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**Full Research Paper**

# A Study on the Characteristics of the Publishers of Rumor-Refuting Information about COVID-19

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**Abstract:** The uncertainty of public health emergencies leads to the diffusion of rumors on social media, and the extensive forwarding of rumor-refuting information has become a way of rumor management. Determining the characteristics of rumor-refuting information publishers that are conducive to rumor information being forwarded has become a concern. This article crawls 3,035 rumor-refuting information data about the COVID-19 event. Based on social capital theory, from the perspective of rumor-refuting information publishers, the characteristic variables of social capital of publishers are selected from the three dimensions of structure, relationship, and cognition to construct the model of influencing factors of information-forwarding behavior of rumor-refuting information, and the negative binomial regression model is used for data analysis and robustness test. Results show that the number of followers, disclosure of geographical location information, gaining membership, and obtaining Weibo professional certification will increase the number of forwarding of the rumor-refuting information, and whether or not having a personal introduction will not significantly affect the forwarding of rumor-refuting information. At the same time, the number of Weibo and fans will reduce the retransmission of the rumor-refuting information. Research results of this paper can help the platform make targeted choices and encourage users to release rumor-refuting information, expand the scope of rumor-refuting information dissemination, and effectively achieve rumor governance.

Keywords: rumor management, COVID-19, social capital, negative binomial regression

## 1. INTRODUCTION

At the end of 2019, COVID-19 swept the world and posed a huge threat to the social economy because of its spread and destruction. At the same time, it brought panic to the people. Negative emotions and rumors caused depression, generated excessive stress reaction, and induced people to suffer from "emotional plague." These problems then lead to rumors and to a flood of negative emotions, thereby creating a vicious circle.

Social media has become a platform for promoting interaction between people and reflecting social values. It has also become a virtual place where people can share personal opinions, experiences, and insights. However, the unknown public health emergencies and the spread of panic often lead to rumors on social media platforms [1]. This confusing information has brought added pressure on the prevention and treatment of the already arduous public health emergencies; if the action to deal with rumors lags behind, it may have a profound impact on public order [2].

As the second major public health incident of pneumonia in China since the beginning of the 21st century, the COVID-19 incident has caused pronounced damage to the social economy and a huge threat to people's lives and safety. Uncertainty and panic have become the breeding ground for rumors, and social media has led to the rapid spread of rumors. Since the outbreak of the COVID-19 incident, the Baidu index of "rumors" has risen sharply. Rumors, such as that about drinking and taking Shuanghuanglian oral liquid which is believed to effectively prevent an individual from catching the virus, lead people to snap up goods and consequently increase the risk of infection. The spread of rumors on public health emergencies will not only cause panic but

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may even delay the timing of treatment among patients, consequently increasing the seriousness of the damage caused by the incident. In 2019 alone, the Weibo platform effectively handled 77,742 pieces of false information and 470 new rumor cases. Looking at the headlines at the peak of rumors, a number of rising rumors in 2017, 2018, and 2019 are found to be related to public health emergencies. Therefore, the management of online rumors has become a serious challenge to the management of public health emergencies in China.

The Letter of Commitment to Jointly Resist Online Rumors signed by the Cyberspace Administration of China mentions that we should take the initiative to identify, resolutely curb, effectively control, and work together to dispel rumors. As Lai <sup>[3]</sup> said, online rumors are akin to viruses in the network environment, and the online rumor governance system corresponds to the immune system of the network environment. Therefore, a good rumor refutation and rumor governance system is the key step to prevent the spread and even the emergence of rumors.

The most effective method of controlling rumors is to publish information to refute rumors <sup>[2]</sup>. In the face of this severe challenge, authoritative organizations and professionals actively publish information on social media to refute rumors, which are forwarded by the majority of netizens. However, the research on the forwarding behavior of rumor-refuting information remains rare. Although Wang <sup>[4]</sup> uses machine learning methods to identify users who may publish rumor-refuting information through user characteristics, the focus of this study lies on the characteristics and attributes of rumor-refuting users. In fact, the publishers of rumor-refuting information on social media have additional complex social attributes and social capital. Identifying which characteristic factors will affect the forwarding behavior of rumor-refuting information is worthy of in-depth exploration, which is conducive to the selection of social platforms and will encourage relevant users to improve the breadth of rumor-refuting information forwarding.

