Social media discussion on covid-19i on mental health in the US, UK, and india

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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 severity and amount of mental health problems, including depression, stress, and anxiety. This research uses real-life Covid-19 Tweets collected from March 2020 until October 2021. The objective is to analyze tweets from the US, UK, and India to discover Covid-19's impact on mental health in the three countries and identify influential users in each country when discussing this topic. The result shows that the major themes in the US were related to government and politics. Some dominant users in the US are news accounts and people who have occupations such as journalists, hosts, and presenters. The UK's theme focuses on relationships between friends and families, with doctors and medical workers as dominant users. India focuses on mental health and education, with dominant users including news-related accounts and some politicians.

Keywords: covid-19, mental health, cross-country comparison, undergraduate students

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 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 globally, 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.

The purpose of this study is to use Tweets collected from March 2020 to October 2021 to compare social media 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 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 (Madara,

2020). As for the situation in India, the pandemic has impacted the psychological well-being of general population due to heightened feat, isolation and information overload (Raval, 2020).

This paper 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 Results 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, the future research and the limitations of this study will be discussed.

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). Covid19 has created increased mental distress in the US adults especially for individuals with higher consumption of alcohol or cannabis or with history of depressive symptoms (Holingue et al., 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. Because of the pandemic, many people may be facing increased levels of alcoholism, drug use, and anxiety. 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 Pierce et al. (2020) in 204 countries and territories 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.

Wang et al. (2020) studied the impact of covid-19 on people's mental health based on 1,738 individual respondents in China. The results of their study show that female gender and physical symptoms associated with a higher psychological impact while hand hygiene, masking-wearing and confidence in doctors reduced psychological impact.

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). In addition, Cui et al (2020) found that people under the following situations (not married, loss of job, poor self-evaluations on health conditions, having problems in getting medical care and mortgage, and having kids enrolled in schools) have higher chances of getting mental health issues.

In a CDC 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 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. In addition, 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. (2015) 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. They identified four themes 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. Some other reasons why individuals discuss mental health on Twitter include a sense of community; raising awareness and combating stigma; safe space for expression; and 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 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.

Extending previous research, the purpose of this study is to investigate how the impact of covid-19 on mental health is discussed on social media in the three countries (US, India and UK) and whether there exists any dominant themes when discussing this topic among those three countries.

Research Methodology

This research is based on covid-19 tweets collected from March 2020 and October 2021 by one of the authors and contained about 1.3 billion tweets. The tweets were limited to the accounts with a location in the US, UK or India and in English. The user location is self-reported and most accounts do not have a location. The total tweets meeting the criteria are 10,861,079. The tweets were further filtered using mental-health related keywords, including "mental health", "depression", "anxiety", "nervous", "hopeless", "lonely", "fear", "anger", "distress", and "depressed". 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.

Each tweet includes a lot of fields, and this research will focus on the user's name, user location, text, language, date of a Tweet posted, and whether it is a retweet. The data was stored in an Amzon S3 Storage and analyzed using pyspark, python and SQL running on a Databricks cluster.

Data Analysis

Emerging Themes by Country

This section will investigate popular words and topics that people were discussing on social media about Covid-19's impact on mental health in each country using three methodologies: top hashtags, word cloud and top modelling analysis.

Top Hashtags

Hashtags can give a Tweet a context, and allow users to follow topics they are interested in. By looking at top hashtags, it can identify theme that people are focusing on when discussing Covid-19's impact on mental health. Since most keywords this study used to filter the original dataset can also be a hashtag, the results of the three countries are very similar and the results are shown in Figure 1a-1c. The hashtags that are the most unique for each country ae highlighted in orange.

