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Online Social Interaction for COVID-19 in Asia

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Abstract

While prior studies have barely explored social interaction for COVID-19 across Asia, this study highlights how people interact with each other for the COVID-19 pandemic among India, Japan, and South Korea based on social network analysis by employing NodeXL for Twitter between July 27 and July 28, 2020. This study finds that the Ministry of Health and Prime Minister of India, news media of Japan, and the president of South Korea play the most essential role in social networks in their country, respectively. Second, governmental key players play the most crucial role in South Korea, whereas they play the least role in India. Third, the Indian are interested in COVID-19 deaths, the Japanese care about the information of COVID-19 patients, and the South Korean focus on COVID-19 vaccines. Therefore, governments and disease experts should explore their social interaction based on the characteristics of social networks to release important news and information in a timely manner.

Coronavirus (COVID-19) is one of the worst phenomena across the world. As of August 3, 2020, about 18 million cases of COVID-19 have been reported in more than 188 countries, resulting in more than 650,000 deaths. In this sense, controlling the COVID-19 pandemic is one of the most important issues for countries all over the world.[1–5]

Most governments and centers for disease control have investigated how COVID-19 plays a severe role in human life and tried to provide true information on COVID-19.[6–10] For example, the government of India releases important COVID-19 information on its homepage because there is a lot of false information to be found elsewhere. Also, there is no evidence that regularly rinsing the nose with saline has protected people from infection with COVID-19. Garlic is healthy, but there is no evidence from the current outbreak that eating garlic has protected people from COVID-19.

Scholars have explored the effects of COVID-19 on people and the growth rate across the world.[11–15] For example, Courtemanche et al. highlight that adoption of government-imposed social distancing measures reduced the daily growth rate by 5.4 percentage points after 1-5 days, 6.8 after 6-10 days, 8.2 after 11-15 days, and 9.1 after 16-20 days based on US counties between March 1, 2020 and April 27, 2020.[16]

However, many previous studies have focused on the effects of COVID-19 on Europe or the US.[17–21] Therefore, this study explores how individuals interact with each other surrounding the COVID-19 issue in Asia by employing social network analysis (SNA) for Twitter, which is one of the most popular Social Network Services (SNS). SNS are some of the most crucial information resources in our information technology era, and most people get relevant information on COVID-19 on the internet. Therefore, understanding the communication networks for COVID-19 on the internet can assist governments in providing relevant news and information to the public.

Specifically, this study chooses 3 Asian countries: India, Japan, and South Korea. While some may wonder why China was not chosen for the study, people in mainland China cannot use Twitter unless they use the virtual private network (VPN) because the Chinese government blocks worldwide US platforms, such as Twitter, Facebook, and YouTube.

This study selected these 3 countries because India is the top Asian country (India, Japan, and South Korea) and ranks third in the world for COVID-19. Japan is an important case because of the high number of COVID-19 patients and the pandemic on board Diamond Princess. South Korea is one of the best examples of coping with the COVID-19 pandemic in the world.[24–26] To the best of my knowledge, this study is the first article exploring social networks for COVID-19 based on various countries in Asia by employing social network analysis for Twitter.

Literature Review

COVID-19 Across Asia

COVID-19 is a respiratory illness caused by a new virus, resulting in fever, coughing, a sore throat, and shortness of breath. It was first reported in December 2019 in Wuhan City in China.

COVID-19 is a new form of coronavirus that is similar to Middle East Respiratory Syndrome (MERS) and Severe Acute Respiratory Syndrome (SARS).

Governments and centers for disease control have put a lot of effort into minimizing COVID-19 damage.[25] For example, many European countries initiated unprecedented non-pharmaceutical interventions, such as the closure of schools and universities, social distancing, banning of mass gatherings and public events, case isolation, and lockdowns.[19] The Chinese government implemented Suspending Classes Without Stopping Learning launched by the Ministry of Education, a switch from school teaching activities to large-scale online teaching while schools were closed.[25]

Asian countries, such as India, Japan, and South Korea, show different preparedness and response to COVID-19.[26–28] For instance, India shows a different COVID-19 response at the state level. Kerala utilizes its experience with the Nipah virus in 2018 to use contact tracing, extensive testing, and community mobilization to control the virus and maintain the very low mortality rate. Maharashtra utilizes unmanned aerial vehicles to monitor physical distancing during lockdown. All houses within 3 km are investigated to discover further cases, trace contacts, and increase awareness if 3 or more patients are confirmed.[22]

Japan does not enforce social distancing rules and implement mandatory lockdown, as seen in other countries. Instead, the Japanese government politely requests people's voluntary self-restraint to avoid crowded areas and settings where there may be close range conversations, as well as spots that have poor ventilation.[23]

South Korea smartly employs its advanced information technology (IT) for tracking COVID-19 patients or those who are in contact with the COVID-19 patents. Korea Centers for Disease Control and Prevention (KCDC) can collect COVID-19 patient data to minimize the disease pandemic at the national level, such as personal identification information, location data, immigration records, medical and prescription records, card transaction data, transit pass records for public transportation, and closed-circuit television (CCTV) footage.[24]

Online social interaction for COVID-19 significantly decreases social interaction in the real world and increases social interaction in the online world.[29–31] This is because COVID-19 has a seriously high infection rate, and people get important news and information about COVID-19 online. In addition, many governments enforce some form of "lockdown" to decrease the spread of COVID-19 among people and release COVID-19 reports and infection rates through their SNS and official homepages.

