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Social Media Discussion on Covid-19 Impact on Mental Health in the US, UK, and India

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HONORS THESIS

Social Media Discussion on Covid-19 Impact on Mental Health in the US, UK, and India

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Submitted in partial fulfillment of the requirements for graduation
with honors in the Bryant University Honors Program
April 2022

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ABSTRACT

Discovered in December 2019, Coronavirus (Covid-19) is an infectious disease that has spread rapidly around the world. The World Health Organization (WHO) declared Covid-19 a pandemic in March 2020. The pandemic has increased the occurrence of mental health problems including depression, stress, and anxiety. This research used real-life Tweets collected related to Covid-19 from March 2020 until October 2021. The objective is to analyze Tweets from the US, UK, and India to discover what topics people are discussing about Covid-19's impact on mental health. The theme for the US was related to government and politics, some dominant users in the group are news accounts and people who have occupations such as journalists, hosts, and presenters. The UK's theme focused on friends and family relations, and it showed the caring for the public safety, resulting in doctors and medical workers as dominant users. India is focusing on mental health and education. However, some important users identified are the majority news related accounts and people related to politics.

INTRODUCTION

Mental illness is one of the primary illnesses worldwide. In recent years, the public has increased their acknowledgment of the importance of mental health. Multiple factors can contribute to the occurrence of mental illness, such as early adverse life experiences, biological factors, and experiences related to other ongoing medical conditions, etc. According to the CDC, some common mental illnesses include depression, bipolar disorder, anxiety, PTSD, eating disorder, and schizophrenia. While anxiety is the most common mental illness in the world, affecting 284 million people (Our World in Data, 2018).

Covid-19 has made mental health even more severe compared to past years. The occurrence of mental health issues including anxiety, depression, stress, irritability, insomnia, anger, and frustration has remained high during the pandemic. According to the CDC, the pandemic has triggered a 25% increase in the prevalence of anxiety and depression worldwide (CDC, 2022). The major reason for the increased occurrence of mental health problems is the unprecedented stress caused by social isolation and pressure at work during the pandemic.

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This project is using Tweets collected from March 2020 to October 2021, which will allow sufficient data to address the results of the research. This research will be comparing the discussion of Covid-19's impact on mental health in the US, UK, and India by conducting topic modeling and network analysis. The above countries were chosen because, on the one hand, they appeared to be the most common countries in the overall Tweets collected. On the other hand, mental health issues are also very common in these countries. In 2019, just before the pandemic started, 19.86% of adults experienced a mental illness in the US, which is nearly 50 million Americans (Mental Health America, 2022). In the UK, one in four people will experience a mental health problem each year, and one in six people will report experiencing a common mental health problem, such as anxiety and depression in any given week (Mind). As for the situation in India, statistics show that about one in seven persons in India suffered from mental disorders, with depression and anxiety disorders being the most common mental disorders (ANI, 2019).

This thesis is divided up into the following sections. The Literature Review section will cover the Covid-19 impact on mental health worldwide also focusing on the US, UK, and India. It will also include topic modeling techniques from previous research. The Research Methodology section goes into detail about the process of exploring topics and retweet networks. The Conclusion section will present the results and findings from the topic modeling along with the retweet network. It will identify possible topics people are discussing regarding Covid-19 impact on mental health and dominant users in each country. Lastly, after presenting the results, a discussion of the future research and the limitations of my research project.

LITERATURE REVIEW

Covid-19 Impact on Mental Health Globally

When the virus first started in Wuhan, China, the medical workers were the first to face the risk of developing mental health illnesses due to the exposure to high-pressure working environments, including features such as overwork, frustration, discrimination, isolation, and patient negative emotions (Kang et al., 2020). This exposure could cause mental health problems such as stress, anxiety, depression, insomnia, denial, anger, and fear (Jones et al., 2017).

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According to Itai Danovitch, MD, the chair of the Department of Psychiatry and Behavioral Neuroscience, “Historically, we know that pandemics and other public health crises, much like natural disasters, have a lasting impact.” His team is studying how Covid-19 affects people's mental health, and they found that national surveys show an increased prevalence of stress and depression (Cedars-Sinai Medical Center, 2020).

The increased occurrence of mental health illnesses during the pandemic has also interrupted the delivery of services. According to a new World Health Organization (WHO) survey, while the demand for mental health services kept increasing during the pandemic, Covid-19 has disrupted the services in 93% of the countries worldwide (WHO, 2020). Because of the pandemic, many people may be facing increased levels of alcoholism, drug use, and anxiety (WHO, 2020). At the same time, Covid-19 can lead to mental complications, such as delirium, agitation, and stroke. The WHO survey was conducted from June to August 2020 in 130 countries, and the results show a significant impact of Covid-19 on mental health services. For example, over 60% of respondents reported disruptions to mental health services for vulnerable people; 67% noted disruptions to counseling and psychotherapy; 30% described disruptions to access of medications for mental and substance use disorder (WHO, 2020).

Two of the most common mental health issues worldwide include depression and anxiety. The study by Lancet in 204 countries and territories in 2020 showed that the Covid-19 has also increased the prevalence of both issues globally. From the 5683 unique data sources obtained from the systematic review, they estimated an additional 53 million cases of depression globally in 2020, which is an increase of 27.6% compared to before Covid-19; and an additional 76 million cases of anxiety globally in 2020, which is an increase of 25.6% compared to before Covid-19 (Lancet, 2021).

Wang et al. (2020) discussed how Covid-19 impacted people's mental health by conducting two surveys. They invited 1,406 participants from 194 cities in China, and they had 1,738 individual respondents who participated in the study. They conducted the survey twice, and the second survey was one month after the first survey. This allowed them to see if the scores were different between the two surveys and determine if mental health problems were developed. The mental health status was assessed by the Impact of Event Scale-Revised (IES-R) and the Depression,

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Anxiety and Stress Scale (DASS-21). There was a significant longitudinal reduction in mean IES-R scores (from 32.98 to 30.76) after four weeks (Wang et al., 2020). However, the IES-R score for both the first and second surveys was above the cut-off scores for PTSD symptoms, and there were no significant longitudinal changes in stress, anxiety, and depression. By comparing the first survey and the second survey, they concluded that there was a statistically but not clinically significant reduction in psychological impact, and there were no significant temporal changes in the levels of stress, anxiety, and depression (Wang et al., 2020).

Covid-19 Impact on Mental Health in the US, UK, and India

The coronavirus revealed problems with the US healthcare system that will need more attention. This system has been both costly and highly inefficient. It especially created issues for people living in rural areas who were unable to afford or access health insurance (Madara, 2020). The high unemployment rate has led many Americans to lose their employer-sponsored insurance. There has also been an unpredictable increased demand for health services. The virus overtaxed many hospitals and imposed unexpected costs on many of them. In the early stage of the pandemic, the country did not implement physical distancing and the usage of some other protective equipment. In addition, national guidelines have been delayed or inconsistent during the pandemic, along with the guidelines in many states (Blumenthal, 2020). Health resources and trained health care workers are now scarce. In the early days of the pandemic, the number of people getting sick and needing to be hospitalized was increasing so fast that even the most prepared hospitals could not handle it (Blumenthal, 2020).