Figure 1a shows that the two hashtags that are unique in the US 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 in Figure 1b 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 1c shows #cancelboardexams2021 as a unique hashtag in India, this hashtag is ranked the second based on number of tweets. 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.
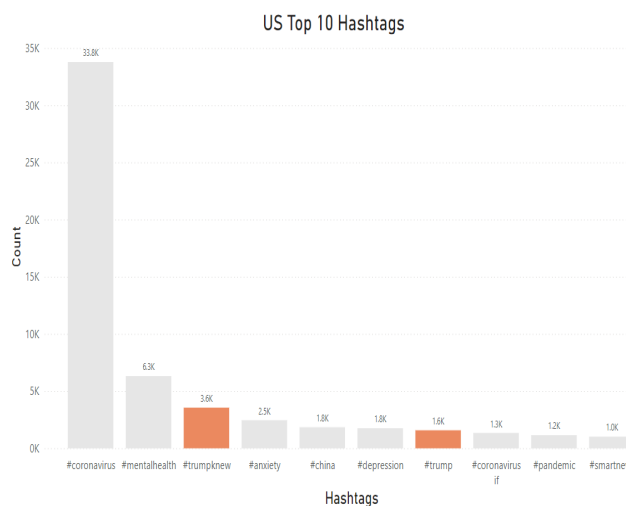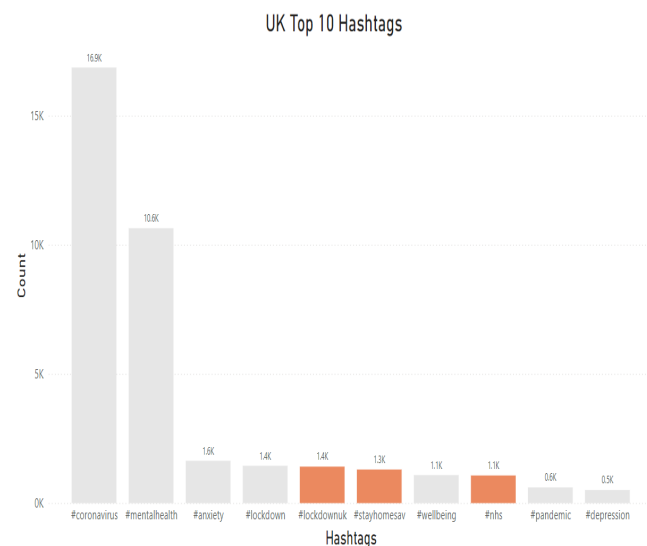

Figure 1a – US Top Hashtags

Figure 1b – UK Top Hashtags

Figure 1c – India Top Hashtags

Word cloud

Figure 2a-2c shows the word cloud in each county after removing stop words. Word cloud can reveal the most popular words appearing in tweets.

All three countries contain top words such as "health", "fear", and "mental". This analysis will mainly look at words that are not directly related to Covid-19 and mental health. The word "dangerous" showed up as one of the most prominent words in all three countries. This word was not used as a keyword when filtering the original dataset. In this case, it represented the public attitude towards the pandemic and mental health issues worldwide. One of the differences between the top word in the US compared to the other two countries is it shows "Trump" as a very frequent word. The presidential election was during the pandemic in November 2020, which was a big topic in the country. President Trump had also been involved in many of the discussions of the Coronavirus, leading to many Tweets about him on Twitter.

Figure 2b shows that the top words in the UK do not appear to have an obvious theme other than mental health and Covid-19 related ones. In Figure 2c, India has a different theme compared to the other two countries. The word cloud contained the top word "student". India is very competitive nation in education. Finding by the Indian Council of Medical Research suggested that 12%-13% of students in India suffer from mental or emotional problems (Barmi, 2022). Students might also be affected by Covid-19, resulting in a higher level of mental health issues.

Figure 2a – US World Cloud

Figure 2b – UK Word Cloud

Figure 2c – India Word Cloud

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. One popular methodology in top modelling is Latent Dirichlet Allocation (LDA), 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).

LDA is used to identify dominant topics in each country and the results were shown in Figure 3a-3c. Figure 3a shows a visual representation of the six topics in the US. 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.

Figure 3a shows that the LDA for topic one in the US has top words including "Trump", "know", "warn", "test", "case", and "start" and can be summarized as a topic in Trump presidency. The same process can be used to determine 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 in Figure 4b and 4c.

Based on the dominant words in each topic, tweets in the US can be classified into the six topics including Covid-19 related to Trump's presidency (topic 1), government issues (topic 2), reopening and the number

of patients in the hospital (topic 3), disinformation (topic 4), the "Black Lives Matter" movement (topic 5) strikes (topic 6).

Figure 3b show that in the UK, Topic 1 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, and Topic 6 is surge related to fans.