In this background, Twitter has become one of the best sources for understanding what made countries differ in their COVID response strategy.[32–37] For example, Nia et al. highlight macro-economic responses to the COVID-19 pandemic using Twitter sentiments according to lower-middle (Nigeria), upper-middle (South Africa), and high (Canada) income.[35] Perlstein and Verboord show public discourses on political authorities during the COVID-19 pandemic across Denmark, Germany, the Netherlands, and Sweden.[36]

Many scholars have highlighted how people have communicated with others by employing social network analysis for COVID-19.[37–38] For example, Yum highlights that people are more likely to show communication networks within groups in New York, whereas those are more apt to exhibit communication networks across groups in California.[37] Pascual-Ferrá et al. report that the network of conversations around COVID-19 is highly decentralized, fragmented, and loosely connected during 3 key communication events from late January to early June of 2020.[38]

Some scholars have explored the relationship between COVID and social network services in Asia.[39–40] For instance, Choi shows that social media use directly and indirectly impacts people's negative emotions through social distancing and risk perception during the COVID-19 outbreak in South Korea.[39] Faruk et al. reveal that SNS play a significant role in disseminating news related to the pandemic based on primary data collected from 400 successful respondents.[40] However, they have not highlighted how people interact with each other around COVID-19-related issues by employing SNA for Twitter across Asian countries. Therefore, this study explores the interaction among people regarding COVID-19 in India, Japan, and South Korea.

Research Methodology

This study employs SNA to highlight the social networks of COVID-19 in India, Japan, and South Korea. SNA is the practice of representing nodes for people and edges connecting 2 or more nodes as graphs.[41–43] SNA is becoming increasingly important in many academic fields.[44–49] This study utilizes Twitter data to highlight online communications of people for COVID-19 across public key players. Twitter has been widely used for big data analyses.[50–53] This study employs the NodeXL program based on COVID-19 keywords and the countries (COVID-19 and India, COVID-19 and Japan, and COVID-19 and Korea) between July 21 and July 28, 2020 because COVID-19 exerted a serious impact on Asian countries during this period.[54] For example, India is the
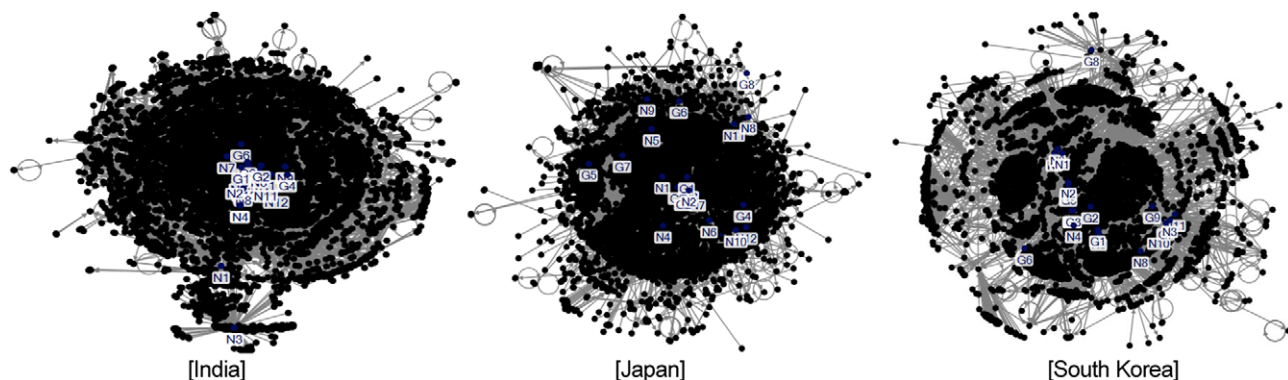
Figure 1. Between centrality.
Note. The label is explained in Tables 2–4.

top Asian country and ranks third in the world for COVID-19 as of July 28, 2020. While this study employs the NodeXL program between the days, NodeXL allows the author to gather Twitter data for COVID-19 from December, 2019. This study selects the best data set for the analyses (July 27 and July 28), which contains the highest number of Twitter users, communication networks, and suitable pieces of content.

This study employs NodeXL to explore the social networks of India, Japan, and South Korea for COVID-19. NodeXL is a visualization software program, which supports social networks and content analysis. NodeXL has been extensively used to analyze social network systems in academic fields.[55–56]

This study employs the "betweenness centrality" method to capture public key players for Twitter users because between centrality is one of the most useful methods of calculating the importance of users.[57–59] To be specific, "betweenness centrality" calculates the fraction of shortest paths passing through a vertex.[60] Betweenness centrality is a widely used measure that captures a person's role in allowing information to pass from one part of the network to the other.[61] Many studies on social network analysis for COVID-19 employ between centrality to explore important nodes of social networks.[90–92] This study chooses the top 20 key players among all Twitter users based on the magnitude of between centrality (Table 1).