According to the Anxiety and Depression Association of America, anxiety disorder is the most common mental illness in the US, affecting 40 million adults 18 or older; in other words, 18.1% of the population every year. Mental health problems are worsening not only among adults but also among the youth. As stated in Mental Health America, 9.7% of youth in the US have severe major depression (MHA, 2021). During the year 2017-2018, 19% of adults experienced mental illness, which is an increase of 1.5 million people compared to the previous year's dataset (MHA, 2021). During the pandemic, mental health has been an issue in the United States, and in particular, it has been very difficult for; people with mental illness who have struggled with feelings of loneliness or isolation (MHA, 2021).

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According to the CDC, in a survey conducted in the US during June 24-30, 2020, 30.9% of the respondents reported having an anxiety disorder or depressive disorder and 26.3% reported having Trauma and Stressor Related Disorders (TSRD). The most common mental illnesses include anxiety and depression. From January to September 2020, the number of people who experienced anxiety increased by 93% compared to 2019, and people experiencing depression increased by 62%. A study using US electronic health records also found an increased occurrence of the first diagnosis of mental health within 90 days of testing positive for Covid-19 (The Lancet, 2021).

A web survey conducted in the UK about Covid-19 impact on mental health showed that for 42,330 participations, the level of mental distress rose from 18%-19% in 2018-19 to 27.3% in April 2020, which is one month into UK lockdown (Lancet, 2021). It also reflected in the CDC's declaration about increased levels of stress during and after the isolation because of Covid-19. In a cross-sectional analysis of mental health in the UK during the Covid-19 pandemic, the result shows that the mean score for depression, stress, and anxiety significantly exceeded population norms (Jia, 2021). It also suggested that younger females in a recognized Covid-19 risk group were associated with increased levels of stress, anxiety, and depression.

Covid-19 has a particular impact on mental health issues among students. A systematic search of the literature on PubMed and Collabovid of studies published from January 2020 to July 2021, found that five studies on children and 16 studies on college students found that both groups reported feeling more anxious, depressed, and distressed compared to before the pandemic (Elharake et al., 2022). Some major reasons include living in rural areas, low family socioeconomic status, and being family members of medical workers.

Among the three countries. India has a much higher pressure education system compared to the US and UK. According to a report by the National Crime Records Bureau, depression has become more common among students in India. Factors that contribute to this finding on Indian students, include academic pressure, societal pressure, and family pressure (Prasad, 2020).

In India, the situation is similar to both the US and UK, Covid-19 has also impacted the mental health of the population. In a study identifying psychosocial factors that predicted distress among the Indian population during the pandemic, it found that females aged 21-35 working on-site

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with pre-existing medical conditions are more likely to have an increased level of mental health issues (Anand et al., 2021). People who have higher social support and psychological capital are not likely to be distressed due to the pandemic.

An online survey conducted from April 6, 2020, to April 24, 2020, in India, suggested that among the 1685 responses analyzed, there is a high level of anxiety and depression occurring in the sample. About 38% of the sample reported experiencing anxiety and 10.5% reported experiencing depression (Sandeep et al., 2020). Overall, 40.5% of the participants had either anxiety or depression. There was also 74.1% of the samples reported having a moderate level of stress, and 71.7% reported poor well-being.

Social Media Discussion on Mental Health

Internet-based social media websites represent a growing space for interpersonal interaction. There has also been an increased utilization of social media by individuals who have experienced mental health problems. The proposed reasons for using social media include access to wider support networks and knowledge that could be beneficial to the users.

This study focused on Twitter as the social media platform. Currently, Twitter is one of the most popular social media platforms among the public. This platform produced a sufficient amount of data on Tweets related to web-based social and health conditions that can be used by researchers. The amount of data on Twitter resulted in an increase in the usage of Twitter data by researchers to conduct data analysis and mental health-related content.

Research has been conducted in relation to the potential role of social media in the support of individuals with physical health conditions. The study presented by Sheperd et al., al focuses on specific discussions on Twitter to assess the role of this social media platform as a medium for interpersonal communication by individuals experiencing mental health issues (Sheperd et al., 2015). They identified 515 unique communications to the specified conversation, and four themes were revealed for why they used Twitter to discuss mental health: (1), the impact of the diagnosis on personal identity and as a facilitator for accessing care; (2), the balance of power between professional and service user; (3), therapeutic relationship and developing professional

communication; and (4), support provision through medication, crisis planning, service provision and the wider society (Sheperd et al., 2015).

Some other reasons why individuals discuss mental health on Twitter include (1) a sense of community; (2) raising awareness and combating stigma; (3) safe space for expression; and (4) coping and empowerment (Berry et al., 2017). Using Twitter as a platform to combat stigma and raise awareness of mental health problems indicates the positive effects brought about by Twitter in the area of public health. The study suggested Twitter is a platform that has a fair amount of mental health-related information and would be suitable for the research.

RESEARCH METHODOLOGY

The research portion of my project was broken down into two major parts. The first part is data collection. It will be using Twitter data collected by Professor Li from March 2020 to October 2021 to conduct my research and will narrow it down to mental-health related Tweets. The second part is data analysis where the data will be further broken down to overview the data by country in order to find themes and identify influencers. The main goal of the research project is to discover what people are discussing on Twitter about the impact of Covid-19 on mental health and explore other information about this topic in the US, UK, and India.

Data Collection

The research uses Twitter data to find social media discussions on Covid-19's impact on mental health in the US, UK, and India. Twitter's open application programming interface (API) allows users to get access to Twitter messages by obtaining a developer account and access token to collect Tweets. The original dataset contained 1,314,705,279 Covid-19 related Tweets and was collected by Professor Li from March 2020 to October 2021. The data has a total of 32 columns, displaying relative information about the user or the Tweet. This research will mainly be focusing on the user's name, user location, tweeted text, language used, date of the Tweet, and user retweet. The data was stored in a Databricks cluster. Databricks is a cloud-based data engineering tool used for processing and transforming massive quantities of data. Professor Li then shared the cluster with me, thus, allowing me to do the rest of the analysis on the platform.

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The coding process was done via Databricks using mainly Python language, and a portion of SQL.

After I got access to data previously collected by Professor Li, I now needed to narrow down the data to only contain mental health correlated Tweets in the US, UK, and India. I created a new dataset by filtering the original one using keywords including “mental health”, “depression”, “anxiety”, “nervous”, “hopeless”, “lonely”, “fear”, “anger”, “distress”, and “depressed”. In order to integrate the language of the Tweets, I limited the Tweets to English. As a result, I ended up having a total of 10,861,079 Tweets.