Existing studies believe that social capital is a major component of social media and has an important impact on the forwarding of information in the media <sup>[5]</sup>. Social media can affect users' perception, emotion, and behavior <sup>[6]</sup>. The sustainable development of social media is inseparable from the active participation and interaction of users, including search, browsing, retweeting, comments, attention, making friends, feedback, and other behaviors. The relationship network structure formed by these behaviors has a profound impact on user behavior. In social media network relationships, users obtain the attention of others and social capital through free knowledge sharing behavior, comment behavior, and like behavior, among others. Therefore, from the perspective of social capital and the characteristics of the publishers of rumor-refuting information, this study examines the factors affecting the amount of information forwarding. Specifically, based on social capital theory, starting from the characteristics of the publishers of rumor-refuting information and taking the COVID-19 event as an example, this research constructs a model of the factors affecting the forwarding of rumor-refuting information and examines the characteristics of rumor-refuting that affect the amount of forwarding. This study aims to obtain the data of refuting rumors from the Sina Weibo platform and conduct empirical research to provide some reference for the platform to expand the scope of the dissemination of rumors and effectively realize the governance of rumors.

## 2. LITERATURE REVIEW AND MODEL HYPOTHESIS

### 2.1 Literature review

Rumor is a kind of news that spreads among specific people; it is generally accepted and different from facts, and has the characteristics of sudden, rapid spread, and wide radiation <sup>[7]</sup>. The destructive and unknown characteristics of public health emergencies accelerate the growth of rumors <sup>[8]</sup> and infiltrate the media network faster than real information <sup>[9]</sup>. For the rumor management of public health emergencies, the existing research is carried out from three angles: rumor dissemination process governance, rumor dissemination subject and object

governance, and rumor governance mechanism.

In the study of the spread of rumors, researchers draw lessons from the idea of the spread of infectious diseases. Some scholars divide the spreading process of rumors into the stages of breeding, spreading, and refuting rumors<sup>[3]</sup> and latent outbreak period, mutation period, and extinction period<sup>[11]</sup>, which are basically in line with the law of growth and disappearance in the spread of infectious diseases. Many researchers carry out mathematical modeling research on the process of rumor spread. Daley and Kendal<sup>[12]</sup> put forward the classical D-K model, drawing lessons from the idea of infectious disease transmission; in this model, people are classified as ignorant, disseminator, and suppressor, in which the disseminator will transform the ignorant into a disseminator, and the suppressor will transform the disseminator into a suppressor. Maki and Thomso<sup>[13]</sup> further improve the D-K model and put forward the M-T model. The core of the model is that rumors spread through direct contact with the communicator, and the disseminator will be transformed into a suppressor when the disseminator touches other communicators in time. Also drawing lessons from the idea of infectious disease transmission, Dodds<sup>[14]</sup> puts forward the SIR model, which includes rumor-susceptible people, rumor-infected people, and rumor-immune people. The researchers also proposed variants of various SIR, SIS, and DK models<sup>[15,16]</sup>. As far as the object of rumor governance is concerned, for general rumors, dealing with false texts is necessary, and for online false information with profound destructiveness, we can also investigate the corresponding legal liability fields while dealing with false texts<sup>[17]</sup>. Official information can restrain the spread of rumors and group behavior when official information somewhat spreads<sup>[18]</sup>. For rumor disseminators, first of all, government departments should severely crack down on the rumor disseminator field<sup>[19]</sup>. In addition, the quality of netizens and the government's behavior of refuting rumors are important factors affecting the interruption of rumors<sup>[11]</sup>. In terms of rumor control and governance mechanism, researchers advocate all-round ecological governance. Dou<sup>[20]</sup> points out that rumor management should be carried out from the subject-information-environment as a whole. Liu<sup>[21]</sup> points out that rumor management should be carried out in such aspects as perfecting relevant laws and regulations, establishing an information certification center, enhancing citizens' moral awareness, strengthening humanistic quality education, and improving citizens' awareness of responsibility. Li<sup>[22]</sup> conducts ecological management of rumors from the perspective of risk analysis from the three dimensions of subject-process-environment.