This study first shows betweenness centrality, the clustering coefficient, and reciprocated vertex pair ratio to highlight social networks for COVID 19 in India, Japan, and South Korea. The clustering coefficient measures the degree to which nodes in a graph tend to cluster together. In most real-world networks, and in particular social networks, nodes are more likely to create tightly

knit groups categorized by a relatively high density of ties. This likelihood tends to be greater than the average probability of a tie randomly established between 2nodes.[62–63] Reciprocated vertex pair ratio is ratio between ingoing and outgoing networks in directed relationships. It is the proportion of vertices (Twitter users) that have a network returned to them. Higher reciprocated vertex pair ratio shows a person engages in more 2-way interaction.[64]

This study also employs content analyses by looking into the most important tweets because content analysis of Twitter data can provide essential information about public health crises.[65–66] The contents demonstrate the public discourse on Twitter regarding COVID-19 among the countries. To be specific, this study analyzes the tweets which have the highest number of retweets or favorites among Twitter users in COVID-19 social networks and utilizes them as the examples of the findings in the results section.

Next, this study employs cluster analysis by utilizing the Clauset–Newman–Moore cluster algorithm. Cluster analysis is a methodology for the task of assigning a set of objects into groups so that the objects in the same cluster are more similar to each other than those in other clusters. The Clauset-Newman-Moore cluster algorithm calculates modularity as a property of a network to create a category of that network into groups. It measures when the category is a good one, in the sense that there are many edges within groups and only a few between them.[67–68]

Results

Figures 1-3 show that social networks for COVID-19 are differentiated by type and country. For example, in the between centrality

Table 1. Descriptive statistics

Graph Type	India	Japan	South Korea
	Directed	Directed	Directed
Vertices (Twitter users)	16139	16294	9532
Unique Edges (networks)	27366	18615	12969
Edges with Duplicates	7598	1505	2690
Total Edges	34964	20120	15659
Self-Loops	3690	3358	1728
Reciprocated Vertex Pair Ratio	0.006	0.002	0.001
Reciprocated Edge Ratio	0.012	0.004	0.003
Connected Components	2156	2638	1004
Single-Vertex Connected Components	1433	1828	723
Maximum Vertices in a Connected Component	11940	12044	7921
Maximum Edges in a Connected Component	29669	15799	13905
Maximum Geodesic Distance (Diameter)	14	17	15
Average Geodesic Distance	5.422	5.508	4.280
Graph Density	0.000	0.000	0.000
Modularity	0.682	0.777	0.604
Minimum Betweenness Centrality	0	0	0
Maximum Betweenness Centrality	24516349	44024075	20168580
Average Betweenness Centrality	39074	40141	21594
Median Betweenness Centrality	0	0	0
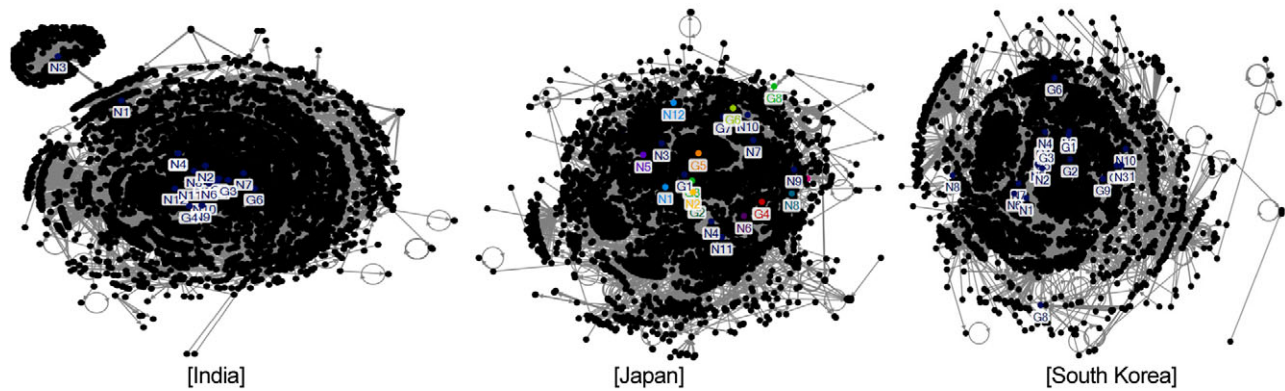
Figure 2. The clustering coefficient.

networks and key players in India are clustered in the central part of the social networks. Key players in Japan are dispersed across the networks. Key players in South Korea are concentrated in specific parts of the networks. In the clustering coefficient networks, N3 (RT en Español) has its own networks in India. Nodes show more dispersed patterns in Japan. In contrast, nodes are more concentrated patterns in Korea. In the reciprocated vertex pair ratio networks, most key players are located in the central part of the network circle in India. G5 (Abe Shinzo: Prime Minister of Japan) is separate from other key players in Japan. G8 (Daejeon: South Korea's fifth-largest metropolis) and N8 (Yonhap News: South Korean news agency) show some distance from other key players in Korea.

Tables 2-4 show the top 20 key players according to countries. In the India networks, the Ministry of Health and Narendra Modi, the Prime Minister of India, play the most important role in social networks for COVID-19 (first and second, respectively). PMO India, which is the Prime Minister's Office, also exerts a significant impact on social networks of COVID-19 (fourth). This is because people tend to mention the Ministry of Health, the Prime Minister, and the Prime Minister's Office in their tweets at the same time to share important information and news. For example, "For the first time, India's death rate due to the COVID-19 pandemic is less than 2.5% and India is in a better position than many other countries. Watch this video for more information. #IndiaFightsCorona @PIB_India @MoHFW_India @PMOIndia https://t.co/UqZitX1uPh."