	date	lang	source	user_screen_name	user_location
1	2020-04-02T12:04:40.000+0000	en	Twitter for iPhone	DrTonyKairnth	London
2	2020-04-03T16:44:38.000+0000	en	Twitter for Android	MennoKools2	Zuid-Holland, Nederland
3	2020-04-04T14:24:34.000+0000	en	Twitter for Android	prtpalinsan09	Faridkot, India
4	2020-04-06T12:20:22.000+0000	en	Twitter for iPhone	clar_jidadE	London, United Kingdom
5	2020-04-07T11:31:46.000+0000	en	Twitter Web App	DanShillito	Milan, London, Sydney
6	2020-04-08T07:36:37.000+0000	en	Twitter for iPhone	DcunhaRaIston	Mumbai, India

user_lang	user_verified	user_followers	user_friends	user_listed	user_favorites	user_statuses	user_profile
null	false	266	245	32	6666	3968	https://pbs.twimg.com/profile_images/1148194468673269761/hQbaKIY__normal.jpg
null	false	187	514	0	8308	6952	https://pbs.twimg.com/profile_images/1240659039488552960/V0n2zqGUN_normal.jpg
null	false	114	26	1	3815	10246	https://pbs.twimg.com/profile_images/1230024276419452929/PjnX8mqc_normal.jpg
null	false	709	675	41	101887	137329	https://pbs.twimg.com/profile_images/1110870476841238530/Ubc9j8Uj_normal.jpg
null	false	170	277	1	854	705	https://pbs.twimg.com/profile_images/1148644996112965633/hQRmb36_normal.png
null	false	1	73	0	121	52	https://pbs.twimg.com/profile_images/1243386063000723456/c5o6Dp8O_normal.jpg

user_joinDate	tweet_country	tweet_place_name	reply_screen_name	quoted_tweet_id	retweeter_screen_name	retweeter_followers	retweeter_friends	retweeter_listed	retweeter_favorites
2015-08-07T14:05:43.000+0000	null	null	null	1245682493019299846	null	null	null	null	null
2020-03-04T12:39:28.000+0000	null	null	null	null	LisaMei62	204581	15852	1269	115708
2017-02-15T15:15:45.000+0000	null	null	null	null	oye_its_simm_u	102	131	0	476
2013-11-22T17:42:36.000+0000	null	null	null	null	Billbrowder	239611	833	2248	9372
2014-06-05T08:09:46.000+0000	null	null	null	null	null	null	null	null	null
2020-03-27T05:54:23.000+0000	null	null	null	null	rsprasad	4035101	474	1762	9388

longitude	latitude	text	full_text
null	null	During times like these even mental health practitioners might struggle (yes, I'm feeling the strain too!) Thankful... https://t.co/FxSj1Kj4dR	null
null	null	RT @LisaMei62: Hydroxychloroquine rated top drug by doctors on front line of COVID-19 who also fear a second wave https://t.co/Br0qvxh51	null
null	null	RT @oye_its_simm_u: The spread of coronavirus has also caused tension and fear amidst masses. But apart from taking necessary precautions...	null
null	null	RT @Billbrowder: Lord Sumption criticizes UK government's response to Corona virus as "hysterical fear of death". This is the same man who...	null
null	null	Check out my latest article: Coronavirus & the markets: don't let fear drive your investment decision making!... https://t.co/WxHm3a6vkk	null
null	null	RT @rsprasad: Let us spread facts and not fear. Take care of your health and protect others from #coronavirus Together we all can fight a...	null

Figure 1 – Overview of the Dataset

Furthermore, I created three separate datasets containing Tweets from one of the three country. This was done by setting the user location column in the dataset equal to the targeted country

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name. The US dataset ended up containing 1,382,832 Tweets, the UK dataset contains 554,484 Tweets, and the India dataset contains 292,054 Tweets.

DATA ANALYSIS

Covid-19 Cases and Tweets

After I completed my data collection, I analyzed the data by each country. Since the dataset contains Tweets from March 2020 to October 2021, I thought it would be interesting to see the comparison of the number of Tweets on the timeline with the number of Covid-19 cases. I obtained the Covid-19 case dataset from the Our World in Data website. It contained new Covid-19 cases each day by countries starting in January 2020. Having the case data will further allow me to compare the monthly number of cases of Covid-19 with the monthly number of Tweets. The comparison of the US Tweets and US cases is shown in figure3.

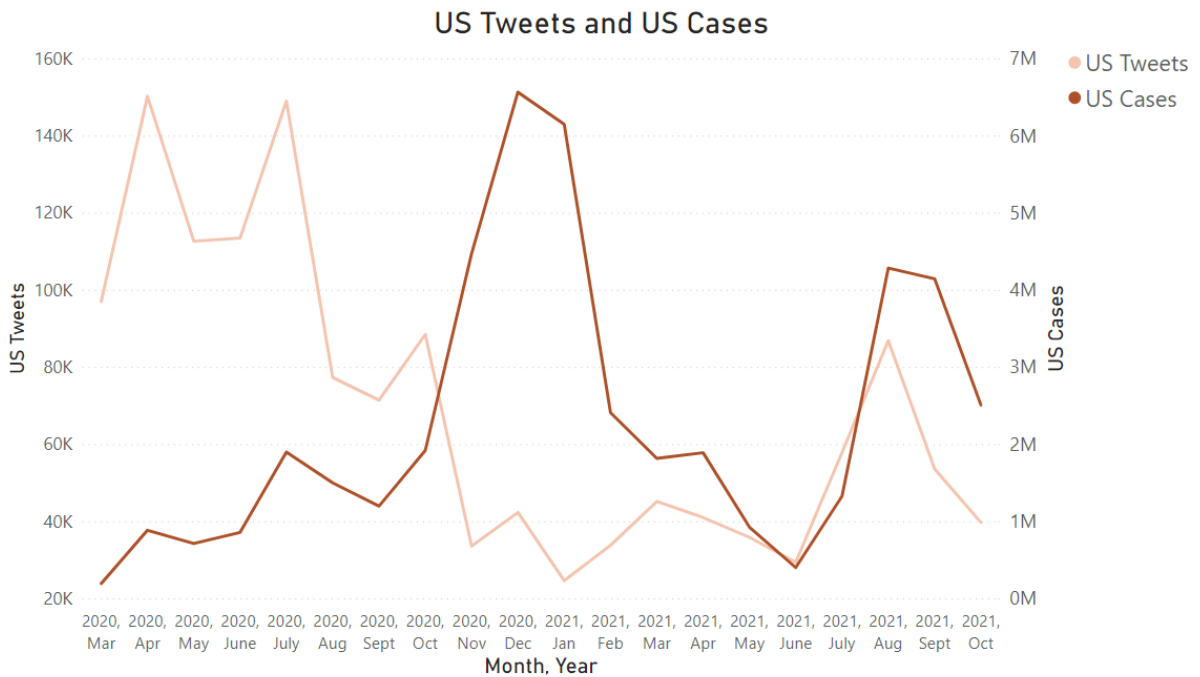


Figure 3 – US Tweets and US Case

The lighter orange represents the number of Tweets, while the darker orange represents the number of Covid-19 cases. Since there is a big difference between the number of cases and the number of Tweets, I used two different y-axes to visualize the graph. The left y-axis is the

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number of Tweets, and the right y-axis is the number of cases. When Covid-19 first started, there were not a lot of cases in the US. However, there was a lot of news and information online. Therefore, while the number of Covid-19 cases remained low, the number of Tweets was the highest from March 2020 to July 2020. When the Covid-19 cases continued to increase, the public was more used to the pandemic, thus resulting in an increasing number of cases, but a decreasing number of Tweets. According to the Harvard School of Public Health, the Covid-19 cases would increase around the end of August 2021 due to the reopening of schools, people gathering indoors, and people's reluctance to get vaccinated (2021). The graph verified the finding since both the number of cases and the number of Tweets were at a peak. The situation was very similar in the UK compared to the US as shown in figure 4.

