#WuhanDiary and #WuhanLockdown: gendered posting patterns and behaviours on Weibo during the COVID-19 pandemic

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ABSTRACT

Social media can be both a source of information and misinformation during health emergencies. During the COVID-19 pandemic, social media became a ubiquitous tool for people to communicate and represents a rich source of data researchers can use to analyse users' experiences, knowledge and sentiments. Research on social media posts during COVID-19 has identified, to date, the perpetuity of traditional gendered norms and experiences. Yet these studies are mostly based on Western social media platforms. Little is known about gendered experiences of lockdown communicated on non-Western social media platforms. Using data from Weibo, China's leading social media platform, we examine gendered user patterns and sentiment during the first wave of the pandemic between 1 January 2020 and 1 July 2020. We find that Weibo posts by self-identified women and men conformed with some gendered norms identified on other social media platforms during the COVID-19 pandemic (posting patterns and keyword usage) but not all (sentiment). This insight may be important for targeted public health messaging on social media during future health emergencies.

Summary box

⇒ Social media is an important source of data to understand social dynamics during health emergencies, and an important source of information on user's experiences during health emergencies.
⇒ It can also be an important platform to target users with public health information, however, for this to be successful it must be targeted in a way to resonate with your users.
⇒ Previous studies suggest users' experiences on social media platforms can be highly gendered, including during the existing pandemic.
⇒ Weibo is China's biggest platform. It was a source of communication during the pandemic, but it has so far not been analysed from a gendered perspective.
⇒ During health emergencies public health messaging on social media needs to be gender responsive to populations posting on particular platforms.

emotional support to users; and circulated outbreak information during emergencies.[2–4] Despite the benefits, users of social media platforms must also contend with internet trolls, conspiracy claims, health misinformation and most importantly in this examination, gender stereotypes.[5]

Social media platforms are increasingly essential sources of information and communication for populations. Observation of social media posts and behaviours during COVID-19 provides a safe (and deidentified) opportunity to observe how populations were receiving public health messaging and responding to emergency measures. This paper is interested in how men and women used Weibo during and after the cordon sanitaire in Wuhan between 1 January 2020 and 1 July 2020. We want to see if there are any different patterns in how men and women made sense of the pandemic during

INTRODUCTION

Social media is an important source of data to understand social dynamics during health emergencies. Before the COVID-19 pandemic, social media platforms (broadly defined to include Facebook, Instagram, Tik Tok, Twitter and Sina Weibo (Weibo)) have been identified as sources for both information and misinformation during health emergencies.[1] The upsurge of online public conversations and statements of sentiment have profoundly shifted the dynamics of health emergency communications from one-way broadcasting to an interactive real-time process. Existing research has shown that social media helped increase the accessibility of health messages, provided tailored information and offered

this period. We are interested in mapping any notable patterns to ascertain first, what the use of Weibo can tell us about the gendered impact of COVID-19 in Wuhan; and second, how social media analysis can inform gender-aware responses to health emergencies.

During the first COVID-19 lockdown, 'community-level' communication on Weibo took on an important life of its own where expression and protest 'swept the Chinese internet'.[6] Below, we examine the gender differences in posts among Weibo users who were interacting with two hashtags most associated with COVID-19: #WuhanLockdown (#武汉封城)—the first cordon sanitaire of the COVID-19 outbreak in Wuhan, China (23 January 2020 till 8 April 2020); #WuhanDiary (#武汉日记) to captures the challenges of daily life and the experiences related to COVID-19 outbreak in Wuhan.

We found that some behaviours on Weibo conform with gendered norms identified on other social media platforms during the COVID-19 pandemic (posting patterns and keywords), but not all (sentiment). We conclude that rapid gender analysis of social media posts during emergencies should be ongoing, to ensure that public health messaging on social media during emergencies is responsive to the populations posting on these platforms.

