standard errors in parentheses are clustered by provinces; *p < 0.05; **p < 0.01; ***p < 0.001.
Table 6 presents the results estimated from IV strategy. In all models, the first-stage IV estimates are positive and significant at a 0.1% level, indicating that the relationship between the instrumental variable and the endogenous variable is consistent with our expectation. The \( F \)-statistic is large than 10, suggesting that our instrumental variable is not a weak instrument. The instrumented results have the same direction as the OLS estimates and are statistically significant (\( p < 0.05 \)). As shown in Model 1, the unbiased effect of \( GSMP_{it-1} \) on \( Move_{it} \) is significantly negative (\( -0.0359, p < 0.05 \)). This effect remains consistent when control variables enter, as shown in Models 2–4 of Table 6. The coefficient estimated from IV is about six times of that estimated from OLS.

### 4.3 Effects of different topics

Next, we examine how local government social media posts influence citizen compliance behavior through different topics, including local crisis situation (\( Situation_{it-1} \)) and prevention measures and policies (\( Prevention_{it-1} \)). We use a simple mediation analysis based on the paradigm proposed by Baron and Kenny (1986) to examine the mechanism. The results are shown in Table 7. Model 1 and Model 2 present the results of regressing \( Situation_{it-1} \) and \( Prevention_{it-1} \) respectively on \( GSMP_{it-1} \), plus control variables and fixed effects. The estimated coefficients of \( GSMP_{it-1} \) indicate that \( GSMP_{it-1} \) is significantly and positively correlated with \( Situation_{it-1} \) and \( Prevention_{it-1} \) (0.2417, \( p < 0.001 \); 0.2808, \( p < 0.001 \)). Then, Models 3 and 4 present the results of regressing \( Move_{it} \) on \( GSMP_{it-1} \), control variables, and fixed effects, adding \( Situation_{it-1} \) and \( Prevention_{it-1} \) as an independent variable, respectively. The estimated coefficients of \( GSMP_{it} \) in Models 3 and 4 are insignificant compared with the baseline model in Table 3, indicating...
that the entrance of \( \text{Situation}_{i,t-1} \) or \( \text{Prevention}_{i,t-1} \) reduce the influence of \( \text{GSMP}_{i,t-1} \) on \( \text{Move}_{i,t} \). The coefficient of \( \text{Situation}_{i,t-1} \) in Model 3 is negative and insignificant (\(-0.0101, p = 0.186\)), while that of \( \text{Prevention}_{i,t-1} \) in Model 4 is significantly negative (\(-0.0185, p < 0.001\)). This suggests that \( \text{Situation}_{i,t-1} \) does not mediate the effect of \( \text{GSMP}_{i,t-1} \) on \( \text{Move}_{i,t} \), but \( \text{Prevention}_{i,t-1} \) does. As shown in Model 5, when we estimate the \( \text{Situation}_{i,t-1} \) and \( \text{Prevention}_{i,t-1} \) simultaneously, the coefficient of \( \text{Situation}_{i,t-1} \) is negative and insignificant (\(-0.0066, p = 0.295\)), while that of \( \text{Prevention}_{i,t-1} \) in Model 5 is significantly negative (\(-0.0171, p < 0.01\)). This result is similar to the result estimated separately, indicating that the effect of local government posts on citizen compliance acts through the topic of prevention measures. Hence, Hypothesis 2a is not supported, and Hypothesis 2b is supported.

4.4 | Heterogeneous effects

Finally, we examine the heterogeneous effects of government social media posts on citizen compliance behavior in cities with different features, including GDP per capita (\( \text{GDPP} \)), internet coverage rate (\( \text{WEB} \)), and average education
TABLE 8 Heterogeneous effects of government social media posts on citizen compliance behavior in cities with different features