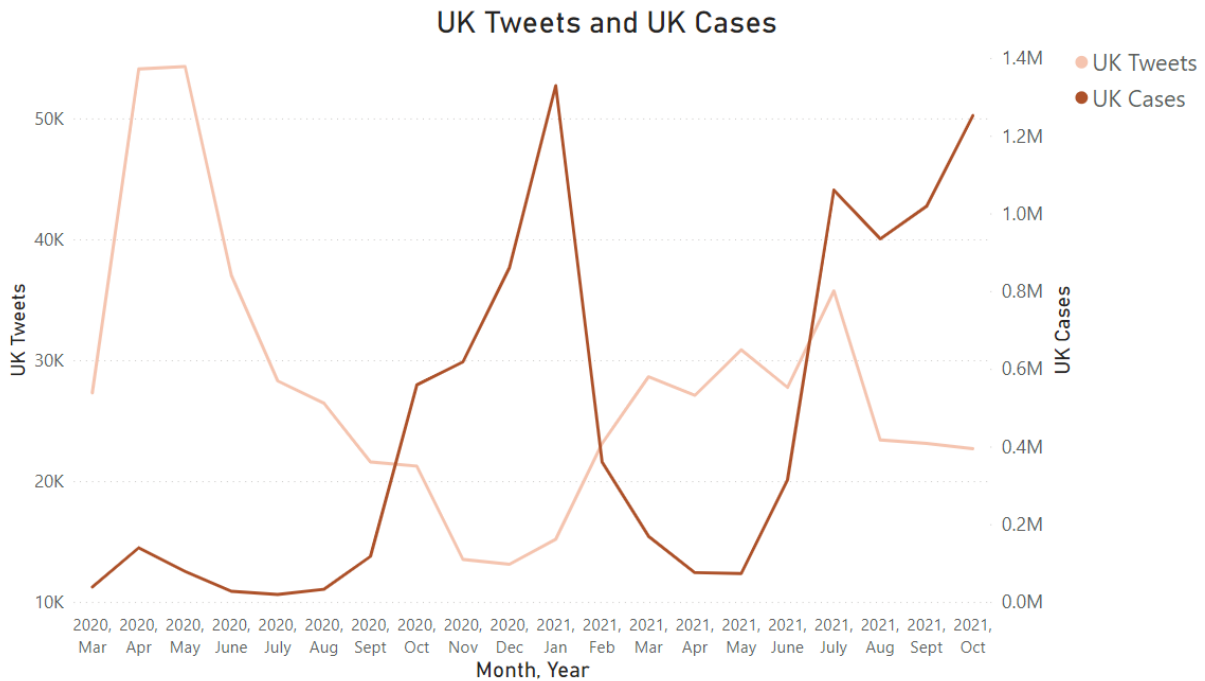


Figure 4 – UK Tweets and UK Case

One noticeable difference is that the UK cases fluctuate more than the US, and they kept increasing in October 2021.

The comparison between India's Covid-19 cases and the number of Tweets is different compared to the US and the UK as shown in figure 5.

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Both Covid-19 cases and Tweets peaked around April and May 2021. The two line graphs have the most overlap among the three countries. India experienced an outbreak of the Coronavirus between April and May 2021, leading to much news related to it. This outbreak is also the reason for the highest number of Tweets throughout the period I focused on for my research.

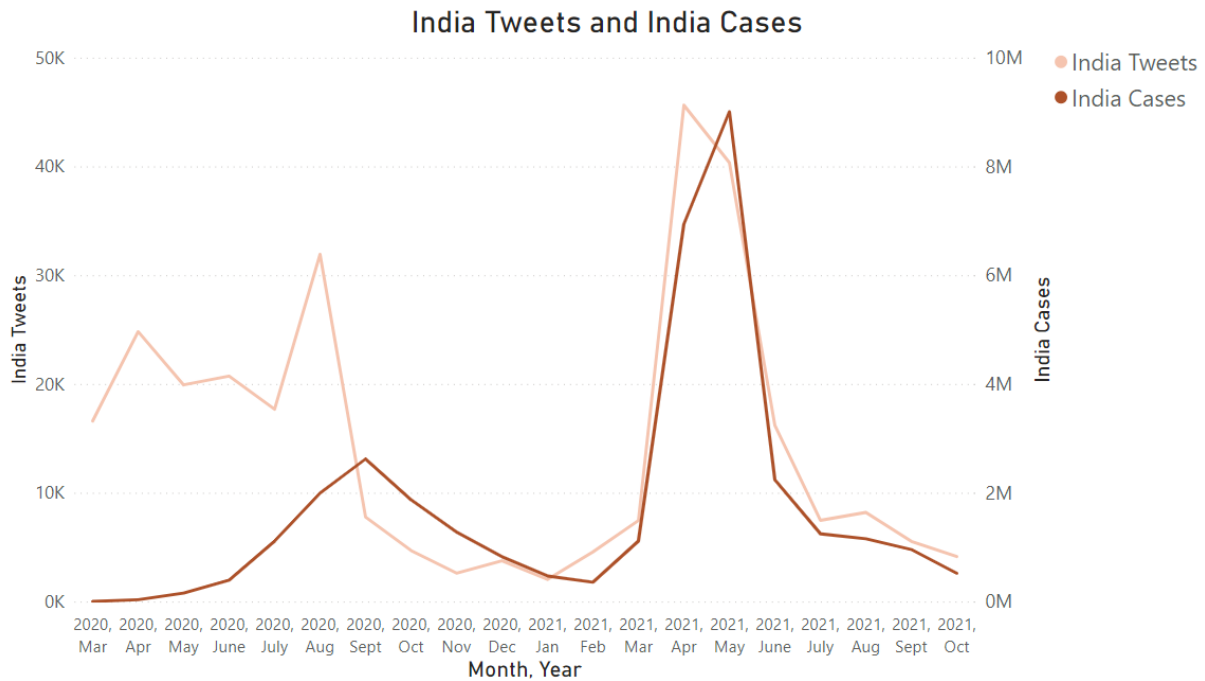


Figure 5 – India Tweets and India Case

Emerging Themes

After looking at the correlation between Covid-19 cases and the number of Tweets, I wanted to focus on revealing themes emerging by country. The goal of identifying themes is to explore fields and topics that people were discussing on social media about Covid-19's impact on mental health. Meanwhile, top words and hashtags were also identified for each country to support the theme results.

Word cloud

The first part of identifying themes was to look at the most prevalent words throughout the tweets in each country. The word clouds of the US, UK, and India are listed below.

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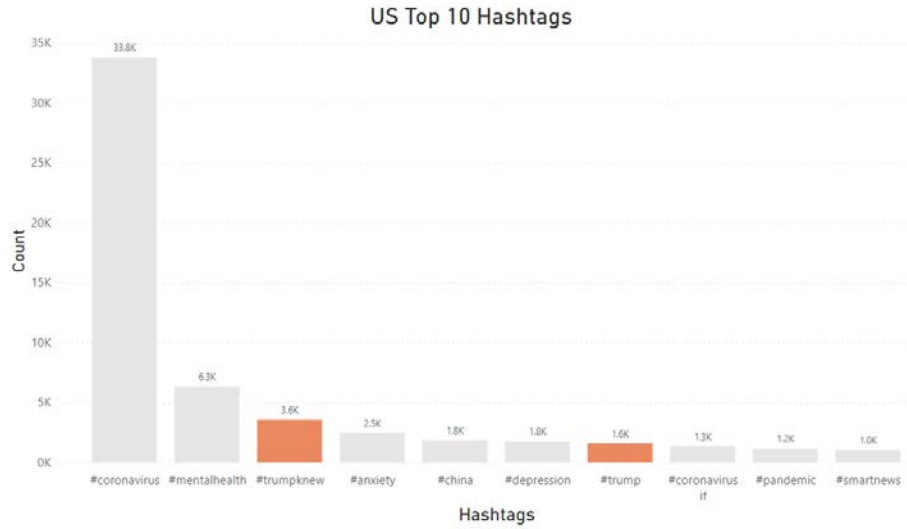


Figure 7 – US Top Hashtags

The two hashtags I highlighted are #trumpknew and #trump. As previously mentioned, the presidential election was in November 2020, thus, leading to many discussions related to President Trump. The hashtag #trumpknew is specifically about when the pandemic just started, Trump was notified about how dangerous the virus was, but downplayed it to the US citizens. This resulted in a big outbreak of the virus in the US and followed by public outcry.