Table 2. The top 20 key players in India

	Label	BC	Name	Description
1	G1	24516349	Ministry of Health	Ministry of Health in India
2	G2	21951095	Narendra Modi	Prime Minister of India
3	N1	14723426	CNN en Español	Pan-American Spanish-language news channel
4	G3	12565565	PMO India	Prime Minister's Office
5	N2	11870327	Corona Update Bot	Important updates about #coronavirus
6	N3	11322218	RT en Español	Spanish-language pay television channel of the RT network
7	G4	9033598	Congress	The Indian National Congress
8	N4	8387868	Bloomberg QuickTake	Global business and markets news, data, analysis, and video QuickTake
9	N5	8292399	Bloomberg	Global business and markets news, data, analysis, and video
10	N6	7605832	Hindustan Times	Indian English-language daily newspaper
11	N7	6929716	Zee News	Hindi-language news channel owned by the Essel Group
12	N8	6633619	IndiaToday	Weekly Indian English-language news magazine
13	N9	6430459	ndtvindia	Hindi news channel in India
14	N10	5751262	Press Trust of India	The largest news agency in India
15	N11	5238460	NDTV	New Delhi Television Limited
16	G5	4427089	Harsh Vardhan	Minister of Health and Family Welfare
17	N12	4341668	Ashok Swain	Chair of the UNESCO.
18	G6	3953688	Ramesh Pokhriyal Nishank	Member of the Lok Sabha.
19	N13	3935083	Republic	Official handle of the Republic Media Network.
20	N14	3832027	ABP News	Indian Hindi news channel owned by ABP Group

Note. BC: Between centrality, G: Governmental key player, N: Non-governmental key player

Table 3. The top 20 key players in Japan

	Label	BC	Name	Description
1	N1	6150503	Yahoo! news	News website by Yahoo!
2	N2	3174357	NHK news	Japan's national broadcast
3	G1	2276949	Yukio Hatoyama	Former Prime Minister of Japan
4	G2	2032642	Mori Masako	Minister of Justice
5	G3	1209175	Genki Sudo	Politician who serves as a member of the Constitutional Democratic Party of Japan
6	N3	900359	Koichi Nakano	Professor of Political Science
7	G4	855034	Hirofumi Yoshimura	Governor of Osaka
8	N4	846356	huffpostjapan	American news aggregator and blog in Japan
9	N5	723280	NHK_seikatsu	NHK account that delivers information on disasters
10	N6	582953	sankei_news	One of the 5leading national newspapers
11	N7	496793	theokinawatimes	Official account of "Okinawa Times"
12	G5	481246	Abe Shinzo	Prime Minister of Japan
13	G6	433496	Kazuo Shii	politician and Chairman of the Japanese Communist Party
14	G7	364706	Nobuto Hosaka	Japanese politician and the current mayor of Setagaya in Tokyo
15	N8	312909	livedoornews	News in a wide range of genres
16	N9	288872	nikkei	The world's largest financial newspaper,
17	N10	266090	NHK_sports	Japan's national broadcast for sports
18	G8	264752	Tetsuro Fukuyama	Politician of the Constitutional Democratic Party of Japan
19	N11	256063	NHK_shutoken	Japan's national broadcast for the Capital Region
20	N12	251208	YouTube	American online video-sharing platform

Table 4. The top 20 key players in South Korea

	Label	BC	Name	Description
1	G1	12581092	Moon Jae-in	President of South Korea
2	G2	7829600	Blue House	Executive office of the President of South Korea
3	N1	4311979	Women news	Female news
4	N2	3000249	MBC News	Munhwa Broadcasting Corporation
5	N3	1437374	YouTube	American online video-sharing platform
6	N4	943370	NewBC	News based on the expansion of the rights of citizens
7	G3	782330	Ministry of Foreign Affairs	South Korea's Ministry of Foreign Affairs
8	N5	676235	KBS news	Korean Broadcasting System news
9	G4	454053	Han Junho	Member of the National Assembly of South Korea
10	N6	300669	SBS news	Seoul Broadcasting System
11	N7	260149	BBC news in Korea	British free-to-air television news channel in Korea
12	G5	223115	Ministry of Gender Equality and Family	Cabinet-level division of the government of South Korea
13	N8	68521	Yonhap News	South Korean news agency
14	G6	64666	Ministry of Culture, Sports and Tourism	Central government agency responsible for the areas of tourism, culture, art, religion, and sports
15	G7	48257	Cho Kuk	Former Minister of Justice of South Korea
16	N9	47888	KTV	Korea TV network
17	N10	37624	Money Today	News on the economy
18	G8	36075	Daejeon	South Korea's fifth-largest metropolis
19	G9	34203	Ministry of Land, Infrastructure and Transport	Cabinet-level division of the government of South Korea
20	N11	28147	Hankook Ilbo	Korean-language daily newspaper in Seoul

The second remarkable characteristic is that news media play a crucial role in social networks in India, whereas India has the least governmental key players. For example, 12 of the top 20 key players are news media, consisting of 60% of the top players. The number of news media is 2 times more than that of governmental key players (6). This is because many news media deliver important COVID-19 news to Indian people. For example, "Nearly one in four people in India's capital may have contracted Covid-19, study finds https://t.co/RMMrujl6nm."

