COVID-19 information dissemination via social media: Content analysis of Instagram posts during the COVID-19 outbreak

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Article Info	A B S T R A C T
	Introduction: Social media platforms provide easy access to an unprecedented volume of information which could influence the awareness and perception of people during public health crises. The current study aims to explore the trends and content of the posts on Instagram.
	Material and Methods: We performed a retrospective content analysis of available public messages posted on Instagram. We collected data between 23 January 2020 and 25 March 2020. The inclusion criteria included an Instagram post with a hashtag related to Coronavirus (i.e. # "Corona" and # "Coronavirus", in the Persian language). Persian hashtags were used for retrieving posts. All posts were categorized into seven categories. We performed descriptive statistics with Microsoft Excel 2019 and SPSS version 26.
* Corresponding author: *Mozhgan Negarestani* *Social Determinants of Health Research Center, Institute for Futures Studies in Health, Kerman University of Medical Sciences, Kerman, Iran* *Email: m.negarestani54@gmail.com*	**Results:** A total of 4280 posts were extracted, out of which 1281 were categorized into seven main categories including News (n=205, 26.7%), Criticism (n=136, 17.7%), Education (n=112, 14.6%), Coronavirus's impact on the healthcare system (n=100, 13%), Combating Coronavirus (n=98, 12.8%), Coronavirus's impact on society (n=89, 11.6%), Joke (n=28, 3.6%).
	Conclusion: Our findings revealed that the trend of posts on social media was influenced by factors such as the nature of the information sources as well as social and political occasions. This study provides insight into health dissemination on social media for future responses to public health crises.

INTRODUCTION

The World Health Organization (WHO) declared the severe acute respiratory coronavirus 2 (SARS-CoV-2) as a pandemic on 11 March 2020 [1]. The novel Coronavirus has caused an international outbreak of respiratory illness named Coronavirus disease 2019 (COVID-19). The first case of COVID-19 was detected in Wuhan, China, in December 2019 and since then it has been spread to more than 210 countries with the total number of confirmed cases of 33,307,577, and 1,002,402 deaths as of 28 September [2]. Meanwhile, in Iran, the first two confirmed COVID-19 cases reported on 19 February 2020, with the total COVID-19 cases have increased to 446,448 on 28 September 2020 [3].

COVID-19 is identified as an infectious disease that spreads rapidly around the globe [4] with the

considerable social and economic burden and public concern. Evidence suggests that public concerns grow during a public health emergency [5]. However, providing timely health information to the public plays a crucial role in controlling the outbreak [5]. In other words, surveillance of public health and control disease activities and plans are linked through health information which is provided to the community [6]. Therefore, there is a need to communicate reliable health information messages to the public to support public health action [7].

In recent years although the authenticity and trustwithiness of the social media contents have been a serious concern, social media has transformed the way news and facts are disseminated and digested around the world and has played a crucial role in public health crisis [8]. In the past decade, we have witnessed tremendous growth in the use of mobile-based social media platforms such as Instagram due to the speed and ubiquity of cellular Internet.social media enable individuals to take constructive roles in covering and sharing news events. The use of social media and online news sources has allowed unrestricted access to information, views, and details on many health-related issues by individuals and organizations [9]. It is estimated that by 2023, 3.43 billion people globally use social media networks, which is one out of four people worldwide [10].

Evidence suggests that social media is a vital source of information for many people in times of crisis and emerging infectious disease outbreaks [11]. Social media can help emergency management efforts by quickly broadcasting messages to a large number of people at very low cost, and in the event of a crisis, serve as information-distribution conduits [12, 13]. Researchers in emergency services have observed that during a health crisis, many people rely on social media for vital information [14]. Consequently, social media has the potential to educate people and increase public awareness [5]. For instance, individuals and organizations can communicate information for growing awareness and participation among diverse and large segments of the population [15]. Thus, there is a growing need for both generating and exchanging accurate health information via social media, which is crucial to managing outbreaks.

The aim of this study was to analyze the trend and contents of the COVID-19 information in Instagram, the most popular social media platform in Iran, during COVID-19 pandemic, which is identified as a public health crisis in most of the countries worldwide. This study provides insight into the coverage of COVID-19 information on social media which could be used to develop interventions for a public health response in the future outbreaks.