The highlighted hashtags for the UK are #lockdownuk, #stayhomesav, and #nhs. These are related to the pandemic, and it showed that the UK cared about public safety and its people's health.

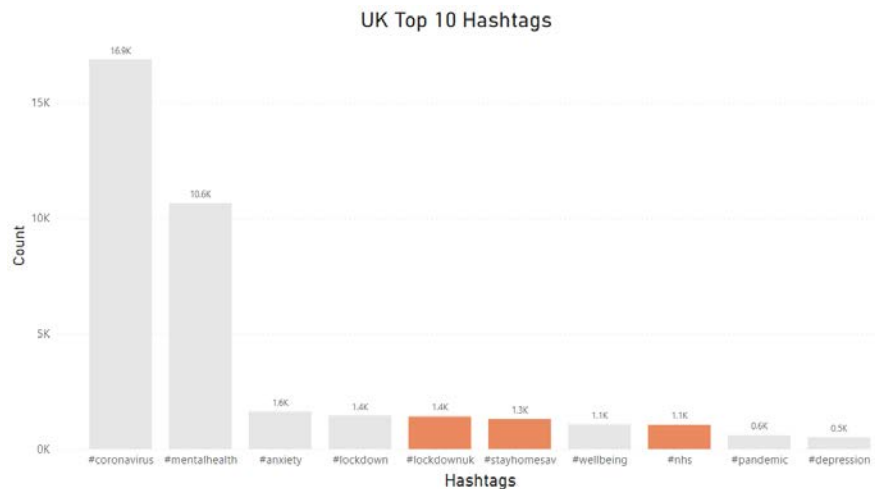


Figure 8 – UK Top Hashtags

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India has highlighted the hashtag of #cancelboardexams2021, this is also the second highest hashtag. Board exams are very important public exams at the end of 10th and 12th grade in India. Aligned with the top words in India, it revealed a similar theme in the country about student mental health problems. It also showed that students want to cancel the board exams due to Covid-19 to reduce their level of stress.

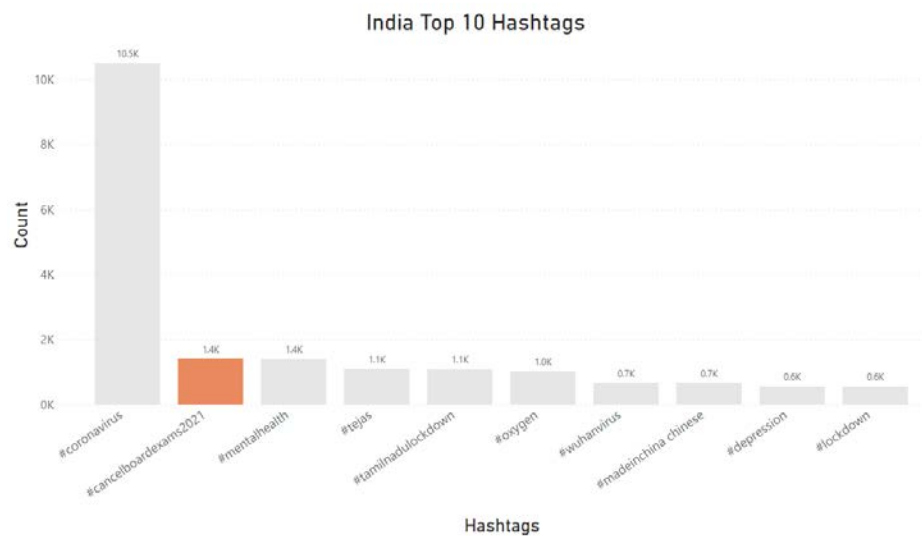


Figure 9 – India Top Hashtags

Topic Modeling

Topic modeling is an unsupervised machine learning technique that can scan a set of documents to detect words and phrase patterns within them, and then cluster word groups and similar expressions that best characterize a set of documents. It is a good tool for my research project because it can identify different topics when people are discussing Covid-19's impact on mental health.

I used a Latent Dirichlet Allocation to generate all topics in the dataset by country. LDA is a generative probabilistic model that assumes each topic is a matrix over an underlying set of words, and each document is a mixture of a set of topic probabilities (Kapadia, 2019). I decided to look at the top six topics. An example of the US LDA visualization is shown in figure 10 below with topic one selected.

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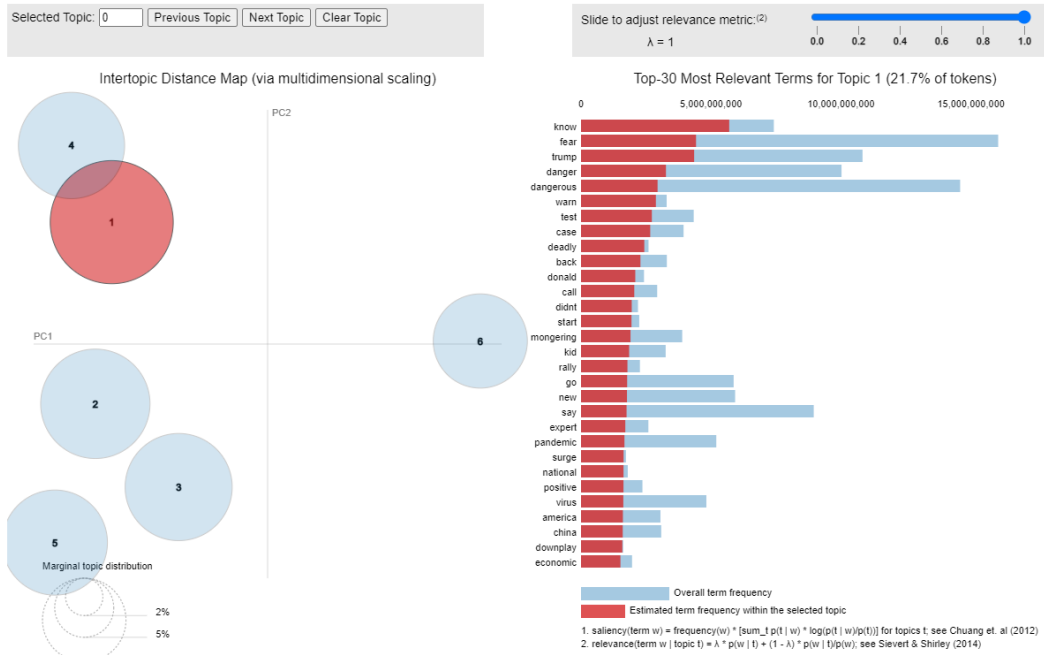


Figure 10 – US LDA

On the left side of the LDA, it shows the top six topics for the selected country. More spreading the topics indicates more differences between each topic. By clicking on different topics, it can display the distribution of the top 30 words of each possible topic on the right side of the LDA. The blue bars show the overall word frequency in all six topics, while the red bars show the word frequency on the topic selected, which in this case is the top word frequency of topic one in the US.