GENDER AND SOCIAL MEDIA DURING COVID-19

During the first year of the COVID-19 pandemic, social media posts became a crucial part of the open-source information available to researchers to collect and analyse users' experiences, knowledge and sentiments.[1 7 8] A systematic review of research conducted on social media and COVID-19 during the first year of the pandemic found that the majority of research examined social media posts to survey public attitudes (ie, sentiment), the spread of infodemics and mental health attitudes as well as to detect or predict COVID-19 cases, analyse government responses to the pandemic, and evaluate the quality of health information in prevention education videos (Facebook, Youtube, and Instagram are the dominant social media platforms (highest number of active users) worldwide; WeChat, Douyin (Chinese Tiktok) and Sina Weibo have highest active users for Chinese language).[9] Due to the widespread use of lockdowns to control the spread of the pandemic, social media also became a ubiquitous tool for populations to communicate.[10]

Social media is a gendered space.[11 12] The study of gendered social communication and post behaviours on social media have found notable congruence between gendered norms in society and social media.[13 14] Debate in digital media studies questions whether the Internet provides 'empowering potential' for women[15] or extends conformist gender social practices.[16] Studies of social media have found hypergender orientation to sexual stereotypes among adolescents[17]; posts by women social media users tend to use more 'emotion words' and first-person singular pronouns; men use more swear words, emoticons and possessive pronouns, that is, 'my wife'[14 18];

women have more connections with the opposite gender in their social media network than men.[19]

Research on gendered patterns of social media posts during COVID-19 have confirmed the literature above: that women post more than men (patterns of posting); men express less emotion and sentiment (sentiment) and women will post more on the emotional impact of the lockdown (keywords).[20–22] However, most of these studies were conducted on Western Social media platforms. There has, to date, been no published observation of gendered differences among users posting COVID-19-related messages on Weibo.

WEIBO AND GENDER DURING COVID-19

The first outbreak of a 'novel pneumonia' in Wuhan, China was circulated on Weibo in late December 2019.[23] The (approximately) 11 million population in Wuhan were placed under an abrupt and strict cordon sanitaire from 23 January 2020 to 8 April 2020. This scale of cordon sanitaire was unprecedented. One means of communication for people in Wuhan during this time was to socially engage with each other and the rest of the world via Weibo. Weibo is the biggest social media platform in China. There are over 500 million registered Weibo users, and of these 50.10% are registered as male and 49.90% as female. Most users post in the Chinese language. There was a significant upsurge of posts on Weibo during the first lockdown, the passing of Dr. Li Wenliang, and the publicity of the Wuhan Diary. These events became popular hashtags such as #Stand by her, #Healthy China, #female HCWs, #WuhanDiary and #WuhanLockdown.[23–27]