|               | Model 1  | Model 2  | Model 3  | Model 4  |
|---------------|----------|----------|----------|----------|
|               | Move_{it} | Move_{it} | Move_{it} | Move_{it} |
| GSMP_{it-1}  | 0.0130** (0.0042) | 0.0135** (0.0043) | 0.0973*** (0.0202) | 0.0847*** (0.0202) |
| GSMP_{it-1} × GDPi | −0.0028*** (0.0006) |                     | −0.0017* (0.0008) |                     |
| GSMP_{it-1} × WEBi | −0.0588*** (0.0124) |                     |                     | 0.0075 (0.0197)    |
| GSMP_{it-1} × EDUi |                     | −0.0117*** (0.0023) | −0.0093*** (0.0027) |                     |
| AQLi          | 0.0021*** (0.0003) | 0.0021*** (0.0003) | 0.0020*** (0.0003) | 0.0020*** (0.0003) |
| Temp_{it}     | −0.0719*** (0.0132) | −0.0677*** (0.0134) | −0.0669*** (0.0128) | −0.0695*** (0.0128) |
| Israin_{it}   | −0.0235** (0.0084) | −0.0250** (0.0082) | −0.0219** (0.0081) | −0.0217** (0.0082) |
| Windi         | −0.0045 (0.0045) | −0.0052 (0.0045) | −0.0034 (0.0044) | −0.0038 (0.0044)   |
| Totalcases_{it}| −0.0006 (0.0007) | −0.0007 (0.0007) | −0.0008 (0.0006) | −0.0006 (0.0007)   |
| Dailycases_{it}| −0.0174* (0.0079) | −0.0181* (0.0082) | −0.0184* (0.0084) | −0.0172* (0.0078)  |
| LockDown_{it} | −0.0093 (0.0710) | −0.0277 (0.0687) | −0.0301 (0.0644) | −0.0091 (0.0690)   |
| City FE       | Yes      | Yes      | Yes      | Yes      |
| Date FE       | Yes      | Yes      | Yes      | Yes      |
| Observations  | 13,986   | 13,986   | 13,986   | 13,986   |
| Number of cities | 189     | 189     | 189     | 189     |
| R²            | 0.868    | 0.868    | 0.869    | 0.870    |

Note: Robust standard errors in parentheses are clustered by cities; *p < 0.05; **p < 0.01; ***p < 0.001.

years (EDU). The results are shown in Table 8. Models 1–3 present the results of regressing Move_{it} on GSMP_{it-1} and the interaction of GSMP_{it-1} with one of the three city features, respectively. The estimated coefficient of the three interaction terms are all negative and statistically significant (−0.0028, p < 0.001; −0.0588, p < 0.001; −0.0117, p < 0.001), indicating that government social media posts about COVID-19 have a stronger effect on citizen compliance behavior in cities with higher GDP per capita, better educated citizens and wider internet coverage. Hence, Hypotheses 3a–3c are supported. The marginal effects of GSMP_{it-1} at different levels of the moderators and their corresponding 95% confidence intervals are illustrated in Figure 3.

When we estimate the three interaction terms simultaneously as shown in Model 4, the coefficient of GSMP_{it-1} × GDPi is negative and significant (−0.0017, p < 0.05), the coefficient of GSMP_{it-1} × WEBi is insignificant (0.0075, p = 0.703), and the coefficient of GSMP_{it-1} × EDUi is negative and significant (−0.0093, p < 0.001). This indicates that the heterogeneous effects of government social media posts on citizen compliance behavior among different cities are mainly driven by the economic level and education level.

We conducted robustness checks by replacing the date fixed effects to province-date fixed effects. This setting may influence the compliance behavior of citizens in the province. As shown in Tables S3–S7, the estimated coefficients of the independent variables of interest are very similar to those in Tables 3, 4, 6, 7, and 8, indicating that our regression results are reliable. In addition, we provide additional mediation and moderation analyses based on instrumental variable strategy. The results are provided in Tables S8 and S9, where we first use our instrumental variable, Followings_{it} × After_Wuhan_lockdown_{it-1}, to predict the core independent variable, GSMP_{it-1}, and then use the predicted independent variable to conduct mediation analysis and moderation analysis. The results in Tables S8 and S9 are similar to those in Tables 7 and 8, further supporting the robustness of the results. We also run regressions for the sample of cities in the Hubei province. As shown in Table S10, the estimated coefficients of GSMP are insignificant in all models, indicating that the government social media posts have no effect on citizen
FIGURE 3  Marginal effects of GSMP (government social media posts about the COVID-19) on Move (inner-city mobility index) for different values of (a) GDPP (gross domestic product per capita), (b) WEB (internet penetration rate), and (c) EDU (average education years)
compliance in the Hubei province. This supports that our strategy of removing the observations from Hubei province is reasonable.