After displaying the visualization of LDA, I will click each topic on the left and then summarize it based on the top words shown on the right side. For example, the LDA for topic one in the US has top words including “Trump”, “know”, “warn”, “test”, “case”, and “start”, I summarize it to be Covid-19 related to the Trump presidency as the topic. I will repeat the same process for the rest of the topics in the US, along with the topics in the UK and India. An example of topic one in the UK and India are shown below.

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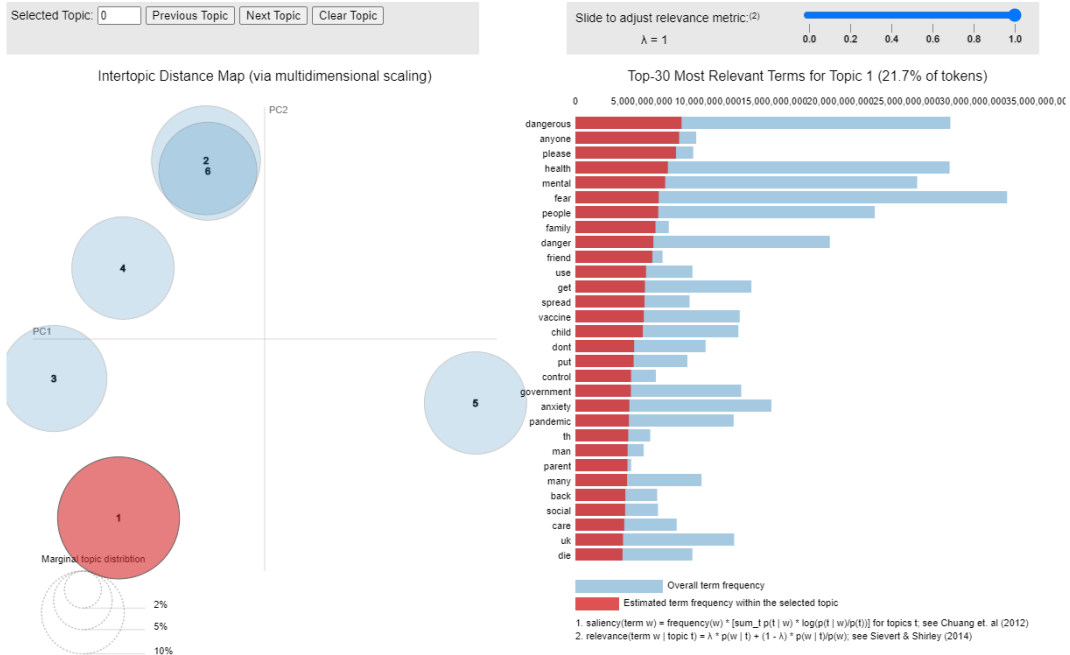


Figure 11 – UK LDA

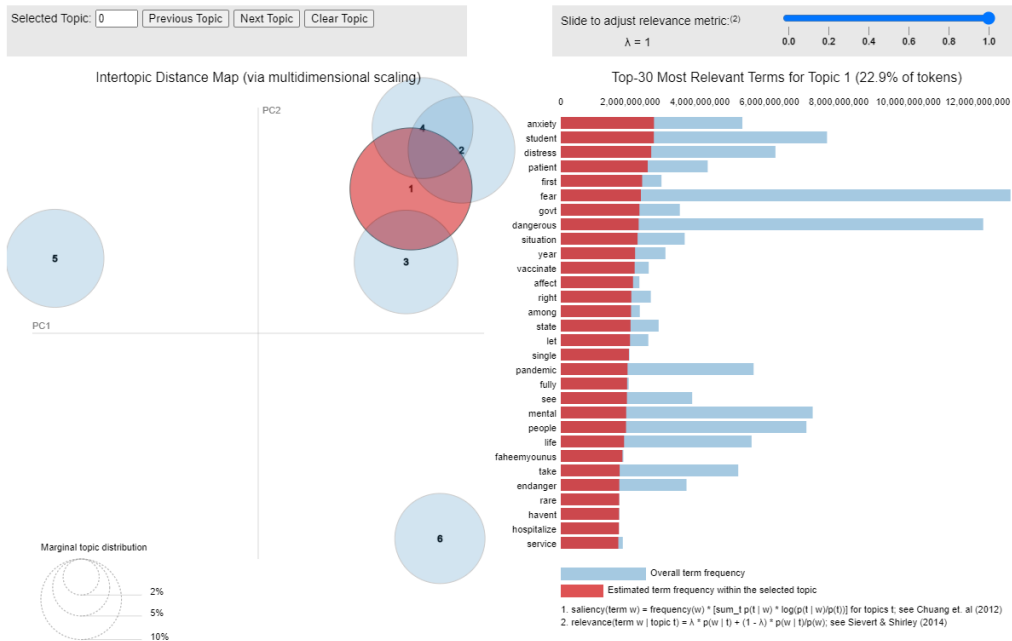


Figure 12 – India LDA

Topic 1 in the US is Covid-19 related to Trump's presidency. Topic 2 is government issues. Topic 3 is reopening and number of patients in the hospital. Topic 4 is disinformation. Topic 5 is the “Black Lives Matter” movement. Topic 6 is about strikes.

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Topic 1 in the UK is about friends and family. Topic 2 is the “Black Lives Matter” movement. Topic 3 is vaccination policy. Topic 4 is waves of Covid-19. Topic 5 is politics in the US. Topic 6 is surge related to fans.

Topic 1 in India is vaccination and cases that are hospitalized. Topic 2 is recovering from Covid-19. Topic 3 is the depression issue. Topic 4 is a discussion about the Twitter trends. Topic 5 is fearless about shooting. Topic 6 is concern about infection.

As a result, when people are discussing Covid-19’s impact on mental health, the US is most likely to discuss economics and politics. The UK showed that they cared about friends and family relations. India has the most topics related to mental health and Covid-19. One thing I found interesting is that the US has the “Black Lives Matter” movement as topic 5, while the UK has the same topic but places it in number 2. It indicates that people from other countries have also shown their interest and care about news in the US.

User Interaction and Influencer

A retweet network analysis was conducted by country to identify users that got the most retweets, which will be declared as influencers or dominant users. Network refers to structures representing a group of objects or people and the relationships between them. A network contains nodes and edges. Nodes represent objects that are going to be analyzed, which are the users in this case. Edges represent the relationship between these nodes, which is the retweets between the two users.

I will be using Gephi as a tool to visualize the retweet network by country. Gephi is open-source software for visualizing and analyzing large network graphs. It uses a 3D render engine to display graphs in real-time and speed up the exploration (Gephi.org). An example of the US retweet network is shown in figure13.