However, most of the existing studies start from the rumor itself, ignoring the perspective of refuting rumors. First of all, in the aspect of refuting rumors, researchers pay attention to the importance of releasing and refuting rumors, and researchers believe that the release of rumor-refuting information is a powerful response to rumors. Although publishing information to refute rumors is much less frequent than publishing rumors<sup>[13]</sup>, timely and accurate release of rumor information can effectively maintain network security and public order<sup>[23]</sup>. Yuan<sup>[11]</sup> also believes that the behavior of refuting rumors is an important factor affecting the interruption of rumor transmission. Second, the researchers also believe that the main approach to eliminate rumors is to refute rumors. Shuhud<sup>[24]</sup> proposes six steps to deal with rumor information: filter, subject classification, identification, notification, verification, and rebuttal. Paek<sup>[2]</sup> also points out that rumor-refuting information is the most effective way for the government to deal with rumors rather than simply make a counterstatement or complete denial of rumor information. Finally, the researchers put forward the way to refute rumors. Wen<sup>[25]</sup> believes that the best way to stop rumors is for influential users to come out and refute rumors in the early stages of the spread of rumors. Wang<sup>[4]</sup> classifies rumor refuters through feature engineering and identifies those who are rumor-refuting users. However, the research focuses on the characteristic attributes of rumor-refuting users, without considering social attributes and social capital. Therefore, most of the current studies focus on the rumor itself and ignore the perspective of rumor refutation. Some scholars start their research from the perspective of rumor refutation, but they still do not consider the attributes of social media and social capital.

When the information of refuting rumors is widely spread, it will reduce the harm of rumors. Therefore, from the perspective of refuting rumors, combined with social capital theory, this study will examine the influence of the characteristics of the publishers on the amount of rumor-refuting information forwarding and provide a clearer understanding of the forwarding mechanism of rumor-refuting information. The goal is for the platform to formulate rumor-refuting strategies to provide a certain theoretical basis and practical reference, thus promoting the spread of rumor-refuting information.

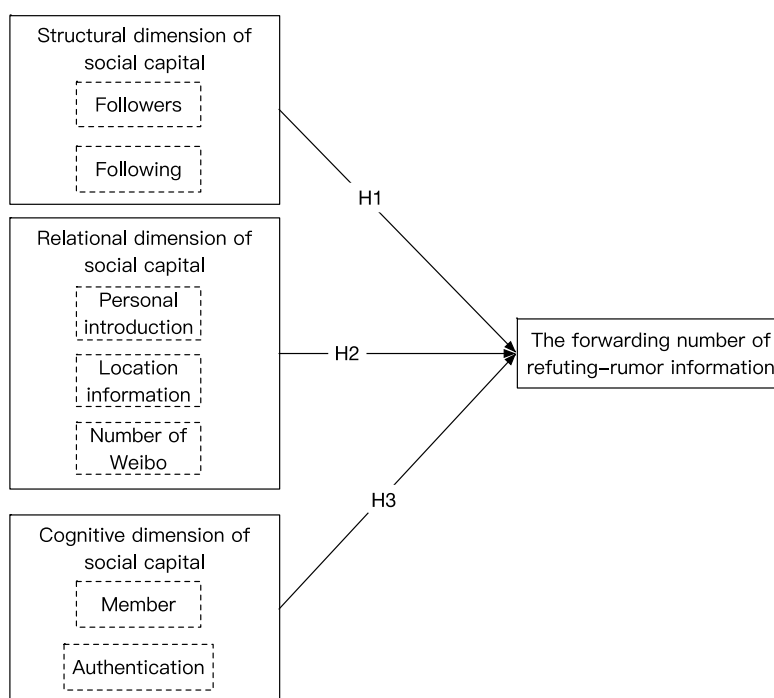
## 2.2 Research models and hypotheses

Social media is the product of the Internet era. Users form a social network with information dissemination as the core through mutual attention, comment, like, retweet, browsing, and other behaviors. The social capital formed by the social network will affect the behavior of users in social activities. Social capital has been widely studied, which helps understand social relations. As the driving force of social behavior in human society, social capital theory is widely used in the analysis of users' shopping behavior, business operation, social media use, and user knowledge payment behavior [3,14,26,27].

