



Research article

Sexually transmitted diseases and immunology articles pushed by WeChat official accounts are of most interest to the Chinese public: A national cross-sectional study in China

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ABSTRACT

Background: Social media has become a new channel for information exchange in recent years. WeChat official account (WOA) is now widely adopted by the Center for Disease Control and Prevention (CDC) for successful information distribution and diffusion online. We aimed to identify features of the most popular articles pushed by WOAs of the China's CDC that are associated with article influence.

Methods: The most popular articles per month between January 2017 and December 2019 were collected through the monthly published influence list of the CDC's WOA. Descriptive characteristics of articles were examined and the amount of reads and likes was converted into the WeChat communication index (WCI) which reflected the article's influence. Univariate and multiple linear regression analyses were applied to identify factors associated with article influence.

Results: A total of 720 most influential articles from 76 WOAs operated by 69 CDCs were selected for analysis. "Suzhou Vaccination", "China CDC News" and "Guangdong CDC" were the three top WOAs pushing the most quantities of popular articles. The average reads, likes and WCI of all articles were 43115.18, 355.82, and 4363.38, respectively. The article content, pushing year, and season were significantly associated with the article's influence. Sexually transmitted diseases [$b = 207.57$, 95 % confidence interval (CI): 82.23–332.91] and immunology ($b = 123.16$, 95 % CI: 39.65–206.67) articles obtained the highest impact.

Conclusion: Our findings are considered helpful for CDCs in improving and enhancing the article content that expands the coverage of health information dissemination. CDCs can make use of the WOAs for formulating, implementing, and refining plans pertinent to public health matters.

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Abbreviations

CDC	Centers for Disease Control and Prevention
CI	confidence interval
Ref	reference category for multivariable linear regression
SD	standard deviation
SE	standard error
STD	Sexually transmitted disease
WCI	WeChat communication index
WOA	WeChat Official Account

1. Introduction

People’s lifestyles have been changed remarkably by the rapid development of the Internet and new media in the world [1]. Social media has become a new channel for sharing information, payment, and socializing [2–4]. Weibo and WeChat are the most popular applications in China, and they are called China’s Twitter and Facebook, respectively. WeChat was released by the Chinese multinational company Tencent in 2011, and it is currently becoming ubiquitous in the daily mobile communication of the Chinese [5,6]. It is reported that more than 1.25 billion people used WeChat every day in 2021, and it has become the most popular social media platform in China [7].

WeChat can also be seen as a public platform for acquiring various information [8,9]. Seeking online health information has become common, and mobile technologies and internet-connected devices have great potential to improve healthcare delivery and services [10]. A functional module of WeChat called WeChat Official Accounts (WOAs) has been used by government agencies, enterprises, and individuals to transmit information to specific users and interact with them. It is easy to attract a large number of users because of its convenience, promptness, effectiveness, and accuracy. Nearly 80 % of WeChat users have subscribed to the WOAs. According to WeChat data, the total number of registered official accounts has exceeded 20 million [11]. A national survey conducted in China found that 98 % of participants sought health-related information on WeChat, and 33 % of them read health education articles on WOAs regularly [12]. Individuals are more aware of various health-related issues by paying attention to the WOAs with more timely and customized health information online [13]. WOAs are widely used by health education and public health institutions in China, including the Centers for Disease Control and Prevention (CDC). They have recognized that they can make use of WOAs to increase the efficiency and reach of public health services to expand their influence [14], allowing the outreach of the promoted topics to a large of the Chinese population. However, with the diversity in function provided by WOA, little is known about its major constitution as well as the influence factors on the WeChat communication index (WCI) [15] which has been used to reflect the dissemination and coverage of articles. To date, few studies focused on public health using WOAs, and the literature base exploring user engagement through the WOAs of CDCs is even more limited [16]. Therefore, it is necessary to establish an optimal pattern to interact with the public using the WOAs of the CDC, which highlights the importance of further exploration in this area.

This study aimed to explore the users’ preferences and feedback of articles based on WOAs and evaluate the factors associated with article influence by investigating the features and WCI of the most popular articles pushed by the CDCs in China. The results will allow us to know the topics of greatest interest to the general population and the importance of continuing with this dissemination methodology. It could provide new evidence for public health agencies to better use WOAs for effective information dissemination and health promotion.