From Figure 3c, it can be seen that in India, Topic 1 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, and Topic 6 is concern about infection.
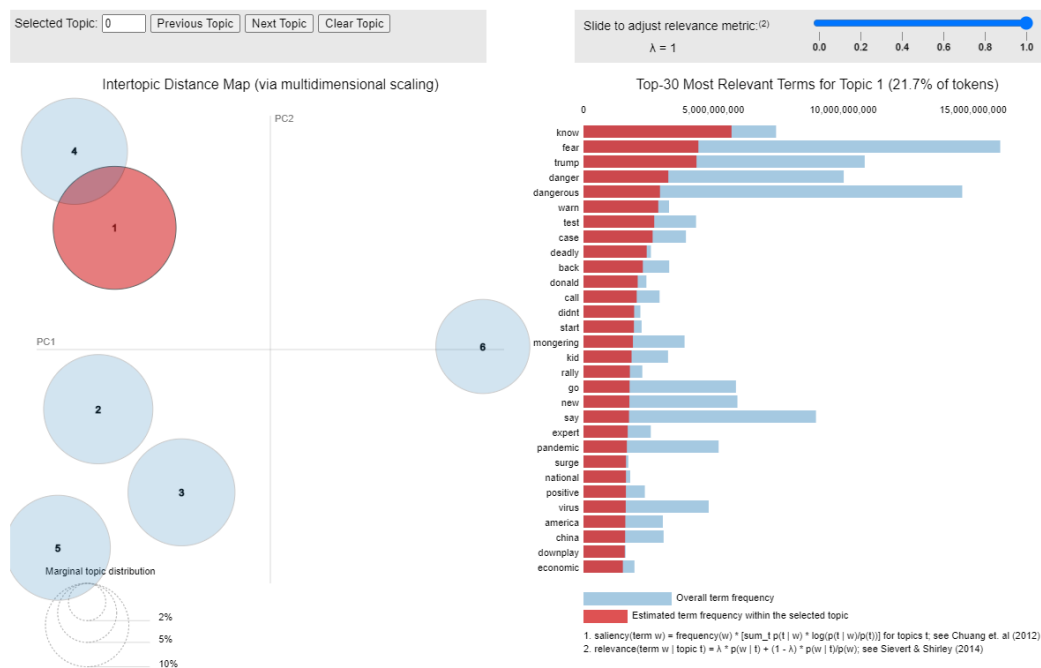
Figure 3a US LDA
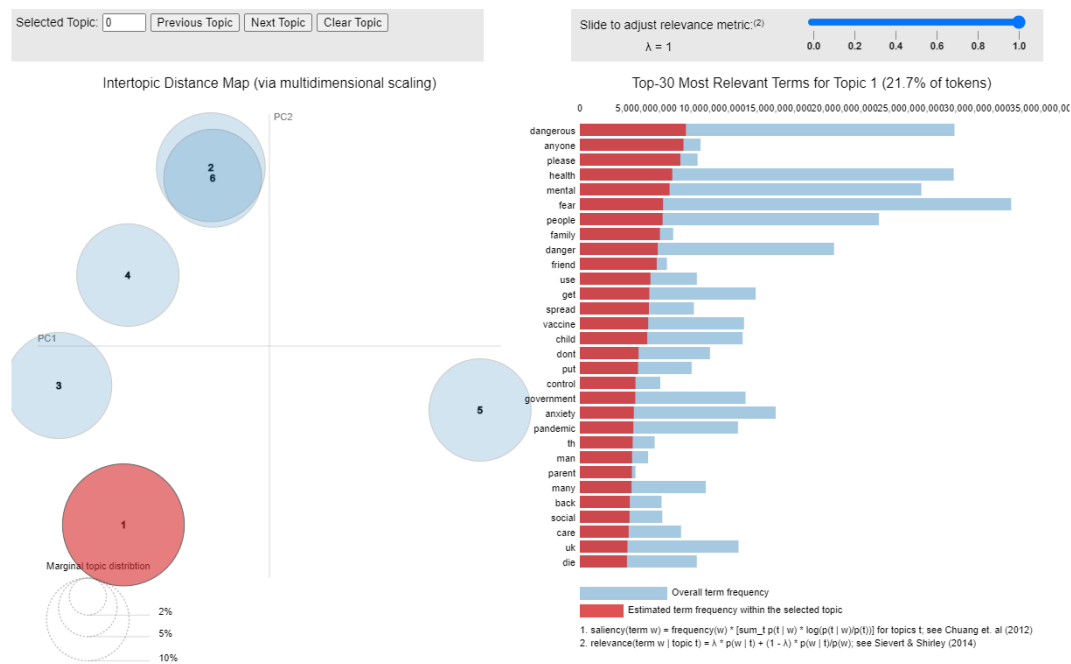
Figure 3b UK LDA
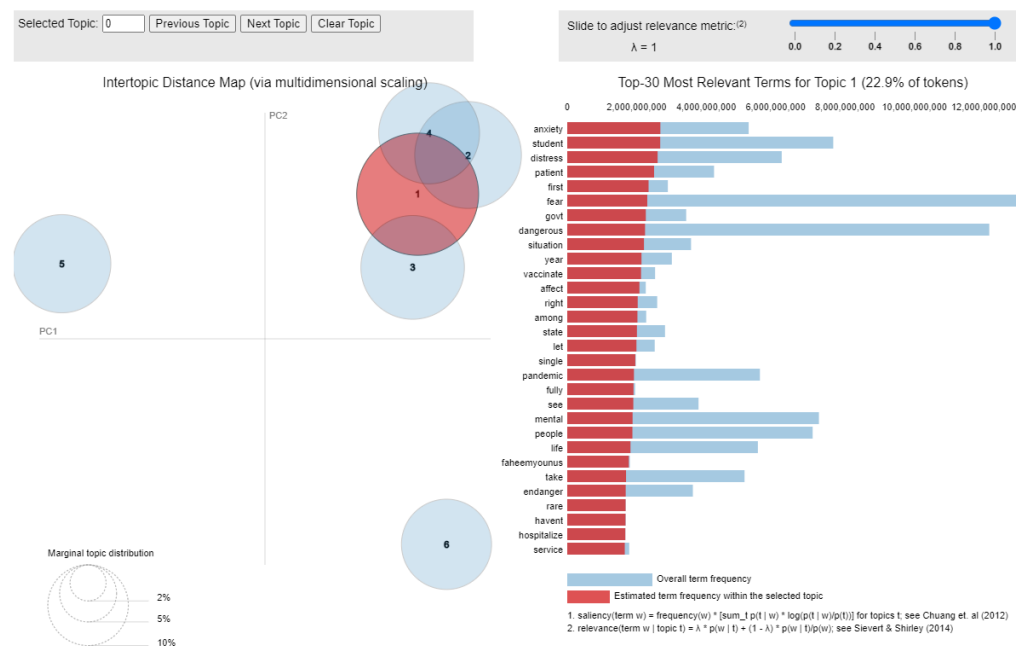
Figure 3c India LDA