Existing research on COVID-19-related posts on Weibo have been concerned with tracking community-level sentiment,[6 28 29] knowledge and understanding of public health information posts,[27] public opinions on trust and government,[15 23 25 30 31] and response to 'fake news' and rumours.[32 33] During the pandemic, Weibo was examined as a potential tool for real-time surveillance, including case characteristic prediction[34–36] and tracking infection transmission.[37] With regards to Weibo, gender and COVID-19, the only two papers to consider gender difference focused on mental health and feminist activism. The first is a sex-disaggregated survey of people who posted feelings of depression and anxiety on Weibo during the first wave of COVID-19 in China.[38] The second publication examined Weibo as a 'site' for feminist resistance against the lockdown during COVID-19.[6] We sought to examine the gender differences in posts among Weibo users who were interacting with two hashtags most associated with COVID-19: #WuhanLockdown and #WuhanDiary, during the first emergency phase of the COVID-19 outbreak in Wuhan, China (23 January 2020–8 April 2020). Wuhan to date remains the only large scale outbreak in China, and the introduction of the measures used to control the outbreak at this time was relatively novel. The significance of this study is that
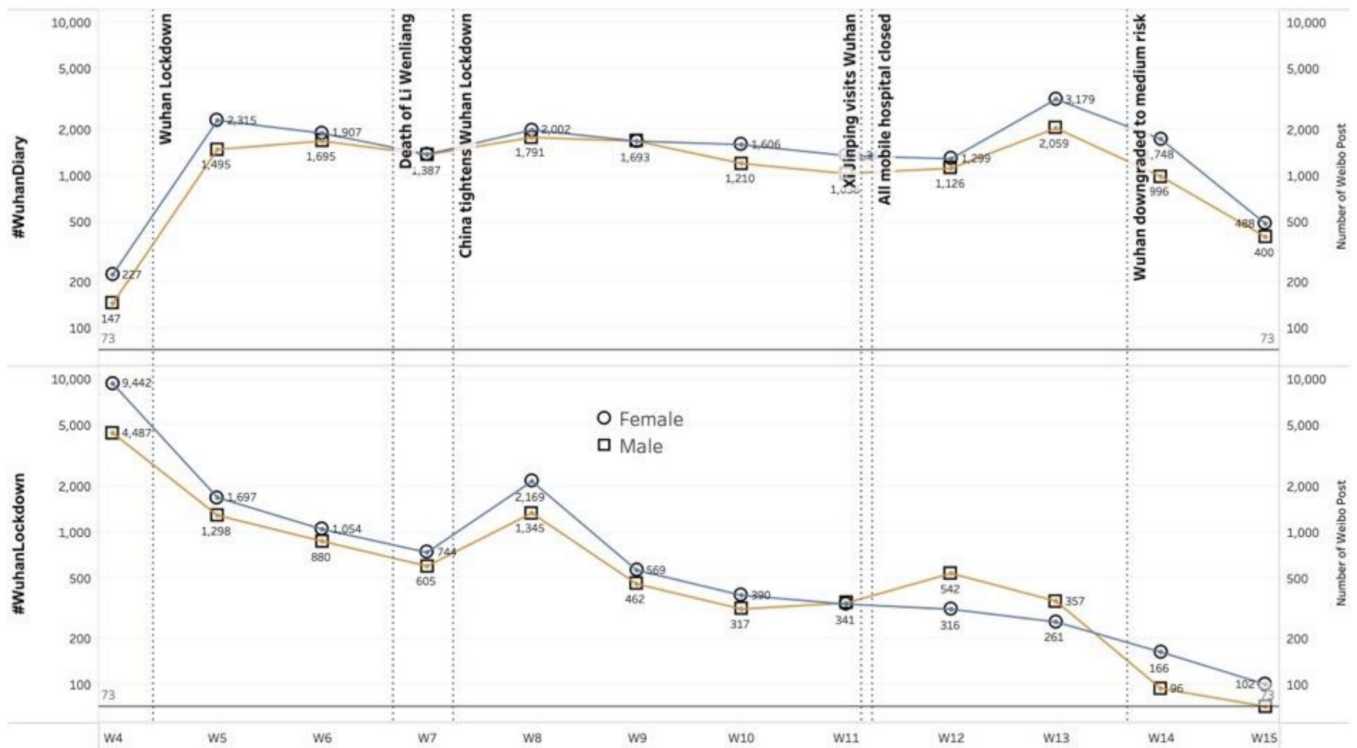
Figure 1 Gender distribution for posts #WuhanDiary and #WuhanLockdown.

it provides an opportunity to understand how individuals were reflecting on the first lockdown experienced globally during the pandemic. The data provides insight into what individuals were thinking and experiencing as they lived the social and economic impacts of the pandemic.

We collected social media posts through Weibo's Open Application Programming Interface, by Weiboscope, a research project led by coauthor since 2010.[23] This was a data pull of 66 235 posts on Weibo posted during the first wave of the pandemic in Wuhan, China, between 1 January 2020 and 1 July 2020. Two data pulls from Weiboscope were conducted according to posts using one of two hashtags: #WuhanDiary and #WuhanLockdown. These two hashtags were selected as they were the most used to journal and record daily lives during lockdown. All posts pulled between 1 January 2020 and 1 July 2020 included one of the following hashtags #Wuhandiary and/or #WuhanLockdown. Registered Weibo users are provided with male or female registration. The data pull for each post included gender identifier (if provided); location of user (if provided); and date of post. Over 90% of posts were gender identified and we only included the posts for which user's gender was provided.