MATERIAL AND METHODS

We performed a retrospective content analysis of available public messages posted on Instagram in Persian language. This method has been successfully used for the content analysis of social media in previous studies [16, 17]. Instagram was selected because of its popularity and frequent use among diverse age demographics [18]. Instagram is a free app for photo and video sharing on Apple iOS, Android, and Windows devices. Instagram allows users to upload photos and videos that can be arranged with tags and location information. Instagram is 6th most popular social network worldwide. It had reached one billion monthly active users. Iran ranks 7th in the world for using Instagram, with over 24 million active users. The penetration rate of Instagram in Iran has been reported as 50 percent in 2020.

Data collection

We collected all data through Instagram application programming interface (API). These data were available to the public; that is, anyone with an Internet connection could view the image at the time it was retrieved. The inclusion criteria included an Instagram post with a hashtag related to Coronavirus (i.e. # "Corona" and # "Coronavirus", in Persian language). Persian hashtags were used for retrieving posts because most of the Instagram posts in Iran are published in Persian language, and therefore Persian contents have much higher societal impact than English posts.

We collected data from Instagram posts between 23 January 2020 and 25 March 2020. The period was selected to capture the posts that were published three weeks after China alerted WHO on several cases of atypical pneumonia in Wuhan on 31 December 2019. This study used a week-based stratified sampling frame with 9 weeks in the study period and randomly sampled in proportion to the number of posts from each stratum. During the study period, a total of 4,280 posts were retrieved, and we randomly sampled 30% of posts each week, producing 1281 posts to be analyzed. We excluded posts if they were non-Persian, ambiguous, or unrelated to Coronavirus or COVID-19. Extracted data included images and videos, caption, date of the post, the number of views for videos. However, we did not extract video subtitles or comments written by other users about the post. All data were organized for coding in a Microsoft Excel spreadsheet.

Coding of Themes

To gain familiarity with the posts, two authors independently reviewed a sample of 100 Instagram posts, which were randomly selected. Then, the contents of each post were read individually by each reviewer, and they synthesized various categories and subcategories. Afterwards, researchers

discussed all identified categories and agreed categories and subcategories. The categories identified were (1) News (2) Education (3) Coronavirus's impact on society (4) Coronavirus's impact on the healthcare system (5) Joke (6) Combating Coronavirus, and (7) Criticism.

Two authors (N.J., M.N.) independently coded all the posts based on latent and manifest contents. They categorized posts based on the initial categories. If a reviewer was not confident with the category of the post, it was discussed with the other reviewer. If necessary, a third reviewer was involved in finalizing the categorization. The coefficient of agreement (Cohen kappa) was used to measure the level of agreement between the two reviewers and was 0.82. Table 1 outlines the coding criteria and the sample of posts.

Table 1: The coding criteria and the sample posts.

Categories	Subcategories	Definition	Example subcategorizations
News	Reported Cases and Deaths	-	-Number of positive cases -Number of dead patients
Education	Prevention method	Posts that teach people about disease prevention	- How to use a mask - How to wash hands
	Food and nutrition	Posts about recommended nutrition to strengthen the immune system during Coronavirus	- Healthy diet
	Corona Characteristics	Posts related to the characteristics of Coronavirus	-Survival of Coronavirus in the environment at different temperature
	Symptoms	Posts which teach different symptoms of COVID-19	-Fever, tiredness, dry cough
	Modes of transmission	Posts which discuss how Coronavirus could transmit among people	-Contact transmission
Corona's impact on society	Economic	Posts about how Coronavirus has affected people's incomes and the economies of countries	-The price of oil - Market crash
	Social	Posts about how Corona has influenced people's relationships and social life	-Closing schools, sports competitions and religious - Distribution free masks by people
Corona's impact on the health care system	Diagnosis and treatment measures	Posts about measures have been taken to diagnose and treat COVID-19.	-Detection Kit -Treatment protocols
	Health care workers	Posts about Problems and challenges health care workers face.	-Lack of Personal protective equipment
Joke	Social	Posts about something funny about Coronavirus which was said or done by people in the society	-Traditional Iranian Medicine
	Political	Posts about Something funny about Coronavirus which was said or done by government politicians.	-Elections during the spread of Corona
Combating Corona	Travel	Posts that discuss actions to prevent people from travelling	-Traffic restrictions
	Cleaning and Disinfecting Public Spaces	Posts about actions have been taken to disinfect cities.	-Disinfection of buses, gas stations and banks
	Providing Online Services	Posts about online services aimed at reducing people's presence in crowded places	-E-Banking, online shopping and E-learning
	Social distancing	Posts about actions have been taken in the community to maintain social distance	-Keep distance from other people -Work from home
Criticism	Social	Posts that criticized people's behavior in society	-Mask holders
	Political	Posts that criticized the government's performance on Coronavirus's actions	- No quarantine of cities - Iran's Mahan Air continue Flights to China