2. Methods

2.1. Study design and data collection

A retrospective national cross-sectional study was conducted to evaluate the factors associated with article influence. The data was derived from the monthly ranking of the CDC’s dissemination influence released by the WOAs named “China CDC News”, which was jointly created by the China CDC and the Health News. The article influence list publishes the 20 most popular articles pushed by the CDC WOAs every month. We searched and crawled the list of data released between January 2017 and December 2019. The scope of account collection is limited to the certified WOA of the CDCs. The comprehensive influence of articles is quantitatively evaluated by the WCI which consists of 4 dimensions including overall communication power, average dissemination power, headline communication power, and peak dissemination power (for the detailed calculation formula of WCI, see Table S1). The WCI has become one of the most rigorous standards for measuring the dissemination effects of WeChat [15,17]. Specifically, higher WCI scores indicate larger dissemination effects. The model (V14.0) is as follows:

$$WCI = \{.6*[.85*ln(R/d+1)+0.09ln(Z/d*10 + 1)+0.06ln(L/d*10 + 1)]+.2*[0.85ln(R/n+1)+0.09ln(Z/n*10 + 1)+0.06ln(L/n*10 + 1)]+.1*[0.85ln(Rt/d+1)+0.09ln(Zt/d*10 + 1)+0.06ln(Lt/d*10 + 1)]+.1*[0.85ln(R_{max}+1)+0.09ln(Z_{max}*10 + 1)+0.06ln(L_{max}*10 + 1)]\} * 1.2 * 10.$$

Where R, Z, L represent the total number of reads, views (“view” means that users not only read the article but also are willing to recommend the article to their WeChat friends, which has certain social recommendation attributes), and likes (“like” is mainly used as a direct feedback mechanism for users to the content of the article, which reflects the popularity of the article inside the public number) of all articles during the evaluation period, respectively; d refers to the number of days included in the evaluation period (generally 7

days for week, 30 days for month, 365 days for year, other custom periods are calculated by real days); n is the number of articles posted by the account; R_t , Z_t and L_t stand for the total number of reads, views, and likes of the headlines pushed by the WOA, respectively; n_t means the number of headlines pushed by the WOA; R_{\max} , Z_{\max} , and L_{\max} are the highest numbers of reads, views, and likes of the articles pushed by the WOA.

According to the monthly list of top articles, the name and attribute of the institution (including the region and the level of the institution), the number of reads and likes of articles, WCI, the article title, and the article content were collected.

2.2. Data analysis

The descriptive characteristics of articles and WOAs, including the title feature, article content, level of CDC, high-frequency words, publication time and the number of reads, likes and WCI per article were examined. Independent samples t -test was used for comparison of means between two groups and one-way ANOVA was used for the comparison of means across multiple groups. The variables with statistical significance in univariate tests were further subjected to multiple linear regression analysis to identify the associations with the article's influence. WCI was the dependent variable, and the 95 % confidence interval (CI) was determined in the multiple linear regression analysis. All statistical tests were two-sided, and $p < 0.05$ was considered statistically significant. All analyses were conducted using R (version 3.1.2, R Foundation for Statistical Computing, Vienna, Austria).