The third interesting finding is that Hispanic key players have a huge impact on social networks for COVID-19. For example, CNN en Español, which is the Pan-American Spanish-language news channel, and RT en Español, which is the Spanish-language pay television channel of the RT network, rank third and sixth, respectively. People tend to retweet some important tweets written in Spanish to share numbers related to COVID-19. For example, "Estos son los 10 países con más muertos por covid-19, según Johns Hopkins (These are the 10 countries with the most deaths from covid-19, according to Johns Hopkins): https://t.co/1w5UKDgPaR EE.UU.: 141.992, Brasil: 81.487, Reino Unido: 45.507, México: 40.400, Italia: 35.073, Francia: 30.168, España: 28.424, India: 28.084, Irán: 14.634, Perú: 13.579."

In the Japan networks, news media play the most important role in social networks of COVID-19. Yahoo! News, which is the news website that originated as an internet-based news aggregator by Yahoo!, ranks first. For the sake of readers, Yahoo! Japan's web portal is the most visited website in Japan, and its internet services are mostly dominant in the country. NHK news, which is the Japan's national broadcast, places second. Its official English name is Japan Broadcasting Corporation and owned by the government of Japan. Also, NHK news channels exert a powerful effect on social networks for COVID-19. For instance, not only do NHK news channels take second, but also, NHK seikatsu, which is the NHK account that delivers information on disasters, takes ninth, NHK sports places seventeenth, and NHK shutoken, which is the news for the capital region, ranks nineteenth. People frequently share COVID-19 news with the link provided by major news media sites. For example, Yahoo! News uploaded its tweet as follows:

"連休が感染拡大のヤマ 医師会 (Consecutive holidays spread infection Yama Medical Association) https://t.co/sne5T9wpLW."

On the other hand, Japan has 8 governmental key players and shows an interesting characteristic. All governmental key players are politicians, whereas India has the same number between politicians and governmental institutes and South Korea has a smaller number of politicians than governmental institutes. For example,

Yukio Hatoyama, the former Prime Minister of Japan, ranks third, and Mori Masako, the Minister of Justice places fourth. Genki Sudo, the Politician who serves as a member of the Constitutional Democratic Party of Japan, takes fifth, and Hirofumi Yoshimura, the Governor of Osaka, places seventh. This is because many Japanese politicians upload their opinions and information on their Twitter. For example, Yukio Hatoyama uploaded his tweets as follows:

"在日米軍が漸くコロナの感染者数を発表した。沖縄で調べた数字より少ないことが気になるが、地元の批判で方針を転換した。ただ気になるのは、米軍はロックダウン(封鎖)と言いながら、基地のメインゲートは開いたままで、車両の出入りは続いていることだ。相変わらず米軍は日本を植民地と思っている。(The US military in Japan finally announced the number of people infected by Corona. I am worried that the number is lower than the number that I researched in Okinawa, but I changed my policy due to local criticism. The only thing that bothers me is that the main gate of the base remains open and vehicles continue to enter and exit, even though the US military says it is in lockdown. The U.S. military still regards Japan as a colony.)"

In the South Korea networks, Moon Jae-in, the president of South Korea and the Blue House, the executive office and official residence of the president of the Republic of Korea, play the most pivotal role in social networks of COVID-19 (first and second, respectively). Also, governmental key players play the most significant role in social networks for COVID-19. For example, the Ministry of Foreign Affairs ranks seventh, and Han Junho, a member of the National Assembly of South Korea, places ninth. The Ministry of Gender Equality and Family and Ministry of Culture, Sports and Tourism rank twelfth and fourteenth, respectively. Cho Kuk, former Minister of Justice of South Korea, ranks fifteenth, and Daejeon, the fifth-largest metropolis in South Korea, takes eighteenth. The Ministry of Land, Infrastructure and Transport places nineteenth. Results show that the Ministries of South Korea play an important role in social networks for COVID-19. This is because Korea has a democratic unitary political system, and its public health governance is centralized.[69] Therefore, citizens get important information and news from the Ministries of South Korea. For example, the Blue House uploaded its tweet about President Moon's COVID-19 response and shared it with South Korea's citizens as follows:

"문재인 대통령은 한국시각으로 16일 새벽, 워싱턴 포스트에 코로나19 백신의 공정하고 투명한 분배를 촉구하는 글을 공동 기고했습니다 (President Moon Jae-in co-contributed an article to the Washington Post on the morning of thesixteenth, Korean
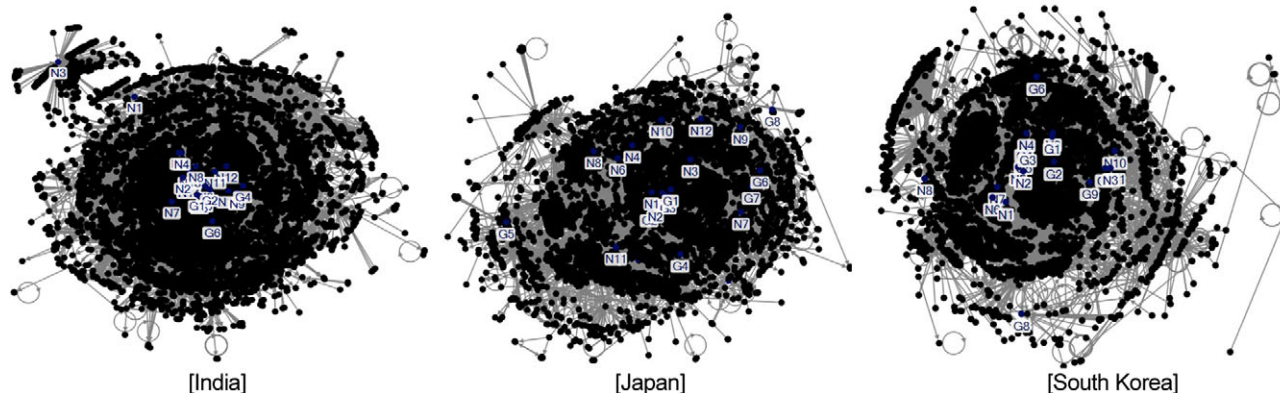