The publishers of rumor-refuting information accumulate social capital in the network through the interaction between social media, such as paying attention to, giving likes, publishing articles, to name a few. This social capital will inevitably affect the forwarding behavior of other users for the rumor-refuting information. Therefore, this paper applies social capital theory to investigate the effect of the social capital of users who publish rumor-refuting information on the amount of the rumor-refuting information forwarding in the case of public health emergencies.

Social capital is rooted in the structure of lasting social networks and the relationship between people who know and recognize each other. Bourdieu [28] first makes a systematic description of social capital; taking "connection" as the starting point, he proposes that social capital is "a collection of actual or undiscovered resources related to the relationship network of mutual understanding." For Coleman [29], social capital is a variety of resources to promote the realization of individual goals. Then, "social capital theory" proposed by Putnam [6] extends social capital to the macro social network structure to describe the reasons for individual behavior in the social network and defines social capital as the characteristics of social organizations, including social networks, social norms, and social trust. Considering that social capital is an invisible force combined with social interaction and relationship, shared values and interests, and common belief and trust, this paper uses the commonly used three-level classification of social capital, namely, structural level, relational level, and cognitive level fields [11].

In essence, the forwarding of rumor-refuting information belongs to a specific user behavior model. Therefore, the rest of this paper will draw lessons from the theory of social capital to construct a model of influencing factors of rumor-refuting information forwarding from the perspective of social capital of the publishers of rumor-refuting information from three levels: structural, relational, and cognitive dimensions.



**Figure 1. Model of factors affecting the forwarding number of refuting-rumor information**

The structural dimension of social capital refers to the trend of establishing interpersonal relationships formed by members and the intensity of members' efforts to connect with other people in the network <sup>[11]</sup>. It is the relationship between individuals formed through connections and reflects the structural characteristics of the network <sup>[15]</sup>. These connections are made possible through interaction with others to maintain contact and expand interpersonal relationships, thus affecting the willingness of users to participate in activities <sup>[30]</sup>. Bi <sup>[31]</sup> believes that on Weibo platform, social capital can be formed by fan relationships and attention relationships. The number of fans and followers has a positive relationship with users' social capital and has a positive impact on the attention of their published content. In addition, social structural capital can enhance users' subjective well-being of using social media and has a positive impact on users' question-and-answer and shopping behaviors <sup>[7,32]</sup>.

Sina Weibo users can have a certain number of followers and fans because of their interest and influence. From the perspective of social capital, these users and their followers constitute the social capital of the user's structural hierarchy. Therefore, combined with the number of Weibo users and the number of followers (fans), this study puts forward the following assumptions:

H1a: The number of followers of rumor-refuting microblog publishers will have a positive impact on the forwarding amount of rumor-refuting information.

H1b: The number of followings of rumor-refuting microblog publishers will have a positive impact on the forwarding amount of rumor-refuting information.

Relationship dimension social capital is the capital rooted in the continuous development of interpersonal relationships <sup>[15]</sup>, which refers to the trust, mutual benefit, and win-win situation generated by the interpersonal relationship in the network. Individuals build relationship trust by participating in interpersonal relationships. Relationship trust refers to the accessibility of other people's access to informative comments and the availability of other people's emotional support. It is an important relationship resource and represents a relationship attribute. The generation of trust begins when users show their true information. Trust has a positive impact on the identity of interpersonal relationships. It can largely enhance knowledge acquisition behavior and

positively promote users' purchase behavior and willingness to pay. Reciprocity refers to the behavior caused by the relationship of interests in the relational community [12,26].