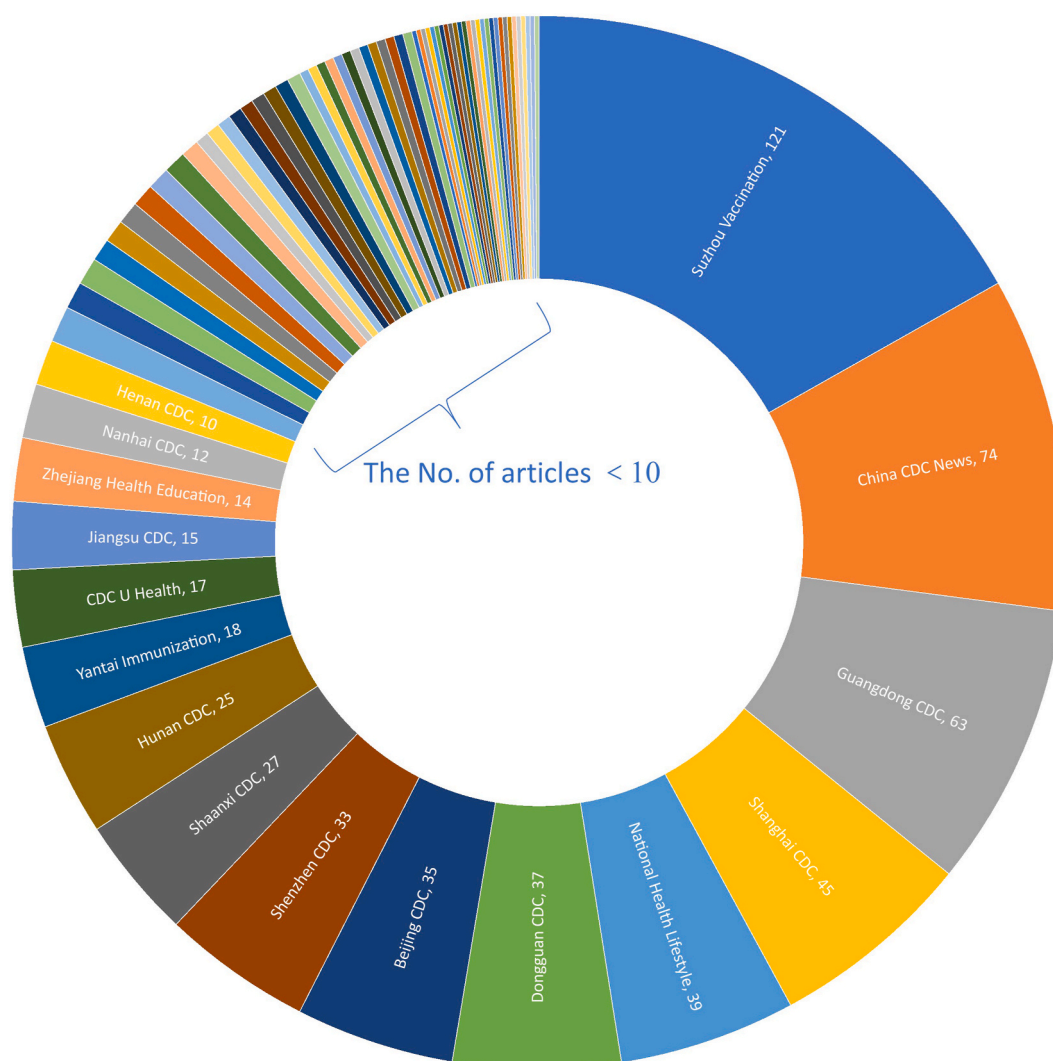


Fig. 1. Distribution of the popular articles pushed by the China's CDCs, 2017–2019.

2.3. Ethical Considerations

As this work involved publicly available WeChat data and did not include human-subjects research, it was exempt from ethical board review.

3. Results

A total of 720 most influential articles from 76 WOAs operated by 69 CDCs between January 2017 and December 2019 were selected for analysis. “Suzhou Vaccination”, “China CDC News” and “Guangdong CDC” were the three top WOAs pushing the most quantities of popular articles, with a number of 121, 74, and 63 articles, respectively (Fig. 1). Beijing, Jiangsu, and Guangdong were the regions with the most popular articles on the list (Fig. S1).

The 720 articles received 31042931 reads and 256193 likes, and the total score of WCI was 3141633. The average reads, likes and WCI were 43115.18, 355.82, and 4363.38, respectively. There were 65 articles (9.03 %) with more than 100000 reads, with combined likes and WCI of 80837 and 311282, and average likes and WCI of 1243.65 and 4788.95. The most popular article had more than 100000 reads (the upper limit of reads display is 100000) and 50000 likes. In the top list, 332 (46.11 %) were released by the CDC below the prefectural-level city, and China CDC, which is the only national CDC, has pushed 121 articles, accounting for 16.81 %. About 62.50 % of articles were original, and the most concerned areas were infectious diseases, immunology, and health education (Table 1). The titles of the popular articles published by the CDCs at different levels had distinct characteristics (Fig. S2).