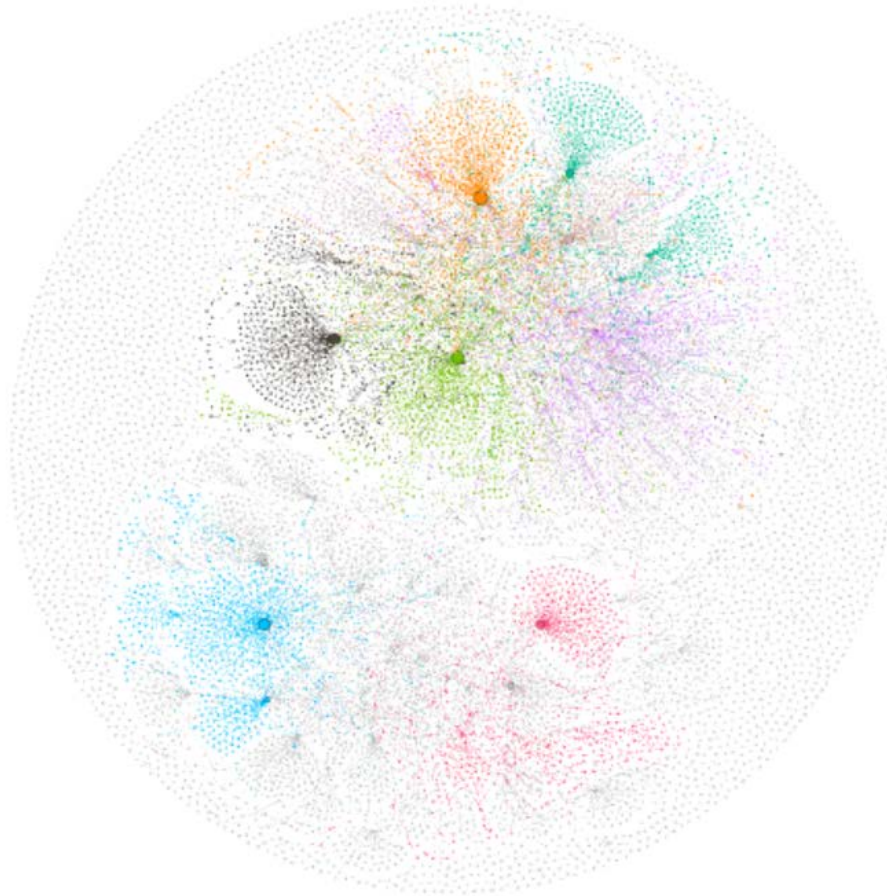


Figure 13 – US Retweet Network Visualization

Each dot represents a user. I adjusted the size of the dots based on in-degree level, which is based on the more retweets one user got, the bigger the dot would be for that user. The visualization will then group users in different colors by modularity class, which is a measurement of the strength of division of a network into modules or groups. Each modularity class contains at least one dominant user, which will be the biggest dots in the color group. I will be looking at the top 7 groups and identify the influencers in each group by three countries. Gephi can display the Twitter ID for each user in the graph, further allowing me to look up the dominant users for each group by their Twitter ID to explore more information about them. A zoomed-in example of Gephi displaying the Twitter ID of all users is shown in figure 14.

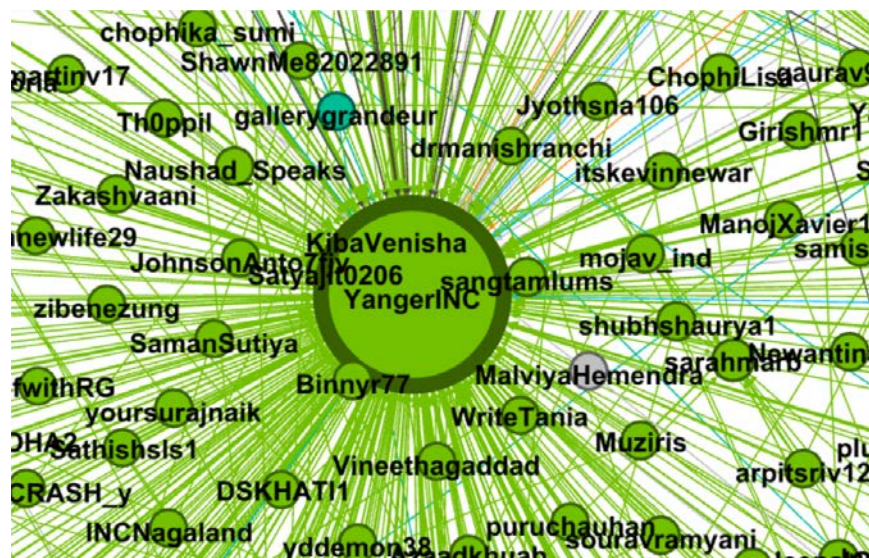


Figure 14 – Zoomed-In Network Visualization with Labels

In this example, I will look up the Twitter ID “YangerINC” on Twitter to get more information about this user.

As a result, for the US, 5.39% of the users are in the purple group, with the dominant users being *CNN* and *NBC News*. The grass green group has 5.34% of the users with the dominant user being Kyle Griffin, the executive producer of *MSNBC*. The blue group has 5.3% of the users with the dominant users being John Solomon, a journalist and the founder of *Just the News*, and Laura Ingraham, who is the host of *Fox News*. The black group has 4.91% of the users with the dominant user being the Lincoln Project. The orange group has 4.73% of the users with the dominant user being Eric Ding, who is a health economist. The pink group has 4.69% of the users with the dominant user being Clay Travis, who is a radio host. Lastly, the green group has 4.13% of the users with the dominant user being Margot Katz, who covers mental health care for *The New York Times*. Most of the dominant users in the US are politically related, and most of them have an occupation related to the news.