Sina Weibo users can choose whether to disclose their information, and the platform will record the number of historical Weibo posts by the user, which constitute the social capital of the user's relationship dimension. Therefore, combined with the openness of user information and the number of Weibo, this research puts forward the following assumptions.

H2a: For rumor-refuting microblog publishers, displaying personal introduction will have a positive impact on the forwarding amount of rumor-refuting information.

H2b: For rumor-refuting microblog publishers, displaying personal geographic information will have a positive impact on the forwarding amount of rumor-refuting information.

H2c: The number of Weibo posted by rumor-refuting microblog publishers will have a positive impact on the forwarding amount of rumor-refuting information.

Cognitive dimension social capital refers to the resources that provide common explanation and collective vision in the collective, including topic and vision consistencies, describing the common interests, values, and expression language of relationship members. Cognitive social capital has a positive effect on users' product selection behavior and information exchange behavior [33].

Weibo has membership functions, and Weibo users who gain membership have the same vision and experience. In addition, Weibo will authenticate professionals or celebrities, which constitute the cognitive dimension capital of the user. Based on the above analysis, the following assumptions are put forward:

H3a: For rumor-refuting microblog publishers, obtaining membership will have a positive impact on the forwarding amount of rumor-refuting information.

H3b: For rumor-refuting microblog publishers, gaining Weibo professional certification will have a positive impact on the forwarding amount of rumor-refuting information.

### 3. DATA DESCRIPTION

Sina Weibo has more than 440 million monthly active users, making it the largest and most active Weibo platform in China. This research crawls 3,035 rumor-refuting information and corresponding user data released in the "COVID-19" incident on the platform from January 22, 2020 to February 22, 2020.

The dependent variable is the forwarding number of rumor-refuting information, and the independent variable is based on the social capital of the publishers of refuting rumors. The number of fans, followers, Weibo posted; whether to disclose the profile, geographic location information; whether to be a Weibo member; and whether to obtain Weibo professional certification are selected from the structural, relational, and cognitive dimensions. Among them, the number of followers (fans), followings, and Weibo posts are discrete non-negative integers, and the other independent variables are 0–1 variable. The corresponding symbols for the data are as follows:

**Table 1. Corresponding table of the personal information of the subject of the publication of rumor-refuting information**

Symbol		Meaning
Dependent variable	repostsnum	Number of information forwarded
Structural dimension independent variable	followers	Number of followers (fans) of Publishers
	followings	Number of publishers focused on others
Relational dimensional independent variable	weibonum	Number of Weibo posted by publisher
	hasintroduce	Whether the publisher opens his/her personal introduction. 1 means yes, 0 means no.
	hasplace	Whether the publisher opens the geolocation information. 1 means yes, 0 means no.

Cognitive dimension	ismember	Whether the publisher is a Weibo member. 1 means yes, 0 means no.
independent variable	hasverified	Whether the publisher has obtained Weibo professional certification. 1 means yes, 0 means no.

The data are described statistically, and the specific description results are as follows:

**Table 2. Information description statistics of the subject of the publication of rumor-refuting information**

Variable	Mean	Standard deviation	Maximum	Minimum	Skewness
repostsnum	8.071e+01	1.995e+03	9.970e+04	1	43.69
followers	8.848e+02	1.229e+03	2.000e+04	1	5.81
followings	1.159e+06	5.331e+06	1.593e+04	1	15.73
weibonum	2.555e+04	3.674e+04	7.562 e+05	1	5.90
hasintroduce	9.600e-01	1.900e-01	1	0	-4.99
hasplace	5.800e-01	4.900e-01	1	0	-0.32
ismember	6.900e-01	4.600e-01	1	0	-0.80
hasverified	7.400e-01	4.400e-01	1	0	-1.11

The deviation values of the three non-binomial independent variables followers, followings, and weibonum are 5.81, 15.73, and 5.90, respectively, all greater than 5, indicating that their distribution is not normal. Considering the subsequent regression model, normalizing the distribution of this variable is necessary. Here, logarithmic transformation is used to logarithmize the three variables, that is, the variables are logarithmic to form new variables, and the corresponding new variables are described as follows.