A total of 2045 valid words were obtained from the titles, and the words that occurred more than 30 times are shown in Table 2. “Vaccines”, “Influenza” and “Prevention” were the three most used words in titles.

Table 3 shows the univariate analysis used to predict the factors associated with WCI. The article’s originality, article content, pushing year, and season were significantly related to WCI ($p < 0.05$). We found that original articles were more popular than forwarding articles. Compared with the other years and seasons, 2018 and summer had the higher WCI.

The variables with statistical significance in univariate tests were further subjected to multiple linear regression analysis. Table 4 lists that after adjusting for the potential confounders, the article content, pushing year, and season were the significant factors associated with WCI. The article content related to STDs, immunology, and infectious diseases was more likely to obtain a higher influence. Articles pushed in the summer and autumn were more likely to obtain a higher WCI. Compared to articles pushed in 2017, the WCI of articles pushed in 2018 and 2019 was higher.

Table 1
Descriptive and frequency statistics for the popular articles of CDC WOAs, 2017–2019.

Article features		n	%	Mean reads	Mean likes
Administrative level	National	121	16.81	40144.94 ± 6263.27	570.13 ± 118.98
	Province	186	25.83	44490.88 ± 6604.95	328.08 ± 64.30
	Municipality	81	11.25	45174.48 ± 6506.44	276.38 ± 19.89
	Prefectural-level city	284	39.44	43775.15 ± 3996.81	317.23 ± 51.35
	County	48	6.67	37891.94 ± 2225.39	285.54 ± 39.87
Article’s originality	Original	506	70.28	42785.81 ± 5007.48	322.92 ± 67.90
	Forwarding	214	29.72	43893.99 ± 5938.22	433.62 ± 74.37
Article content	Infectious diseases ^a	275	38.19	43761.72 ± 5551.52	294.89 ± 75.39
	Immunology	166	23.06	48649.72 ± 5635.32	326.92 ± 23.96
	Health education	130	18.06	37184.27 ± 1894.19	365.91 ± 57.05
	Notices & Announcements	61	8.47	38220.49 ± 5718.98	531.98 ± 122.80
	Nutrition and food safety	42	5.83	39932.31 ± 3500.33	322.74 ± 50.68
	Vector biology & Disinfection	28	3.89	34412.54 ± 2826.82	243.25 ± 46.59
	Sexually transmitted diseases (STDs)	18	2.50	62582.78 ± 5975.57	1135.83 ± 216.83
Title length	0-15 words	200	27.78	39032.83 ± 1789.19	333.87 ± 25.95
	16-30 words	467	64.86	44647.73 ± 6353.59	370.67 ± 58.91
	>30 words	53	7.36	45016.53 ± 6515.63	307.87 ± 69.80
Using special symbols in titles	Yes	630	87.50	43597.82 ± 5720.11	341.62 ± 97.61
	No	90	12.50	39736.71 ± 1731.40	455.27 ± 99.82
Using letters in titles	Yes	645	89.58	44388.13 ± 4127.03	233.29 ± 24.67
	No	75	10.42	42967.16 ± 5418.58	370.07 ± 93.39
Year	2017	240	33.33	33611.11 ± 1513.39	317.90 ± 77.50
	2018	240	33.33	47612.43 ± 7044.70	471.29 ± 52.23
	2019	240	33.33	48122.00 ± 8317.50	279.28 ± 45.53
Season	Spring(March–May)	180	25.00	38614.46 ± 1568.27	245.21 ± 29.84
	Summer(June–August)	180	25.00	47123.62 ± 7567.32	405.67 ± 49.42
	Autumn(September–November)	180	25.00	44593.42 ± 5582.64	431.29 ± 35.73
	Winter(December–February)	180	25.00	42129.23 ± 5428.69	341.13 ± 41.91

^a Excluding STDs.

Table 2

High-frequency words in the title of the popular articles of CDC WOAs, 2017–2019.