5 | DISCUSSION

The central question of this study is how social media use by local government agencies influences citizen compliance behavior in crises. Our study contributes to the existing literature by, first, focusing on the first stage of a crisis when timely communication and accurate information are crucial to the containment of damage. The first wave of COVID-19 in China, as an unpredictable crisis, has brought great uncertainty to the citizens and stimulated their demands for information, making government social media an important information source which can influence citizens’ behavior. We delineate how the number and the content of government social media posts as well as regional socioeconomic factors play out in affecting offline citizen compliance during the first stage of the pandemic. It is a short-term effect, but may have contributed significantly to the containment of the spread of the disease (Kraemer et al., 2020). Second, as a complement to previous microlevel research, our analysis of aggregate compliance based on observational data at the city level may provide more practical implications for policymakers, who may care less about a small fraction of non-compliant individuals but more about improving aggregate compliance (Weaver, 2014). Third, our study also contributes to the literature of government social media in crisis management by identifying the effect of government online actions on citizen offline behaviors. We demonstrate that government use of social media not only promotes citizen online engagement (Bonsón et al., 2015; Chen et al., 2020; Luo et al., 2021), but also has substantial influence on citizen offline compliance behavior in a crisis. In addition, such influence is mainly mediated by the content of policies and measures for the crisis.

The COVID-19 pandemic has provided a natural experiment for researchers to empirically investigate the causal effect of government use of social media on citizen compliance. After controlling for time-invariant city features, national time trends, local epidemic statistics, lockdown policies and weather conditions, our two-way fixed effects model, combining with an instrument variable strategy, identifies a positive effect of government use of social media on citizen compliance behavior (reversely measured by inner-city mobility index) during the COVID-19 crisis. According to our estimation, one government social media post will reduce inner-city mobility index by 0.0056–0.0064. This value (0.0060) is about 0.16% of the mean value of Move (3.808) or 0.43% of the standard deviation of Move (1.388). Though relatively small, the reduction in mobility is still considerable as it only represents the effect of a single post. On average, a city account published 7.72 posts about the COVID-19 every day. Therefore, the total average effect is about 1.22% of the mean value of Move or 3.34% of the standard deviation of Move for a day. In addition, according to the instrumental variable estimation, the unbiased effect (0.0345) is about six times of that estimated from OLS. That is 6.99% of the mean value of Move or 19.19% of the standard deviation of Move for a day. Given that the cost of publishing such posts is very low, our result suggests that social media can be an efficient tool for government agencies to promote citizen compliance during crises.

Regarding the mechanism of government use of social media on citizen compliance in a crisis, the content topics in the posts can be an important mediator. The mediation analysis shows that the topic of prevention measures rather than crisis situation mediates the effect of government use of social media on citizen compliance. Our result presents a different pattern of government-citizen interactions from Chen et al. (2020), who have reported that the information about the epidemic situation has the largest impact on promoting citizen online engagement during the COVID-19 disease. This difference implies that government use of social media may affect citizen online behavior and offline behavior through different mechanisms. In the online space, citizens are more interested in and more willing to engage in (vote, comment, or share) information about crises situations. Meanwhile, in the offline space, information related to government mandates are more influential to citizen behavior. This may also reflect the political context of our study, as China is an authoritarian country, government mandates have a stronger power to influence citizen behaviors (Norris, 2011), particularly during crises (Wang et al., 2012).
The effects of government use of social media on citizen compliance behavior in a crisis are heterogeneous across cities. The moderation analysis reveals that people living in cities that are richer, with better educated population or with wider internet coverage are more responsive to government social media posts about crises. Previous microlevel research has found the positive effect of education level on perceived legitimacy of the government (Grimmelikhuijsen & Meijer, 2015), and our results complement the existing research by emphasizing the role of regional economic status, internet coverage, as well as education level, which were rarely examined.

Due to different political institutions and cultures, both government responses and citizen reactions to COVID-19 emergency were quite different across countries. However, our research results based on the context of the first COVID-19 wave in China can have implications beyond China. First, although China's political institution is different from democracies, local government agencies in China use social media to communicate with citizens (Ma, 2014) as active as those in democracies (Bonsón et al., 2015). Correspondingly, during worst moments of the pandemic, some local governments in democracies including Italy, India, and Argentina also enacted lockdown policies like China (Hale et al., 2021). Given the resemblance of local governments' responses to the pandemic crisis around the world (van der Voet, 2021), it is reasonable to infer that the effect of government use of social media on citizen compliance can also exist in other countries with different political institutions. In future crisis management, public managers should attach more importance to government use of social media, carefully consider different topics in the posts, and allocate more offline resources to less developed regions.