Figure 3. Reciprocated vertex pair ratio.

time, calling for a fair and transparent distribution of the Corona 19 vaccine)."

Another remarkable finding is that female key players have a significant impact on social networks for COVID-19. For example, Women news and the Ministry of Gender Equality and Family rank third and twelfth. Also, YouTube ranks fifth, which is 4 times higher than its role in Japan, implying that YouTube plays a more important role in social networks in South Korea than Japan.

Figure 4 highlights the social networks of COVID-19 for the typical case. In the India networks, nodes make a large circle and a small rectangle. All key players are concentrated in the central part of the circle except for CNN en Español (N1) and RT en Español (N3). N1 is located in the right side of the circle, and N3 is located in the lower part of the rectangle. The results show that Hispanic key players have different social networks, compared to other key players. In the Japan networks, nodes are more dispersed than those in India, but they still are concentrated as a large circle and have many nodes under the circle. Key players show the most dispersed pattern among the 3 countries. Yukio Hatoyama (G1) is placed in the center of the circle, whereas Abe Shinzo (G5) is located in the outside of the circle. In the South Korea networks, nodes are highly distributed in the social networks, whereas key players are relatively concentrated in the central part except for the Ministry of Culture, Sports and Tourism (G6), Daejeon (G8), and Yonhap News (N8).

Figure 5 demonstrates the social networks of COVID-19 according to groups. In the India networks, most key players are located in large groups. All key players have their social networks within group 20, and 16 key players are within group 10. For example, Congress (G4) and Ashok Swain (N12) have their social networks in group 1, and the Ministry of Health (G1), Narendra Modi (G2), PMO India (G3), Harsh Vardhan (G5), and Ramesh Pokhriyal Nishank (G6) belong to group 2. All governmental key players have the same communication group except for Congress.

In contrast, in the Japan networks, key players tend to belong to small groups. This is the most different characteristic of Japan, compared to India and South Korea. For example, only 2 key players are located within group 10. Nobuto Hosaka (G7) has its channel in group 6, and Kazuo Shii (G6) is placed in group 7. NHK news (N2), Sankei news (N6), and Abe Shinzo (G5) belong to group 12.

In contrast, in the South Korea networks, many key players are concentrated in group 1. Eight of the top 20 key players are placed in group 1. For example, the Blue House plays the central role in group 1, and the Ministries of South Korea, such as the Ministry of Foreign Affairs (G3), Ministry of Gender Equality and Family (G5), and Ministry of Land, Infrastructure and Transport (G9), are concentrated in group 1. In contrast, Moon Jae-in, the president of South Korea, has his own separate group (group 4).
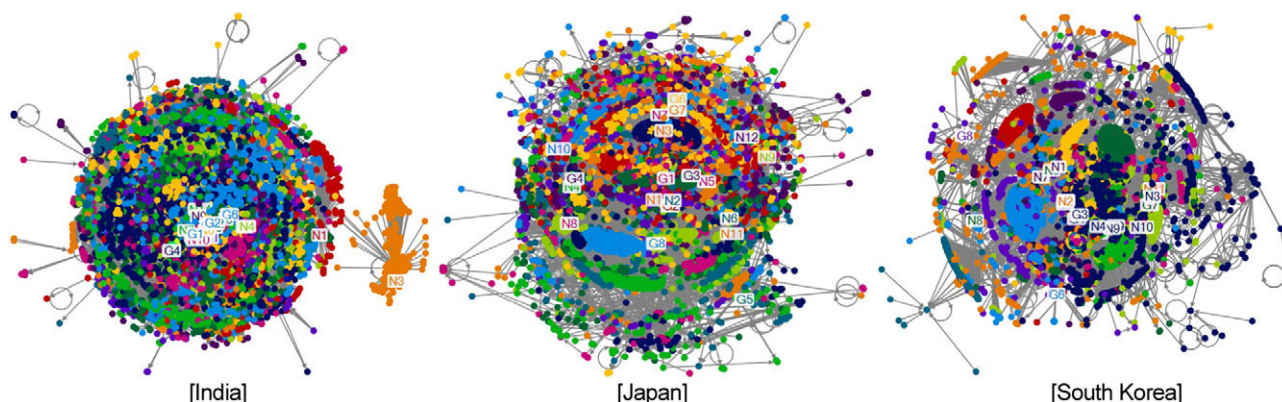

[India] [Japan] [South Korea]

Figure 4. Social networks for the typical case.