The results show that when people discuss 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 interesting finding is that both the US and the UK has the "Black Lives Matter" movement as a dominant topic. It indicates that people from the UK have also shown their interest and care about news in the US.

Twitter User Interaction and Influencer by Country

A retweet network analysis was conducted by country to identify users that received the most retweets, which can be considered as influencers or dominant users in a specific topic. A network contains nodes and edges. Nodes in this study represent Twitter users. Edges represent the number of tweets one user received from another user. Gephi is used to visualize the retweet among users in each of the three countries and the results are shown in Figure 4a-4c.
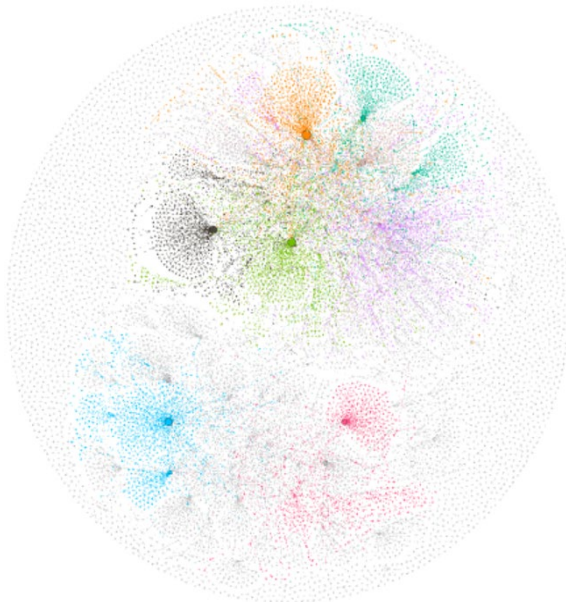
Figure 4a US Retweet Network Visualization

Figure 4a_1 – Zoomed-In Retweet Network with Labels in the US

Figure 4a shows retweet network in the US. Each node represents a user. The size of the node is based on in-degree, which is the number of retweets one user receives. The color is represented by modularity and the node with the same color belongs to the same group. Figure 5a shows there exist 7 dominant groups in the US and each group contains at least one dominant user, which will be the biggest node in the color group. The group can be zoomed in to look at the specific users in each group. A zoomed-in example of Figure 4a displaying all users in the green cluster is shown in Figure 4a_1. It can be seen that YangerINC is the dominant user who received a lot of retweets from other users in this group.