Hashtags allow Weibo users to find relevant posts on a certain topic, to foster public attention and engagement.[26 39–41] Our analysis involved three methods designed to examine whether Weibo exhibited similar gendered user patterns and behaviours identified in other social media platforms during the COVID-19 pandemic. First, we examined gendered patterns in posting behaviour. We plotted the number of posts, disaggregated by gender, against the 6-month timeline

to track increase/decline of posts per week by gender. We also noted post behaviour (weekdays vs weekends). Second, we graphed the percentage of posts that adopted a negative tone to align with our definition of negative sentiment posts over time among female and male registered users. Previous sentiment studies of Weibo posts at the early stage of outbreak (prelockdown) found that use of words including fear, disappointment, guilt and anger increased significantly during the outbreak period (between 20 January to 23 February).[42] To plot sentiment during the lockdown period we also adopted a timeline of 'significant' public events to monitor the content of posts during and after these events within the 6-month period; we also traced gender differences
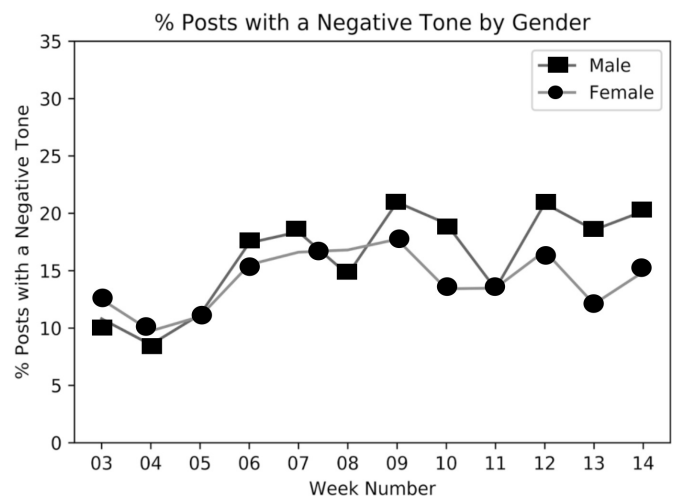

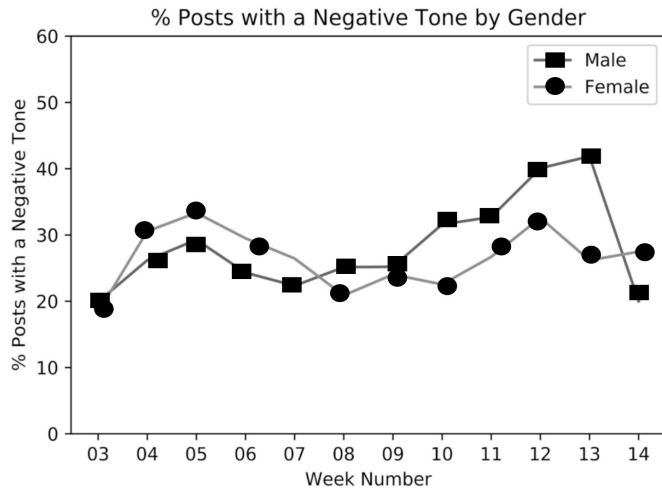**Figure 2** Gender sentiment for #WuhanDiary.

Figure 3 Gender sentiment for #WuhanLockdown.

in post sentiment and content over this timeline. Finally, we examined the keywords used in posts that included hashtags #WuhanDiary or #WuhanLockdown and disaggregated by user's gender. We sought to understand the association between the most frequently used keywords and gender during the 6-month period. In total, the final analysis included 62 297 posts (#WuhanDiary: 34,237; #WuhanLockdown: 28,060). Below, we present our results on the number of posts between men and women users referencing #Wuhandiary or #WuhanLockdown; we compare the negative sentiment expressed in posts by

gender over the 6-month timeline; and we examine the keywords associated with #Wuhandiary and #WuhanLockdown and gender.