[India] [Japan] [South Korea]
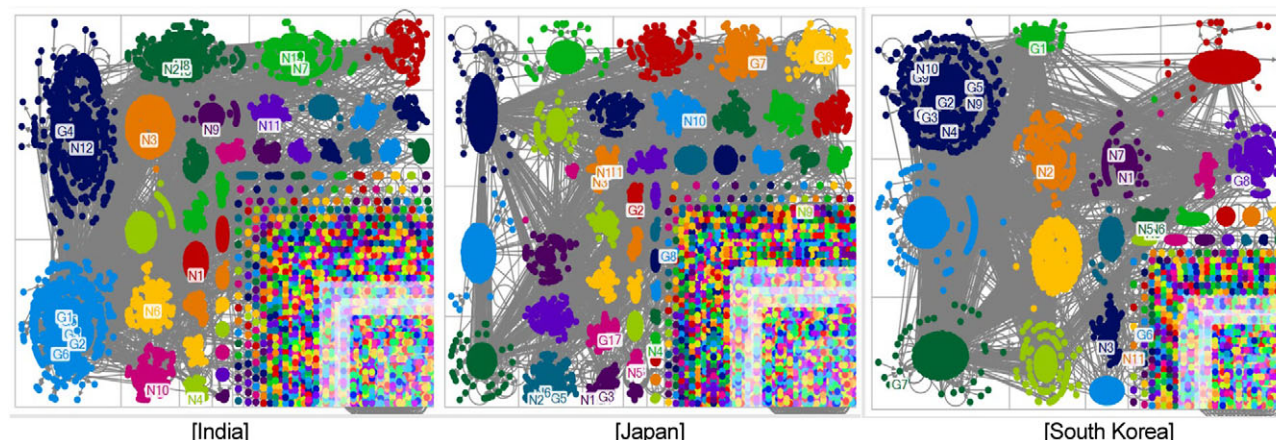
Figure 5. Social networks according to groups.

Table 5. The top URLs

	India		Japan		South Korea	
	Top URL	Count	Top URL	Count	Top URL	Count
1	https://www.financialexpress.com/lifestyle/health/covid–19-deaths-in-india-fatality-rate-drops-to–2–43-among-lowest-in-the-world/2030862/	361	https://www.moeruasia.net/archives/49666250.html	431	https://trjsee.tistory.com/771	1224
2	https://hindi.opindia.com/reports/international/who-says-india-is-responding-with-utmost-urgency-to-fight-covid–19-from-start/	224	https://www.jri.co.jp/MediaLibrary/file/report/viewpoint/pdf/11945.pdf	260	https://trjsee.tistory.com/772	521
3	https://www.indiatoday.in/india/story/95-year-old-beats-covid–19-in-odisha-cm-naveen-pattnaik-congratulates–1703033–2020–07–22	220	https://toyokeizai.net/articles/-/363402	232	https://news.v.daum.net/v/20200715163644338	181
4	https://trib.al/hyJm7qf	172	https://www3.nhk.or.jp/news/html/20200722/k10012528571000.html	132	https://news.v.daum.net/v/20200716100846823	155
5	https://khabar.ndtv.com/news/india/in-biggest-one-day-jump–45720-new-covid19-cases–1129-deaths–2267349	125	https://mainichi.jp/articles/20200722/k00/00m/040/372000c	114	https://news.v.daum.net/v/20200716050136622	126

Lastly, this study employs website analyses to understand people's interests according to countries (see Table 5). In the India networks, people are most interested in COVID-19 deaths. The URL indicates that the fatality rate dropped to 2.43%, among the lowest in the world. The Union Health and Family Welfare Ministry on Tuesday announced that the death rate due to COVID-19 complications in India has fallen to 2.43 per cent from 2.97% on July 1, 2020. Rajesh Bhushan, the officer on special duty of the Health Ministry, mentioned that the number of COVID-19 deaths per million people in India continues to be among the lowest in the world.

In the Japan networks, people care about how Japan can manage the information of COVID-19 patients for epidemiological analysis and the infection route. The URL shows that COVID-19 has different infection rates and mortality rates depending on races and countries. Therefore, they suggest 2 urgent needs to improve the current government response. First, the number of nationally infected persons by nationality is not disclosed. Secondly, the number of infected persons in the airport quarantine has not been revealed before the nationality breakdown of Japanese nationals and foreign nationals. The next interests are a report on the re-expansion of COVID-19, Japan's low severity and mortality of COVID-19, 4 consecutive holidays for COVID-19, and curfews.

In the South Korea networks, people focus on South Korea successfully securing COVID-19 vaccines. The URL highlights that South Korea made a letter of intent, a document outlining an understanding between 2 or more parties intended to be formalized in a legally binding agreement, with AstraZeneca. AstraZeneca PLC is a British-Swedish multinational pharmaceutical and biopharmaceutical company with its global headquarters in Cambridge, England, which is one of the fastest companies developing the COVID-19 vaccine. The next URL contains the same news about the letter of intent with AstraZeneca. The next interests are the support of the South Korean government in bringing Korean people back from foreign countries, the successful car sales during the COVID-19 pandemic, and the relationship between low COVID-19 patients and Kimchi, which is a traditional food of South Korea.