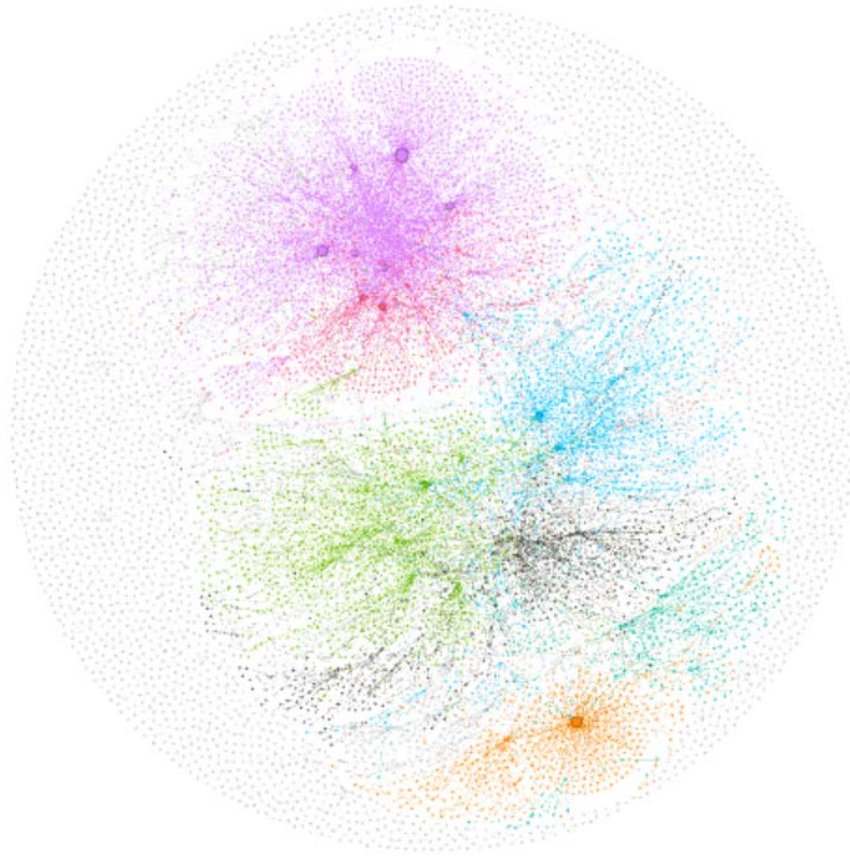


Figure 15 – UK Retweet Network Visualization

The above diagram is the retweet network visualization of the UK. The purple group has 17.52% of the users with the dominant users being Michael McConville who is a medical doctor, and James Melville, who is a communications and sponsorship consultant. The grass green group has 10.04% of the users with the dominant users being Piers Morgan, who is a TV presenter and journalist, and Rachel Clark, who is an NHS doctor. The blue group has 7.84% of the users with the dominant users being *Sky News* and *Independent News*. In the black group, 5.67% of the users with the dominant users being Christina Pagel, who is the director of the University College London clinical operational research unit, and Eric Ding, who is a health economist. The orange group has 5.48% of the users with the dominant user being the Mental Health Foundation. The pink group has 4.55% of the users with the dominant users being Laurence Fox, who leads the Reclaim Party, and Julia Brewer, who is a presenter on talk radio. The green group has 3.42% of the users with the dominant users being Centre for Mental Health and Andy Bell, who is their Deputy Chief Executive Officer. Compared to the other two countries, besides news

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accounts, the most dominant users in the UK retweet network work are in the medical field. It also has the most health organization accounts.

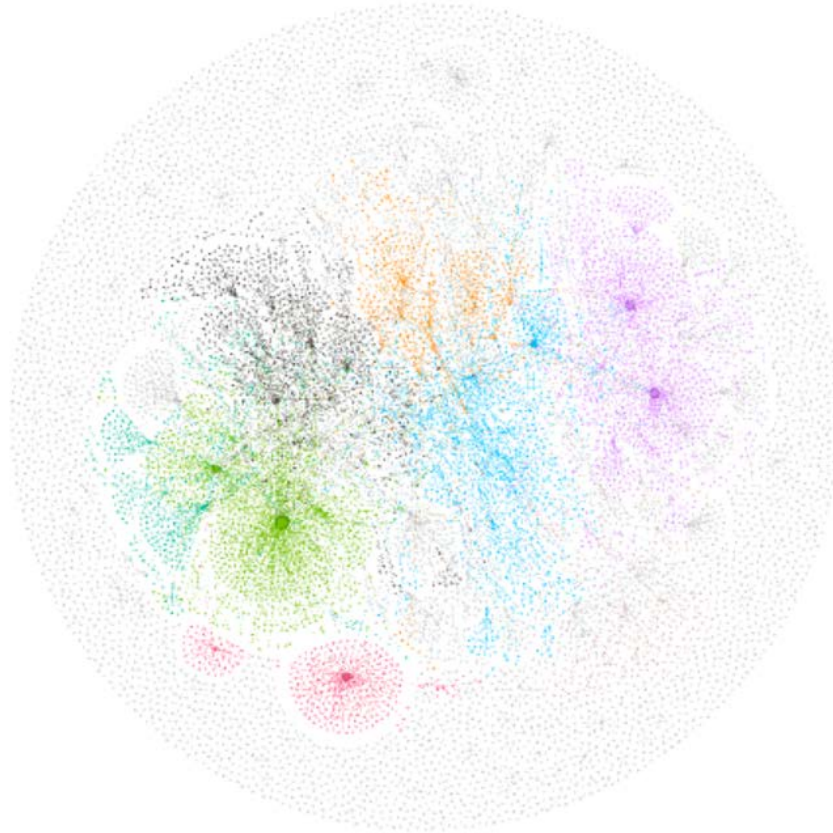


Figure 13 – India Retweet Network Visualization

The above diagram is the visualization of the Retweet Network visualization of India. The purple group has 8.79% of the users with the dominant users being *MeghUpdates* which updates news daily, and *OpIndia*, which is a news and opinions website. The green grass group has 7.58% of the users with the dominant users being Yanger Longkumer and Gaurav Pandhi, who are both congressmen. The blue group has 7% of the users with the dominant users being *ANI* (Asian News International) and *Press Trust of India* which is also a news account. The black group has 6.36% of the users with three dominant users being identified. They are Ashok Swain, who is a professor of peace and conflict research, Prashant Bhushan, who is a public interest lawyer and activist, and Rana Ayyub, who is a journalist with *The Washington Post*, *Time*, and *The New York Times*. The orange group has 3.31% of the users with the dominant users being *India*

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Today, *Hindustan Times*, and *TIMES Now*. The pink group has 3.02% of the users with the dominant user being Licypriya Kangujam, who is a 9-year-old environmental and climate justice activist. The green group has 3%, with the dominant user being the Indian National Congress. Compared to the US and UK, India has the most accounts and users related to politics and news. If groups containing news accounts in the top 7 modularity classes are combined, the percentage will be close to 20% of the users.

The dominant users in the retweet network in three countries are mostly verified users, who have a blue verified badge on their accounts. This badge lets people know that this account of public interest is authentic. In the dataset I am using, the verified accounts are only one to two percent. The dominant users also all have a range from 100k to 10m followers, indicating that they are actual influencers on Twitter as well as in society. As a result, users that get the most retweets when people are discussing the impact of Covid-19 on mental health are news accounts, people who have occupations related to news and politics, as well as doctors.

CONCLUSION

In conclusion, my thesis shows that the themes varied in the US, UK, and India when discussing Covid-19's impact on mental health on social media. While each country had similar topics, different themes were identified. Users in the US are more likely to discuss issues related to the government, politics, and economics. The number of Tweets do not appear to have a direct correlation with the number of Covid-19 cases. The US also had a majority of dominant users who have occupations such as media hosts, presenters, and journalists, all related to news and politics. Topics in the UK showed the importance of relations with family and friends. It suggested that the country cares about public safety more than the other two countries based on the results from the topic modeling. The number of Tweets also do not appear to have a direct correlation with the number of Covid-19 cases. When looking at dominant users, the UK has the most users in the medical field, which also is connected to the theme of the country. India, on the other hand, is likely to discuss topics related to education, students, and mental health. This is due to the high-pressure education environment in India, which might also be related to an increasing level of mental health issues among the students in the country. However, the number of Tweets and the number of Covid-19 cases are directly correlated, meaning that when Covid-19 cases were increasing, the number of Tweets would also increase. The dominant users of India are mainly news accounts and people related to politics. This finding was a bit surprising since the theme of India is mental health and education, and I had expected to find more accounts in the above fields.

LIMITATIONS AND FUTURE RESEARCH

In my thesis, I only used Twitter as the social media platform, but it cannot represent other social media platforms. My results only show a small portion of the public who uses Twitter on a daily basis. The other limitation of my research is that I manually combined duplicate locations for each country to create the overall dataset. There will be some other locations such as cities or states for each country that I did not combine. This could result in the dataset being smaller. However, the amount of data I had for each country is enough to do an unbiased analysis. Thus, this limitation could be improved in the future, but would not create an impact on my result.

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Some future research for my thesis includes using more social media platforms other than Twitter. On the one hand, it could make my study more well-rounded; on the other hand, comparing results from different social media platforms would provide other valuable insights into the research. Since my research only contains English-language Tweets, it limits the countries that I can explore. If I also include Tweets in other languages, it would allow me to compare results and findings from more countries. Lastly, since the research is only from March 2020 to October 2021, I could expand the period by incorporating data from November 2021 to April 2022 to make my findings more current.

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