Quantitative data analysis of the posts

We performed descriptive statistics with Microsoft Excel 2019 and SPSS version 26. We calculated frequency and percentage to describe the characteristics of the posts. These characteristics included post source, post format, and topics covered, number of views for Instagram videos, number of likes for Instagram photos. We presented weekly trends of the posts in the bar chart based on the identified categories. We numbered the weeks according to the timeline of the COVID-19 outbreak: the week that the first case of COVID-19 was officially confirmed in Iran was labeled as week 0. Three weeks before that was labeled as week -3 to week -1. The weeks after the announcement of the first case, were labelled as week 1 to week 5.

RESULTS

A total of 1,281 Persian posts were retrieved from Instagram. Of the total Instagram posts, 60% (n=768) were related to COVID-19 or Coronavirus. The average number of views of posts was 24,836 (10,090 - 352970). The posts were in two types of video (n=210, 27.3%) and photo (n=558, 72.7%).

Contents of the Posts

Seven categories were emerged from the analysis including Joke 28 (3.6%), News 205 (26.7%), Education 112 (14.6%), Criticism 136 (17.7%), Combating Coronavirus 98 (12.8%), Coronavirus's impact on the health care system 100 (13%), Coronavirus's impact on society 89 (11.6%).

Table 2: Categories identified on Instagram platforms

Categories	N (%)
News	205 (26.7)
Education	112 (14.6)
Coronavirus's impact on society	89 (11.6)
Coronavirus's impact on the health care system	100 (13)
Joke	28 (3.6)
Combating Coronavirus	98 (12.8)
Criticism	136 (17.7)
Total	768 (100)

Among the all categories, news with 205 (26.7%) of posts ranked as the most frequent category. Then there was Criticism, which involves 136 posts (17.7%) including Social and Political Criticism posts, (50.7% and 49.3%), respectively. Education on different area of the disease came in the third place with 112 posts (14.6%). Among them the most popular area was the Prevention method with 46 posts (41.1%), and the least frequent posts were related to food and nutrition with 5 (4.5%). Finally, Joke ranked as the least frequent posts with 28

(3.6%),

Table 3: Categories and Subcategories of Content

Categories	Subcategories	N (%)
News	Reported Cases and Deaths	205 (100)
Education	Prevention method	46 (41.1)
	Food and nutrition	5 (4.5)
	Coronavirus Characteristics	33 (29.4)
	Symptoms	21 (18.8)
	Modes of transmission	7 (6.2)
Coronavirus's impact on society	Economic	24 (27)
	Social	65 (73)
Coronavirus's impact on the health care system	Diagnosis and treatment measures	66 (66)
	Health care workers	34 (34)
Joke	Social	14 (50)
	Political	14 (50)
Combating Coronavirus	Travel	17 (17.3)
	Cleaning and Disinfecting Public Spaces	20 (20.4)
	Providing Online Services	9 (9.2)
	Social distancing	52 (53.1)
Criticism	Social	69 (50.7)
	Political	67 (49.3)

Trend of Posts on Instagram

Fig 1 shows the number of Instagram posts based on categories over nine weeks. At the beginning of the study in the week -2, which is two weeks before occurring of the first case in Iran, the number of posts on Education with 27% (26 out of 95) and Coronavirus's impact on the healthcare system 24% (23 out of 95) and News 18% (18 out of 95) were slightly higher than the other categories of posts. During this week, Joke had the lowest post with just 3% (3/95). In the week -1 and 0, the number of posts in all categories decreased.

After that, there was a significant upward trend in the number of posts in the first week. This week, the News peaked at 32% (61/190). Then, the highest number of posts were in Combating Coronavirus and Criticism with 16% (32/190), and Coronavirus's impact on society 16% (29/190).