No.	High-frequency words	n (%)	No.	High-frequency words	n (%)
1	Vaccines	138(15.07)	11	Tips	36(3.93)
2	Influenza	65(7.10)	12	Please	36(3.93)
3	Prevention	64(6.99)	13	HPV	35(3.82)
4	Disease Control	55(6.00)	14	Hand, Foot and Mouth Disease (HFMD)	34(3.71)
5	Vaccination	49(5.35)	15	CDC	33(3.60)
6	Health	48(5.24)	16	Beijing	32(3.49)
7	Attention	43(4.69)	17	Baby	32(3.49)
8	Month	43(4.69)	18	People	31(3.38)
9	Virus	42(4.59)	19	Reminder	31(3.38)
10	Parents	39(4.26)	20	Prevention and Control	30(3.28)

Table 3

WCI Comparison of the popular articles of CDC WOAs, 2017–2019.

Variable		Mean	SD ^a	F/t value	p value
Administrative level	National	4340.36	247.55	1.08	.37
	Province	4361.61	228.21		
	Municipality	4393.23	222.54		
	Prefectural-level city	4371.63	210.03		
	County	4329.06	195.53		
Article's originality	Original	4374.04	222.62	−2.00	.046
	Forwarding	4338.18	219.08		
Article content	Infectious diseases ^b	4365.20	225.22	5.27	<.001
	Immunology	4415.66	202.75		
	Health education	4308.72	220.86		
	Notices & Announcements	4336.21	232.52		
	Nutrition and food safety	4325.37	213.24		
	Vector biology & Disinfection	4303.28	186.01		
	STDs	4522.40	233.02		
Title length	0–15 words	4337.94	198.98	1.82	.16
	16–30 words	4373.11	228.21		
	>30 words	4373.65	244.84		
Using special symbols in the title	Yes	4365.63	226.34	−.82	.41
	No	4347.65	189.51		
Using letters in the title	Yes	4362.56	212.58	−.03	.97
	No	4363.47	223.26		
Year	2017	4259.53	223.84	44.61	<.001
	2018	4424.41	219.61		
	2019	4406.20	183.18		
Season	Spring(March–May)	4325.14	189.83	4.99	.002
	Summer(June–August)	4398.19	236.17		
	Autumn(September–November)	4391.08	205.52		
	Winter(December–February)	4339.11	244.76		

^a SD: standard deviation.^b Excluding STDs.

4. Discussion

In recent years, social media has played an important role in disseminating public health information, assisting in emergency management, and spreading health knowledge [18]. The CDC's use of social media for health advocacy is an emerging field, and WeChat has been widely applied by the CDC. WeChat platform is publicly accessible, which allows the dissemination of information to a large part of the population with the possibility of knowing data on a huge diversity of topics. CDC's WOAs conduct professional and authoritative health education and promote open and transparent dissemination of information through posts. In our study, we found that using WOAs is an effective mean for information dissemination that help with reaching more people, and the appropriate and targeted article content of WeChat has attracted a large number of readers' attention. Identifying the topic of an article and aligning it with a seasonal disease is important for increasing the influence of WeChat and wildly disseminating disease prevention knowledge.

In general, the WOAs of CDC agencies in China have a good influence on the public and have accumulated a large number of fans. According to a survey conducted by the China CDC in 2016, the number of WOAs of certified CDCs nationwide reached more than 200, and the WOAs have become the front line for the CDC to carry out health communication and work promotion. The WOAs of the CDC are positioned to disseminate frontier health knowledge and publish disease prevention information. They can also conduct health education and alert at critical moments, such as during an epidemic while making better decisions based on interactive feedback and better detecting or preventing disease to improve public health outcomes [19,20].

In our study, we found that these popular articles have a huge number of reads and likes, indicating the wide range of interaction

Table 4

Multiple linear regression analysis of the WCI of the popular CDC WOAs articles, 2017–2019.