In 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 4b 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 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 4c 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 Today*, *Hindustan Times*, and *TIMES Now*. The pink group has 3.02% of the users with the dominant user being Licyprriya Kangujam, who is a 9-year-old environmental and climate justice activist. The green group has 3%, with the dominant he 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.
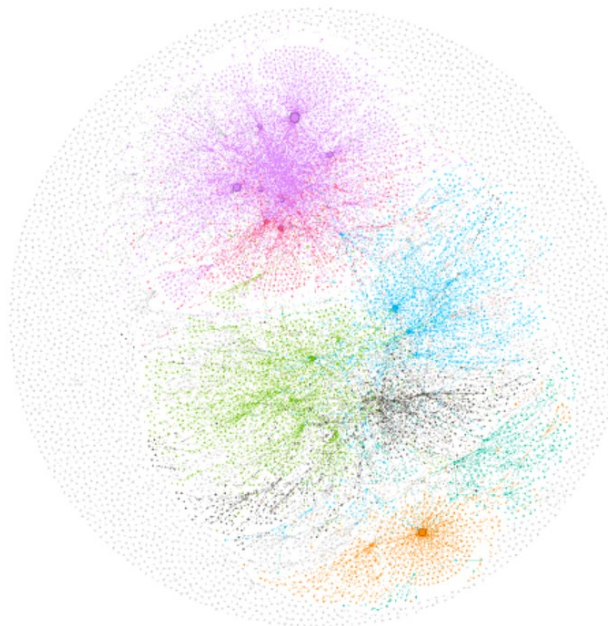

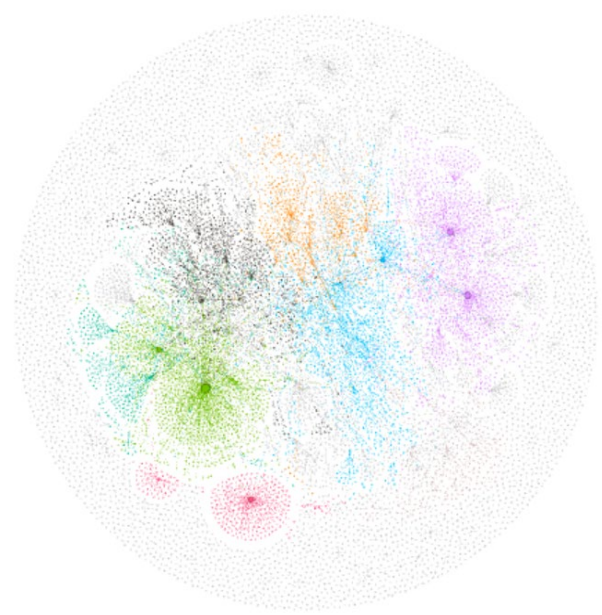**Figure 4b UK Retweet Network Visualization**   **Figure 4c – India Retweet Network Visualization**

It can be seen that 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. Verified accounts only account for less than 2 percent in the dataset. The dominant users also all have a range from 100, 000 to 10 million 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

The purpose of this study is to investigate how the impact of covid-19 on mental health is discussed on social media in the three countries (US, India and UK) and whether there exist any dominant themes when discussing this topic among those three countries. This study 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 US also had most 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. 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. The dominant users of India are mainly news accounts and people related to politics. No accounts are related to mental health and education, which is unexpected.

Limitation and Future Research

This study only looked at the covid-19 discussion on Twitter, it overlooks the covid-19 discussion in other social media platforms. The other limitation of this study is related to the identification of country. The country is extracted from the location. Location is a self-reported field by a user when creating an account. Some users did not enter a location, and some entered a fake location. Therefore, this study only represents those users with a valid location.

Future research can include more social media platforms other than Twitter. Being able to compare results from different social media platforms would provide additional insights on this topic. In addition, a future study can incorporate tweets in other languages. Lastly, this study focuses on tweets from March 2020 to October 2021, and future study can incorporate more recent tweets beyond October 2021.

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