Discussion

The findings of this study can be summarized as follows: key players are clustered in the central part of the networks, with most concentrated in large groups in India. In contrast, in Japan, key players are dispersed across the networks and tend to belong to smaller groups. In South Korea, key players are concentrated in specific parts of the networks, with many located in Group 1. In India, the Ministry of Health and the Prime Minister play the most significant roles, while news media are central in Japan's networks. In South Korea, the executive office and official residence of the President play the most pivotal roles. People in India are primarily concerned with COVID-19 deaths, while those in Japan are more interested in infection routes. In contrast, South Koreans focus on vaccines (see Table 6).

This study finds some scientific findings and compares the findings among countries to provide their importance to policy as follows: first, India has multiple social networks according to their languages, inconsistent with Japan and South Korea. This is because India writes in many languages and speaks in many more voices. According to the government of India, there are 22 official languages in India under the Eighth Schedule of the Constitution as of 2022.[70] Therefore, governments and disease experts should

Table 6. The different results among India, Japan, and Korea

	India	Japan	Korea
Key players	Centered	Dispersed	Biased
The top key players	Ministry of Health and the Prime Minister of India	News media	President of South Korea and the Blue House
Locations of key players in groups	large groups	small groups	group 1
Contents	COVID–19 deaths	infection route	COVID–19 vaccines

deliver important news and information on COVID-19 in multiple languages.[71–73]

In the Japan networks, news media are some of the most powerful institutions affecting the lives of citizens. Japanese citizens tend to learn about what their government does from their news media, such as Yahoo and NHK.[74] News media are the most frequently used sources of information among all information sources in the COVID-19 news and information in Japan.[75] Therefore, governments and disease experts should deliver important COVID-19 news and information via famous news media accounts.

In the Korea networks, female key players have a significant impact on social networks for COVID-19. This is because Moon Jae-in is a feminist president and supports various feminism organizations and institutes under his administration.[76] Many female key players, such as Women news and the Ministry of Gender Equality and Family, have strong political influence not only in the real world, but also on SNS.[77–79] In this background, many females get important COVID-19 news and information through these female news sites and the Ministry of Gender Equality and Family and more actively share important news and resources and talk about the COVID-19 pandemic because females are more concerned about the COVID-19 issue than males.[80–82] Therefore, the Korean government and disease experts should understand the female networks and deliver important news and information on COVID-19 in a timely manner to relieve women's concern and stress.

This study has some important implications. First, governments and centers for disease control should investigate key players in their country because key players are differentiated by countries. Second, governments should find out which governmental key players play an important role in the social networks of their country because some governmental key players exert significant impacts on social networks related to COVID-19. Third, governments should explore the social networks of COVID-19 according to groups because they show different characteristics by countries. Fourth, governments and policy makers should understand people's interests and needs by exploring SNS to provide valuable information on COVID-19 to their citizens, relieving concern and anxiety in a timely manner.

This study has some limitations. First, social network analysis was employed between July 27 and July 28, 2020 because this period experienced the highest number of Twitter users, communication networks, and suitable contents; therefore, the social networks for COVID-19 could be further differentiated by periods. Future studies should investigate COVID-19 according to a multitude of periods. Second, this study explores social networks for COVID-19 in the online world, while social networks for COVID-19 might be different in the real world. Future research should explore social networks in the real world, as well. Third, this study employed SNA for COVID-19 for Twitter because Twitter has become one of the most important data resources for COVID-19;[83] SNS of other platforms could show results different from those of Twitter. Therefore, future articles should investigate other platforms, such as Facebook, YouTube, and Instagram.

COVID-19 is one of the most serious diseases in the history of humankind. Governments and policymakers enhance social distancing and lockdowns for COVID-19, and people interact with each other through SNS to get important news and information on COVID-19.[85–89] With this background, this study provides useful implications and guidelines for understanding online social interaction surrounding COVID-19. By understanding the top key players and social networks for COVID-19, governments and disaster experts could deliver important COVID-19-related news and updates to their citizens in a timely manner.

Conclusions

COVID-19 has completely changed people's normal lives, and people are worried about contact with others in person. Most people stay at home for social distancing and search for relevant information on COVID-19 on the internet. Therefore, understanding online social networks is essential for governments providing valuable COVID-19 information to the public. With this in mind, this study highlights the online social networks of people for COVID-19 across India, Japan, and South Korea.

This study finds some important results as follows: first, countries have different key players for social networks of COVID-19. For example, the Ministry of Health and Prime Minister of India play the most important role in social networks for COVID-19 in the India networks. News media, such as Yahoo! News and NHK news, play the most critical role in social networks of COVID-19 in the Japan networks. The president of South Korea and the Blue House play the most pivotal role in social networks of COVID-19 in the Korea networks.

Second, governmental key players play the most crucial role in South Korea, whereas they play the least crucial role in India. Third, news media play a crucial role in the social networks of India, politicians exert a crucial impact on the social networks of Japan, and the ministries of South Korea have a significant effect on the social networks of South Korea. Fourth, YouTube plays an important role in both Japan and South Korea, whereas it has an insignificant impact on India.

Fifth, most key players are located in large groups in the India networks, key players tend to belong to small groups in the Japan networks, and many key players are concentrated in the largest group in the South Korea networks. Sixth, people are most interested in COVID-19 deaths in India in India's networks; people care about how Japan manages the information of COVID-19 patients in Japan's networks; and people focus on South Korea successfully securing COVID-19 vaccines in South Korea's networks.

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