Variable		b ^a	95%CI ^b	SE ^c	t value	p value
Article's originality	No	Ref ^d				
	Yes	15.92	−19.86–51.69	18.22	.87	.38
Article content	Vector biology & Disinfection	Ref				
	Infectious diseases ^e	102.42	20.73–184.10	41.61	2.46	.01
	Immunology	123.16	39.65–206.67	42.54	2.90	.004
	Health education	45.06	−40.45–130.58	43.56	1.04	.30
	Notices & Announcements	71.65	−21.49–164.79	47.44	1.51	.13
	Nutrition and food safety	52.21	−47.06–151.49	50.56	1.03	.30
	STDs	207.57	82.23–332.91	63.84	3.25	.001
Year	2017	Ref				
	2018	147.29	109.52–185.06	19.24	7.66	<.001
	2019	147.07	110.11–184.03	18.83	7.81	<.001
Season	Winter(December–February)	Ref				
	Spring(March–May)	−13.63	−56.64–29.37	21.90	−.62	.53
	Summer(June–August)	70.32	26.13–114.51	22.51	3.12	.002
	Autumn(September–November)	47.61	3.62–91.61	22.41	2.13	.03

^a b: regression coefficient.^b CI: confidence interval.^c SE: standard error.^d Ref: reference category for multivariable linear regression.^e Excluding STDs.

between WOAs and the public. In an observational study, scholars reviewed the use of WOAs by Chinese provincial CDCs and found that the median number of reads and likes was 551.5 and 10, respectively [16]. It was significantly lower than our results and implied that there was still a huge gap between general articles and popular articles in the influence and much room in the promotion of health education. In terms of the number of lists, the most popular articles were concentrated in a limited number of CDCs, mainly province-level and prefectural-level CDCs, and the dominance of the article influence from CDCs in the eastern provinces and cities of China was obvious. This may be due to the relative maturity of public operations in developed regions and the ability to secure sufficient staff and funding for article creation and promotion. A study also found that the rate of social media registration in the eastern CDCs was higher than in the west of China, which was determined by the level of local economic development [21]. In addition, higher administrative-level accounts might be more authoritative for message delivery and are more well-known than lower-level accounts [11]. Currently, there are 2762 county-level CDCs in China, and they play a primary role in improving public health, while the percentage of county-level CDCs that have opened WOAs is low (about 3.5 % in 2018). Therefore, it is necessary to promote the use of WOAs among grassroots organizations [11].

According to our results, the article content, pushing year, and season were associated with the article's influence. Although originality was not associated with the article's influence in our study, forwarding articles can produce similar influence as the original articles if the original articles are good enough to make people forward them. Research has found that original posts got more views [22]. Article content is related to user engagement and is identified as an essential factor in determining whether users share or forward articles with their family members or friends. Studies on other social media platforms have also revealed that the contents of posts seemed to have a significant effect on the article's influence [23,24]. Similar to previous findings, our study further showed that what the public liked to view and praise most were articles about STDs, immunology, and infectious diseases, which reflected that readers were interested in popular science articles about daily health knowledge [16,22]. Wang Z et al. developed a WOA platform to disseminate HIV-related information and knowledge and provided personalized consultations for users, which had a strong communication effect and ranked first within HIV counseling and services [7]. While readers were relatively less interested in articles related to health education and food safety and nutrition, which were also close to daily life as well. Time including year and season was also an important factor in article influence. Summer is the season when infectious diseases occur frequently, and there are more flies and mosquitoes. Summer and autumn are conducive to the growth and reproduction of bacteria due to the higher temperature and humidity [25], which also accelerate food spoilage. Therefore, users may pay more attention to the articles pushed during this period. We have observed a higher influence of articles in 2018 and 2019 than in 2017. It may be due to some occasional special events that triggered public attention. For example, when the Changsheng vaccine incident (The production of freeze-dried human rabies vaccine produced by Changchun Changsheng Biotechnology has falsified records) exploded in July 2018, social media and the press began paying a substantial amount of attention to the topic and CDCs [26]. In 2019, there was a dengue fever outbreak in mainland China, with 15187 indigenous cases in 13 provinces [27], which attracted a large number of readers' attention and interaction through the WOAs. In addition, several studies found that article type [24,28] and the addition of links [29,30] played an important role in increasing article influence. Some scholars suggested that humorous articles and using an optimistic tone can increase the readers' interaction [31,32]. Wang FZ et al. evaluated the quality of health-related WeChat and found that the distinctive titles were more attractive to the public [33]. Yin M et al. used multiple logistic regression analyses to identify features of articles with higher reading and re-sharing levels from CDCs and suggested that public health agencies should make full use of WOAs and consider the information needs and preferences of users in order to better carry out health communication and education with the public [34].