**Table 3. Logarithmic description statistics of information of the subject of the publication of rumor-refuting information**

Variable	Mean	Standard deviation	Skewness
log(followers)	6.240e+00	1.080e+00	-0.47
log(followings)	1.038e+01	3.510e+00	-0.24
log(weibonum)	9.160e+00	1.800e+00	-1.14

The skewness value of the logarithmic variable accords with the normal distribution, and the original variable is replaced and used as the follow-up regression model.

Finally, through the kappa test of the eigenvalue of the independent variable matrix, the condition number  $k$  is 10.74, which is much less than 100. This finding indicates that no multicollinearity problem exists in the model and can be analyzed by regression.

## 4. EMPIRICAL ANALYSIS

### 4.1 Negative binomial regression analysis

Considering that the dependent variable is a discrete non-negative integer and has a residual with non-normal distribution, the regression model chooses the negative binomial regression model for estimation. The following is a brief description of the basic concepts of the negative binomial regression model.

Negative binomial regression is similar to conventional multiple regression, except that the dependent variable  $y$  follows the observed value of negative binomial distribution. Thus, the possible value of  $y$  is a non-negative integer. It is a generalization of Poisson regression model, in which the mean and variance of variables cannot be equal. The negative binomial distribution in negative binomial regression is composed of Poisson distribution plus a gamma noise variable with a mean value of 1 and a scale parameter (scala parameter)



of  $v$ . Therefore, the negative binomial distribution is expressed as follows:

$$P_r(Y = y_i | u_i = \alpha) = \frac{\Gamma(y_i + \alpha^{-1})}{\Gamma(y_i + 1)\Gamma(\alpha^{-1})} \left(\frac{\alpha^{-1}}{\alpha^{-1} + u_i}\right)^{\alpha^{-1}} \left(\frac{u_i}{\alpha^{-1} + u_i}\right)^{y_i}, \quad (1)$$

$$u_i = t_i u, \quad \alpha = \frac{1}{v}, \quad u \text{ is the probability of } y \text{ occurrence at each exposure (described by time here).}$$

In negative binomial regression, the average value of  $y$  is determined by exposure time  $t$  and  $k$  regression variables ( $x$  values) as described in formula 2.

$$u_i = \exp(\ln(t_i) + \beta_1 x_{1i} + \beta_2 x_{2i} + \dots + \beta_k x_{ki}). \quad (2)$$

$\beta$  is the parameter to be estimated.

Furthermore, the negative binomial regression model can be described as equation 3.

$$P_r(Y = y_i | u_i = \alpha) = \frac{\Gamma(y_i + \alpha^{-1})}{\Gamma(y_i + 1)\Gamma(\alpha^{-1})} \left(\frac{1}{\alpha^{-1} + 1}\right)^{\alpha^{-1}} \left(\frac{\alpha u_i}{1 + \alpha u_i}\right)^{y_i}. \quad (3)$$

Finally, the parameters can be obtained by the maximum likelihood estimation method.

The generalized linear model `glm` in MASS package in R language integrates the negative binomial regression function. This article uses R for programming. The version number of R is 3.6.2. The version number of the Master package is 7.3–51.4.

The regression results are as follows:

**Table 4. Results of negative binomial regression model**

Variable		Coefficient	Standard error	Significance level
Constant term	(Intercept)	1.302	0.233	2.330e-08***
Structural dimension dependent variable	Followers	-0.333	0.030	<2e-16***
	Followings	0.471	0.013	<2e-16***
Relational dimension dependent variable	Weibonum	-0.309	0.021	<2e-16***
	Hasintroduce	-0.196	0.164	0.234
	Hasplace	1.555	0.074	<2e-16***
Cognitive dimension dependent variable	Ismember	0.243	0.070	0.001***
	Hasverified	0.734	0.092	1.210e-15***

Signif.codes:0'\*\*\*'0.001'\*\*\*'0.01'\*'0.05'.'0.1' '1

The rest of the model parameters are as follows:

**Table 5. Other parameters of negative binomial regression model**

Parameters	Parameter value
Null deviance	8,049.0 on 3,034 degrees of freedom
Residual deviance	3,575.6 on 3,027 degrees of freedom
AIC	21,362
2 x log-likelihood	-21,344.199

## 4.2 Robustness test

To test the robustness of the model, this study divides the data and uses the divided data for regression fitting. Specifically, the original data are sorted according to the user id (uid). In part, user id indicates the event that a user creates an account. The smaller the id, the sooner the account is created. Therefore, by classifying users by the size of id and analyzing the model results of classified user data, we can further explore the

robustness of the model.

A total of 3,035 pieces of data are found in the original data, and the first 1,517 pieces of data sorted from small to large are selected for negative binomial regression. The regression results correspond to the coefficient parameters of the model as shown in the table below.

**Table6. Results of negative binomial regression model after screening data**

Variable		Coefficient	Standard error	Significance level
Constant term	(Intercept)	0.418	0.393	0.287
Structural dimension dependent variable	followers	-0.341	0.048	7.610e-13***
	followings	0.509	0.018	<2e-16***
Relational dimension independent variable	weibonum	-0.263	0.033	8.610e-16***
	hasintroduce	-0.114	0.246	0.644
	hasplace	1.897	0.104	<2e-16***
Cognitive dimension dependent variable	ismember	0.271	0.098	0.006**
	hasverified	0.441	0.127	0.001***

Signif.codes:0'\*\*\*'0.001'\*\*\*'0.01'\*'0.05'.'0.1' '1

By taking the sorted "forerunner" data for negative binomial regression, except for the decrease in the significance level of "ismember" in this variable (here is also significant), the significance level and parameter symbols of other parameters have not changed. Therefore, the change in the data has no huge impact on the results. The model is robust.

### 4.3 Result analysis

For the structural dimension of social capital from the level of significance, the number of Weibo publishers' followings has a positive impact on the number of retweets, and the result is significant, assuming that H1b is established. Although the number of followers' (fans) parameter is significant, its symbol is negative. This finding indicates that the number of fans of the publisher has a negative impact on the forwarding of rumor-refuting information, assuming that H1a is not true. From the significance level, the number of Weibo publishers' followings has a positive impact on the number of reposts of refuting rumors, and its coefficient is 0.471, indicating that for each additional following of the user, the user publishes 0.471 more retweets of rumor-refuting information. Additionally, the meaning of the other coefficients is similar, which shows that when the activity and influence of users are enhanced, they will have closer ties with other users and more influence on the forwarding behavior of others. This finding is consistent with the description of Bi<sup>[31]</sup>. At the same time, the number of followers of Weibo publishers and the number of Weibo posts significantly reduced the number of Weibo retweets, with a regression coefficient of -0.33309. This finding is inconsistent with the previous hypothesis that the number of followers represents the social cost of the user's structural dimension. This result may be related to the proliferation of the Weibo platform, and the excessive number of fans may be due to the water army rather than the influence gained by the user through the network relationship. No significant positive or even negative correlation exists between the number of fans and the forwarding number of refuting-rumor information.

For the relational dimension of social capital, the number of Weibo and whether open personal introduction are negative and the introduction parameters are insignificant, indicating that H2a and H2c are not valid. Whether the disclosure of geographical location information is significant, indicates that H2b is established. The regression coefficient of Weibo variable is -0.30897, indicating that a negative correlation exists between the number of Weibo and the forwarding number of refuting-rumor information. The higher the number of Weibo,

the more it can reflect the social capital of the user relationship dimension. However, at the same time, combined with the entertainment of the media platform, the high number of Weibo may reflect that the user has a wide range of interests and distractions but cannot be extremely professional and can reduce others' willingness to forward refuting rumors. The variable of whether or not to display profiles is insignificant. It is speculated to be related to the fact that most users display profiles, which can also be seen from the descriptive statistics. Thus, no significant relationship exists between an open personal introduction and the number of Weibo retweets. The disclosure of geographic location information by Weibo publishers has a positive impact on their forwarding volume, indicating that Weibo publishers' trust in others will positively affect the forwarding behavior of others. The results show that certain information disclosure on Weibo platform can improve the social capital of users and promote the operation of the information dissemination network. In addition, the coefficient of whether the geographic location information variable is disclosed or not is remarkably at 1.555, which has the greatest positive impact on the dependent variable; this finding is consistent with the fact that trust is an important social capital and can promote user behavior in Wu [2] and Zhou [26].