More generally, our study speaks to the theory of hyperpluralism in the social media era (Tedesco, 2004), especially in the context of authoritarian regime. Social media has dismantled the authorities' monopoly of information. As a matter of fact, multiple actors were active on China's social media platforms and denounced the government during the COVID-19 crisis (Li et al., 2020; Tao, 2021). However, as an authoritarian government, the Chinese government still has the predominant power in information management, but uses the power in a more strategic way in the social media era (Lorentzen, 2014). Our study emphasizes that the role of social media as a communication tool. In addition to empowering the ordinary people, social media can also be leveraged by government agencies in authoritarian regimes to communicate with citizens (Medaglia & Zhu, 2017), attract their attentions (Lu & Pan, 2021), and effectively promote their compliance behaviors during crises. From a microlevel perspective, the positive effect of government use of social media on citizen compliance during crises can occur through many microlevel channels, including enhancing the perceived transparency and trustworthiness (Bertot et al., 2010; Stamati et al., 2015), and fostering a shared sense of direction and expectations and trust (Im et al., 2014). Due to the limitation of our data, these micro-level mechanisms are beyond the scope of this study and we hope to further examine these mechanisms in future work.

6 | CONCLUSIONS

Given that risk society and technological innovation are intrinsic traits of modernity in today's world (Beck et al., 1992), how government agencies leverage emerging technologies to promote performance in administration and crisis management deserves more detailed investigations. Based on an original daily panel data of 189 cities in China, this study provides empirical evidence that local government social media posts related to crises have a significantly positive effect on citizen compliance behavior. In addition, this effect is mediated by the content of prevention measures in the social media posts, and is stronger in cities that are richer, with better education population or with wider internet coverage. These results could deepen our understanding of the relationship between government use of social media and citizen behavior.

Improving citizen compliance is a major goal of public administration. We believe that our study results are beneficial to public administrators and managers. First, this study demonstrates that social media is an efficient and low-cost tool to assist local government agencies in increasing citizen compliance. Administrators and managers can therefore use social media widely so as to reduce information asymmetry in crises. Second, this study finds that the reactions of citizens toward
different themes of government social media posts vary, and the topic of prevention measures or policies is more likely to promote citizens’ compliance. Hence, public administrators and managers should focus more on clarifying and explaining policies, regulations, rewards, and punishments. Finally, this study shows that the effectiveness of government social media is largely dependent on regional socioeconomic status. Factors including internet coverage, educational level, economic condition will affect the result of the usage of government social media. This finding suggests that public administrators and managers should take such regional socioeconomic status into consideration before using social media to communicate with citizens. By doing this, they might be able to use this tool more wisely.

Our study has several limitations. First, the inner-mobility index, as a proxy variable for citizen compliance, is specifically proposed corresponding to the social distancing policy during the outbreak of the COVID-19. Consequently, the econometric results based on the inner-mobility index cannot be fully generalized to other crisis scenarios. With regard to different kinds of crises in the future, measurement of citizen compliance with other policies should be carefully designed according to the specific crisis context and policy background. A possible solution is to use cross-validation based on both objective data and subjective data. Second, our data of government social media posts are only derived from one platform, Weibo. Although Weibo is the major platform for government use of social media in China, some government agencies can be simultaneously active on multiple platforms, such as Tik Tok and WeChat. Future research can collect data from multiple sources and conduct a more comprehensive analysis. Finally, we should be very cautious to avoid over-generalizing the results to other contexts given the specificities of the Chinese context. China’s political institution and culture are different from that of western countries, leading to very different motivations in policymaking and implementation. In addition, the degree of citizens’ trust in government is relatively high in China compared with other countries (Norris, 2011), particularly during crises (Wang et al., 2012). Future research is needed to compare different countries to examine the mechanisms tested in our study.

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CONFLICT OF INTEREST
The authors declare no conflict of interest.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher’s website.

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