The number of reads and likes is the best indicator of the influence and interactivity of an article, which can also reflect the

institution's ability to respond to the public. It should be noted that most of the current popular articles are single unilateral output, lacking two-way communication on public health topics. Research has shown that interactive media experiences will gain more public attention, especially at special times [35]. Zhang W et al. also confirmed the importance of local authorities using social media official accounts to communicate during public health crises [36]. Thus, equal dialogue, two-way interactions, and effective communication with the public through WOAs still need improvement. Additionally, some confounding factors cannot be ignored in the research on the dissemination of similar WOAs. The degree of professionalism of the content of the article is an important confounding factor, and the dissemination scope of the article with strong professionalism may be relatively narrow, and its influence may not be as high as that of simple and easy to understand health care tips. The timeliness of information also has a great impact on WCI. Related articles published during hot events will get more reading and dissemination due to high public attention. The number and quality of fans of public accounts also have a direct impact on the spread of articles. Public accounts are authoritative and have a large number of fans, and their articles have a high initial exposure rate and are likely to get a high reading volume. For instance, the People's Daily is the most authoritative official media channel in China and, as such, the WCI of its WOA ranked the highest during the COVID-19 epidemic [17]. Based on our findings, the operating organization of WOAs should disseminate the type of information that the public is most concerned about, and select those dissemination practices that effectively responsibly spread information to curtail misinformation, regulate public fear, and improve information governance. The ultimate goal of effective disease prevention and control knowledge dissemination is to reduce the occurrence of disease and promote the health of the population.

There are several limitations in our study. Firstly, since the study adopted a retrospective cross-sectional design, there could be issues regarding incomplete information collection. For instance, some highly read articles might not have been included in the study because they were re-edited or deleted. Although the WeChat platform has a certain control over the authenticity of the data, it is still difficult to completely avoid the existence of fake data such as the number of views and likes. Secondly, only the most popular public articles per month were collected, which may be limited in representing the situation of the entire WeChat platform. In addition, as an evaluation index, the WCI reflects the dissemination breadth and attention degree of the article, rather than considering the scientific, accurate, and practical content of the article. Statistics toward "view" was not included in the list data obtained from the WOAs, therefore, no verification can be made on the scoring of WCI, caution may be needed while interpreting score of WCI. Thirdly, other factors that may also affect article influence, such as article length, emotional color, and comment-specific analysis were not included in this study. These individual factors and article features should be analyzed comprehensively in the future study.

5. Conclusions

Our study examined the features and interaction of the most popular articles pushed by CDCs in China and found that article content, pushing year, and season were associated with the article's influence. The findings provide new evidence of what readers are most concerned about in public health. The results of the study suggest that WCI can be a useful tool for monitoring the "state" and tracking the trend of the article's influence. CDCs can make use of this tool for formulating, implementing, and refining plans pertinent to public health matters, which can help with effective information dissemination and improve public opinion and information governance.

CRediT authorship contribution statement

Yi Li: Writing – original draft, Software, Methodology, Formal analysis, Data curation, Conceptualization. **Yinan Zhao:** Writing – original draft, Supervision, Software, Methodology, Formal analysis, Data curation. **Ning Yao:** Software, Methodology, Formal analysis. **Shuang Zhou:** Methodology, Investigation, Formal analysis. **Beibei Jiang:** Investigation, Formal analysis. **Ying Xiong:** Writing – review & editing, Visualization, Methodology, Data curation, Conceptualization. **Chunbei Zhou:** Writing – review & editing, Supervision, Resources, Project administration, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Data availability

The data sets generated during and/or analyzed during the current study are available from the corresponding author upon request.

Declaration of competing interest

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

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.heliyon.2025.e41820>.

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