We acknowledge the limitations of this dataset. The sample is representative and does not reflect the diversity of all Weibo users. However, the two hashtags were chosen to collect specifically the social media posts that represented public response to the unprecedented large-scale public health intervention–entire city lockdown in Wuhan in mid-January 2020–during the time when the unprepared public had very limited knowledge about COVID-19, that is, unknown infectiveness, mortality and no vaccine/treatment. This scenario highlights the gender difference of Chinese people under isolation and anxiety in the crisis. The two terms were selected to represent the hashtag campaign launched and popularised by the public and the social media platform with dedicated purposes to encourage individual's help-seeking, coping, and emotional expression via social media at that very moment.[23–27] It is common practice to draw representative samples of Weibo posts rather than filter and analyse an entire Weibo dataset.[23] User registration is another limitation in the sample. People who self-identify as male or female for Weibo registration (only two options provided) is the basis of the analysis. We recognise that this binary registration requirement has limitations on our findings as it excludes other gender identities and their experiences.

Table 1 Female users keywords #WuhanDiary

Rank	Chinese	English	Frequency	Proportion of posts w/ keyword	% Negative posts
1	武汉	Wuhan	6017	51.6	18.35
2	加油	Cheer up	1918	16.5	3.80
3	新型冠状病毒	COVID-19	1611	13.8	7.41
4	社区	Community	1413	12.1	21.80
5	希望	Hope	1139	9.8	5.42
6	感谢	Thank	909	7.8	2.54
7	封城	Lockdown	835	7.2	27.25
8	医护人员	Medical Personnel	812	7.0	10.88
9	出门	Go out	794	6.8	23.06
10	朱一龙	Yilong Zhu	747	6.4	0.42
11	患者	Patient	744	6.4	12.57
12	生活	Living	702	6.0	8.93
13	工作	Work	610	5.2	14.21
14	隔离	Quarantine	557	4.8	20.05
15	中国	China	540	4.6	2.41
16	妈妈	Mother	473	4.1	10.34
17	医院	Hospital	438	3.8	16.67
18	家里	Stay Home	392	3.4	17.92
19	确诊病例	Confirmed Cases	389	3.3%	16.13
20	肺炎	Pneumonia	388	3.3	8.70
Total			**11 654**	**100.0**	**14.24**

Table 2 Male users keywords #WuhanDiary

Rank	Chinese	English	Frequency	Proportion of posts w/ keyword	% Negative Posts
1	武汉	Wuhan	5226	56.0	21.83
2	确诊病例	Confirmed cases	2756	29.5	56.91
3	新型冠状病毒	COVID-19	2552	27.3	38.51
4	医护人员	Medical personnel	1498	16.1	9.20
5	患者	Patient	1474	15.8	13.74
6	加油	Cheer up	1237	13.3	3.90
7	社区	Community	1022	11.0	21.03
8	希望	Hope	944	10.1	3.89
9	肺炎	Pneumonia	814	8.7	23.10
10	工作	Work	798	8.6	17.89
11	新增	New cases	730	7.8	49.11
12	中国	China	677	7.3	5.03
13	隔离	Quarantine	631	6.8	30.52
14	湖北	Hubei province	607	6.5	17.60
15	出院	Discharged from hospital	577	6.2	37.82
16	记者	Journalist	559	6.0	7.66
17	生活	Living	519	5.6	8.47
18	医院	Hospital	478	5.1	16.84
19	感谢	Thank	475	5.1	2.23
20	物资	Supplies	475	5.1	16.30
Total			**9332**	**100.0**	**15.90**

GENDERED POSTING PATTERNS ON WEIBO

Our findings show the number of posts from both women and men users first peak on week 4 (22 January) 2020 and the second peak comes on week 7 (7 February 2020). These two peaks might be associated with the news of the Wuhan lockdown and Dr Li Wenliang's passing, the Wuhan-based ophthalmologist who warned doctors in a group chat about the outbreak of COVID-19 and was arrested by authorities for 'spreading rumours' before falling with COVID-19.

The patterns of posting between women and men differ by 400 per day at the onset of the lockdown for #WuhanDiary. More women post than men, but the space between the number of posts divided by gender narrows at the lockdown continues (see figure 1 Gender distribution for posts #WuhanDiary and #WuhanLockdown). For #WuhanLockdown the posting pattern is the same but with a 5000 post difference between women and men users at the onset of the lockdown. This gender gap narrows as the lockdown continues. A third peak in posts comes on week 13 for #WuhanDiary, but the gender-user difference in distribution of posts does not return to the week 1–3 difference. For #WuhanDiary, women continue to post more than men; and for #WuhanLockdown, there is only one period between week 11 and 12 when men post more than women.