In the second week, Coronavirus's impact on the health care system, Education and Joke had an increasing trend, while the number of posts in other categories decreased. During the third to fifth weeks, the number of posts in Combating Coronavirus and Coronavirus's impact on the healthcare system experienced an upward trend while Joke decreased. Other categories fluctuated during this period.
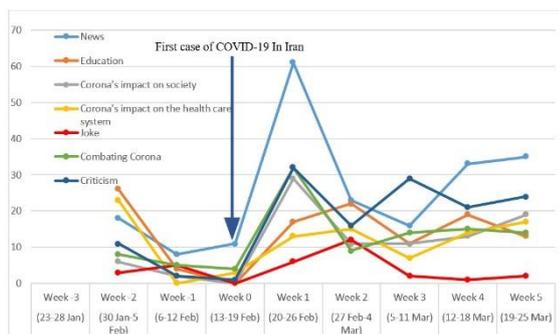
Fig 1: Weekly Instagram posts by categories during 9 weeks

Fig 2 shows synconization of social and political occasions in countries with confirmed Coronavirus cases during three months: from 23 January 2020 to 25 March 2020. The first case of Coronavirus in Iran was reported eight days after the anniversary of the Islamic Revolution. It is celebrated on 11th February. Although the first Coronavirus was confirmed on 19 February, the Parliamentary election was held on 21st February, amid public health cautious expressed by some people.
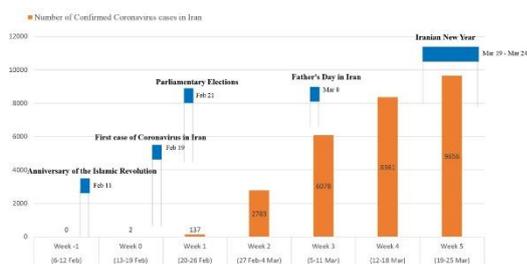

Fig 2: Timeline of new cases of COVID-19 in Iran and social/political occasions

DISCUSSION

In this study, we analyzed the contents of the posts' and categorized them on one of the most popular social media platforms (Instagram) in Iran during nine weeks of COVID-19 crisis. Our findings showed that News, Criticism, and Education had the highest number of posts. Furthermore, analysis of the trend of the topics in different categories over time showed that posting trends might be influenced by social-cultural occasions and the number of identified COVID-19 cases.

Contents of the Posts

On Instagram, most of the posts were related to the News. Posts reported that a COVID-19 epidemic was already happening in Iran. Many posts reported the number of Coronavirus cases and deaths around the world and especially in Iran. This finding further supports the idea that many individuals have used social media to obtain an understanding of the pandemic and COVID-19 [19, 20]. On the other hand, Joke had the lowest number of posts on Instagram,

which is in line with the result of Cynthia Chew's study [21]. This study conducted a content analysis of "tweets" about Swine flu pandemic (H1N1). The results showed that less than 10% of H1N1 Twitter posts were Joke. Contrary to the results of this study, the results of Seltzer et al. study [16] revealed that most of the images related to Ebola on Instagram were about Joke. A similar study also showed that 21% of Ebola's tweets were interpreted as a joke [22]. This discrepancy could have resulted from the nature of the diseases. Ebola is less contagious than COVID-19 and H1N1, and transmits only through bodily fluids, rather than in the air and touch surfaces. So, people might be more concerned with coronavirus infections and avoid circulating joks on social media. Also, that might be due to different charctristics of users of these platforms.

Criticism posts, especially social criticism, were dominant on Instagram. The reason could be due to the critical role of people in controlling the Coronavirus outbreak. After the announcement of the first COVID-19 case in Iran, many people did not take health advice seriously. For example, many people traveled to other cities for holidays and did not follow the social distancing recommendations. As a result of these behaviors, more posts were posted on social media criticizing their heedlessness . From the posts, it was clearly understood that people need to change their behaviors to reduce the spread of Coronavirus and control the epidemic. In addition, political criticism posts were shared frequently, which shows that people are not satisfied with the government's performance in controlling the disease. Most of the posts criticized the government's decision on not to impose adequate border controls and quarantine rules which resulted in increasing the number of cases across the country.

Education ranked the third topic. The highest number of posts in the Education category was related to prevention methods, which shows the importance of prevention compared to treatment. In line with our findings, similar studies showed that prevention is a popular topic on social media about Zika virus [23, 24]. Also, during the influenza epidemic, information about the virus and prevention were popular topics on social media websites in the Netherlands [25]. Moreover, another study by [26] showed that about 84% of Internet users want to learn about patient education materials. Therefore, social media networks have the potential to be used as a tool for educating people. Besides, the number of posts about the virus's characteristics was high. This means the society tends to get more information about this virus due to the novelty of the virus [27].