For the cognitive dimension of social capital, whether it is a member and whether it has received professional certification are significant and its symbol is positive, indicating the assumption that H3a and H3b are established. Opening members and obtaining Weibo professional certification can increase the retransmission of Weibo, which is similar to the research results in Wu [2]. This finding indicates that users will consider the professional background of the posting subject and the same intention to use the platform when forwarding refuting rumors. Professionals on the Weibo platform are also indicated to be more recognized, and people easily resonate with those having the same willingness to use the platform.

## 5. CONCLUSION AND DISCUSSION

The problem of rumors of public health emergencies has become a major challenge to digital governance in China. To deal with the rumors in public health emergencies, social media platforms, government agencies, and netizens actively carry out measures to refute rumors. Therefore, based on the theory of social capital, this study constructs a model of factors affecting the forwarding of rumors from three levels: structural, relational, and cognitive dimensions. Taking the COVID-19 event as an example, we obtain the data of the Sina Weibo platform, investigate the characteristics of the publishers that affect users' forwarding and dispelling rumors, and use the negative binomial regression to model. On this basis, we carry out a robustness test.

The results show that structural, relational, and cognitive dimensions of social capital all have an impact on the forwarding behavior of rumor-refuting information. Specifically, factors such as the number of followers of publishers, disclosure of geographic location information, opening members, and obtaining Weibo professional certification will increase the forwarding number of the rumor-refuting information, and whether or not open personal introduction will not significantly affect the forwarding of the rumor-refuting information. At the same time, the number of Weibo and fans will reduce the retransmission of the rumor-refuting information.

The current study aims to enrich and expand the theoretical research results of public health emergency rumor governance and social capital by exploring the behavior of refuting rumor information in public health emergency. At the same time, it provides certain empirical and theoretical bases for the national Internet digital governance.

Based on the above data analysis results, this study puts forward the following suggestions.

First, expanding the scope of information to refute rumors is a direct method of effectively achieving the effect of refuting rumors. Media platforms should pay attention to users' social capital, and social media platforms must further control the water army on the platform. The research results overturn the hypothesis that the number of fans represents the social cost of the structural dimension of users. Too many fans do not

represent the influence that users gain through network relationships. This phenomenon may be related to the proliferation of the water army on the Weibo platform. Therefore, purifying the platform environment and optimizing the fan recommendation mechanism are both necessary.

Second, users must be pertinently encouraged to conduct behaviors such as information disclosure, the degree of trust among users must be enhanced, various new functions for users must be customized, the social capital of users' relationship dimension must be improved, and the retransmission of information to refute rumors must be further promoted to enhance the status of user relations.

Finally, the platform should develop a reasonable authentication mechanism to improve the professionalism of platform users, give platform members and professional certification qualifications, and improve users' cognitive dimension of social capital.

In a word, expanding the spread scope of rumor information is the direct approach to effectively achieve the effect of rumor information. The media platform should pay attention to the social capital of platform users, expand the spread of rumor information, and curb the Internet rumor industry chain.

Of course, as an exploratory study, this research has the following shortcomings.

First, although Sina Weibo is a representative social media, this study only selects the Sina Weibo platform as the starting point. It lacks horizontal research between platforms. Notably, the factors affecting the forwarding behavior of rumor-refuting information on other platforms may be different.

Second, this research does not consider the dynamic nature of the forwarding of rumor-refuting information and does not explore from the time series. Nonetheless, the behavior of forwarding and rumor-refuting information itself is a continuous process, and investigating the influencing factors of rumor-refuting information forwarding in the dynamic process is a worthy endeavor.

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