GENDER AND SENTIMENT POSTING PATTERNS ON WEIBO

Our results reveal some differences between genders in terms of total posts using emotional expression (sentiment).

Figures 2 and 3 reveal that men were more likely to post messages involving negative emotions compared with women. Several crossovers happened in week 5 (Wuhan downgrade from high to medium risk) and week 8 (arrival of medical crews) with #WuhanDiary posts which was the largest number of dispatched in non-wartime military operations in the last decade. Week 3 (highest level-imposed lockdown) and late week 7 posts with #WuhanLockdown (death of Dr Li Wenliang).

For both #WuhanDiary and #WuhanLockdown male users posted a higher portion of posts, over a longer period, with negative tones. One explanation is that men had higher percentage of negatives posts partially because women posted shorter messages compared with men (see online supplemental appendix 1). This suggests that men were using social media to express their emotional state, which does not reflect the literature on gendered practices in social media and specific studies on COVID-19.

GENDER AND KEYWORD POSTING PATTERNS ON WEIBO

We have evidence of gender differences in keyword usage (ie, some keywords are more likely to be mentioned by one gender than another) during this period. There were gender differences in the thematic content of posts using both #WuhanDiary and #WuhanLockdown. Tables 1 and 2 reveal major thematic differences in posts associated with #WuhanDiary: care tasks and emotions associated

Table 3 Female users keywords #WuhanLockdown

Rank	Chinese	English	Frequency	Proportion of posts w/ Keyword	% Negative Posts
1	武汉	Wuhan	11 645	82.1	25.42
2	加油	Cheer up	4505	31.7	7.01
3	封城	Lockdown	3144	22.2	33.54
4	新型冠状病毒	COVID-19	2294	16.2	21.21
5	希望	Hope	2037	14.4	11.62
6	出门	Go out	1361	9.6	28.41
7	口罩	Mask	990	7.0	27.64
8	医护人员	Medical Personnel	980	6.9	9.60
9	中国	China	972	6.8	7.45
10	社区	Community	919	6.5	29.03
11	担心	Worry	871	6.1	29.44
12	确诊病例	Confirmed cases	744	5.2	19.12
13	物资	Supplies	683	4.8	29.10
14	病毒	Virus	679	4.8	19.48
15	消息	News	653	4.6	21.53
16	恐慌	Panic	630	4.4	21.97
17	相信	Believe	605	4.3	9.15
18	生活	Living	584	4.1	15.55
19	医院	Hospital	581	4.1	25.78
20	全国	Across China	561	4.0	23.78
Total			**14 190**	**100.0**	**22.36**

words posted by women; the spread of the virus followed by care responsibilities posted by men.

Table 1 reveals the economic and financial concerns of women users as well as the impact the lowdown likely had on increased domestic duties. They are the group buying supplies and doing online shopping to save money. The phrase 'Re Gan Mian (热干面)' (hot and dry—a special way of cooking noodles famous in Wuhan) shows the concerns of women with household responsibilities. Sakura was also in blossom at this time and many families would normally go for public walks to view the blossoms in Wuhan. Women may have been more sentimental about this tradition. Table 2 reveals that men users were primarily communicating about current politics and epidemiological developments. There was one care-related concern mentioned by men but not women: children. COVID-19 shifted the focus to family while under lockdown, and this mention of children could be due to men spending more time with children and/or concern with the long-term impacts of lockdown on children.

For #WuhanLockdown, tables 3 and 4, the pattern continues with men authored posts focused on infection events and politics; while women authored posts are primarily concerned with supplies and care roles, but their concern with infection also figures strongly (ie, mask, pneumonia).