During the Coronavirus crisis, the health care systems faced many challenges due to the high number of patients and the spread of the disease worldwide. These challenges include the lack of

diagnostic kits, shortages of hospital beds, and insufficient medical staff. Besides, health care providers experienced severe work conditions. There was a shortage of personal protective equipment in many countries, resulting in a large number of health care workers getting infected with Coronavirus. However, on social media, Coronavirus's influence on the healthcare system was very low. Less than a tenth of the posts were related to Coronavirus's impact on the health care system. This issue is in line with the results of Corey H. Basch that indicated only 18% of the videos on YouTube discussed danger for health care personnel [28]. The results of a study by Chun-Hai Fung [23] also showed that less than a fifth of Instagram posts were relevant to the treatment of Zika in a healthcare setting.

In the category of Coronavirus's impact on society, the number of posts was low despite its significant impact. Coronavirus led to the quarantine and closure of many businesses and jobs. Therefore, it has remarkably reduced the income of individuals and harmed the economy of countries. It is essential to note the importance of Coronavirus's impact on people's financial situation by posting on social media. This will make policymakers aware of the difficult financial situation of people's lives so that they can make the right decisions to provide facilities to support people. This might be related to the time of the study. Our study was conducted for the first three months, which might be too early to discuss the disease's economic impacts.

Combating Coronavirus category discusses different actions which people and government should take to control the outbreak. People are advised to stay at home and avoid unnecessary travel, to maintain social distance, which can reduce the spread of Coronavirus [29]. Moreover, government and many organizations provide online services such as online shopping, e-banking, e-learning to avoid gathering of groups of people [30]. Public health measures have been implemented to curtail the spread of COVID-19 such as cleaning and disinfecting public spaces, including parks, public transportations, and stores.

Trends of Instagram posts

At week -3, most of the posts were educational because, during this period, the number of infected people and deaths in China had increased. So, it deemed important to enhance individual's awareness of Coronavirus and sharing educational posts on social media. There were few posts in the fourth week, and with the official announcement of the first case of COVID-19 in Iran, the number of posts increased in the first week. In addition, the earlier presence of details regarding influenza behavior on social media websites is consistent with research suggesting that such information is reported through social media websites earlier than through official

registration attempts [31].

News, Combating Coronavirus, and Coronavirus's impact on society and criticism reached a peak. This may be due to Instagram is not filter, and people can have access to information easily. So, after the official announcement of the first case of COVID-19 in Iran, Criticism and News had the most posts. After the second week, the number of posts related to the impact of Coronavirus on society increased due to the problems caused by Coronavirus in society. Besides, declining Joke posts indicated the issue has become more serious.

In the third and fifth weeks, the criticism peaked again, and most of the posts were social criticism. The reason goes back to the increase in the number of confirmed cases. In the 7th week, it was Father's Day, and in the 9th week, it was New Year holidays, which People gathered together and did not keep the social distancing recommendations. As a result, a large number of infected with COVID-19 reported.

CONCLUSION

The aim of this study was to investigate the trends and contents of the information on Instagram during COVID-19 in Iran. The findings of this study strengthen the idea of the importance of social media as a useful tool in health communication during disease outbreaks. One of the most significant findings emerged from this study was that News, Criticism and Education had the highest number of posts on social media. Therefore, public health agencies can use social media to spread health information among people and increase their awareness of general issues in a timely manner. In addition, the content of posts on social media can be affected by the nature of information sources. In some social networks, most non-serious posts are published to attract the audience. While other popular social media such as Instagram focus more on educating and informing people to help control the outbreak. Moreover, social and political occasions in countries can affect the contents and trend of posts. People can also share their social and economic challenges on social media which could lead that policymakers informed about people's need and provide solutions in a time of crisis.

Limitations

There are two limitations to our study. Firstly, we did not examine the trustworthiness of the posts, especially education posts, due to the limited knowledge available on the Coronavirus and continued controversy about various aspects of COVID-19 at the time of writing this paper. Future studies can analyze the content of posts to identify the spread of misinformation about COVID-19 or Coronavirus. Secondly, our study examined a sample

of social media posts in Persian language and may not appropriately represent the disease information on social media in other languages.

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AUTHOR'S CONTRIBUTION

NJ, FZ, AV, MN, and FF participated in the design and coordination of the study. NJ, SA, and SK performed data acquisition and sampling. NJ and MN interpreted the data. SA analyzed the data. SA, SK, SM, and MH helped draft parts of the manuscript. NJ wrote the paper. AV, FF, and FZ revised the paper.

All authors contributed to the literature review, design, data collection and analysis, drafting the manuscript, read and approved the final manuscript.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest regarding the publication of this study.

FINANCIAL DISCLOSURE

No financial interests related to the material of this manuscript have been declared.

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