CONCLUSION

Gender stereotypes observed in society tend to be replicated on social media, but social media platforms can also be an opportunity to disrupt and challenge gender norms. Social media studies of COVID-19 have identified, to date, observations of traditional gendered norms in operation: women post more than men (posting patterns); men express less emotion (sentiment); and women will post more on the emotional impact of the lockdown (keyword usage). In our examination of gender differences in posts on Weibo in association with #WuhanDiary and #WuhanLockdown during COVID-19 pandemic, we identified gendered patterns of posting behaviour that add nuance to these observations.

First, except for the first 3 weeks of lockdown, men and women posted with similar frequency. Women posted more than men, but women posted shorter posts than men. Further research on the posting time pattern and frequency of website visits would help answer more detailed questions about gender differences in posting behaviour (time to post, length of posts and other tasks while posting).

Second, we extend existing social media studies and specific COVID-19 studies to reveal that men were posting a higher percentage of negative sentiment posts.[20 22 43] Men were engaged in posting throughout the 6-month timeline and their sentiment often rose and fell in accordance with key timeline of events over the course of this outbreak. Our

Table 4 Male users keywords #WuhanLockdown

Rank	Chinese	English	Frequency	Proportion of posts w/ keyword	% Negative posts
1	武汉	Wuhan	6403	45.1	30.36
2	新型冠状病毒	COVID-19	2524	17.8	25.00
3	封城	Lockdown	1902	13.4	35.48
4	加油	Cheer up	1671	11.8	8.24
5	确诊病例	Confirmed cases	1460	10.3	54.01
6	中国	China	864	6.1	7.25
7	希望	Hope	747	5.3	8.83
8	肺炎	Pneumonia	742	5.2	26.01
9	患者	Patient	667	4.7	29.41
10	医护人员	Medical personnel	637	4.5	16.67
11	日记	Diary	589	4.2	32.94
12	担心	Worry	548	3.9	38.15
13	湖北	Hubei Provicne	523	3.7	25.52
14	病毒	Virus	522	3.7	23.27
15	社区	Community	516	3.6	29.61
16	物资	Supplies	443	3.1	32.37
17	感染	Infection	431	3.0	27.7
18	隔离	Quarantine	422	3.0	22.82
19	全国	Across China	410	2.9	26.72
20	口罩	Masks	399	2.8	29.98
Total			**8524**	**60.1**	**24.26**

research shows that this activity did not conform with the gendered expectations around women vs men engagement with social media to express emotions.[44] This finding may have important implications for public health interventions for mental health: men are turning to social media to express negative sentiment and more research is needed to understand these expressions.

Finally, during the pandemic lockdown in Wuhan, the content of Weibo posts on #WuhanDiary and #WuhanLockdown reveal that men were more preoccupied with external lockdown events than women (although only slightly). When we examined keywords, women were communicating about their care tasks and responsibilities during the lockdown, and they discussed these roles with reference to the emotions (ie, hope, panic). This needs to be understood in context. Women's posts were about the impact of the lockdown on their roles (noodles, supplies) and responsibilities (go out, China, hope). Men expressed more preoccupation and concern with the spread of the virus rather; but, in keeping with our sentiment findings above, men also revealed a degree of preoccupation with care responsibilities (education, children, resume work) and concern (confirmed case, worry, hope, family). We can observe a general pattern that men posted about the spread of COVID-19 and, to a degree, the impact of the pandemic on their lives; while women were much more focused on impact rather than spread.

Public health engagement and communication via social media may be an opportunity to break down gendered barriers during health emergencies to assist with information sharing, recovery and care. These posts on non-Western social media reveal important differences in how individuals were expressing their concerns via social media, and communicating their experiences of the social and economic impacts of lockdown pandemic. The lockdown was clearly a time of emotional stress and people found a space to express themselves via Weibo. During this health crisis, engagements in the social media space did not always conform with traditional gender norms in society. For example, it was not just women who expressed concern about the impact of the pandemic on their families. This concern was also expressed in the posts of men. We suggest this research provides a starting point for more research into how social media communication can assist with health emergency messaging. The findings also suggest that public health messaging not assume gender stereotypes are present in online communication.[45] Information during health emergencies needs to not only be gender sensitive, but gender transformative, recognising that user behaviour may not always conform to stereotypes.

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