World Health Organization's Twitter Use Before and During Covid-19 Pandemic: Sentiment and Textual Analysis of Tweets

Dünya Sağlık Örgütü'nün Covid-19 Pandemisi Öncesi ve Sırasında Twitter Kullanımı: Tweetlerin Duygu ve Metin Analizi

Sadettin DEMİREL[1] iD
Uğur GÜNDÜZ[2] iD

ABSTRACT: Social media as a form of mass self-communication offers a great deal of potential and opportunities for users and organizations to get, diffuse, redistribute, and monitor information and messages due to its features of accessibility, digitality, and time-space independence. Especially during a crisis, being able to harness the power of social media is an imperative management practice not only to provide the public with accurate information but also to deter misleading claims and rumors regarding the subject. Based on this assumption, this study aims to measure and compare the overall sentiment of the World Health Organization's (WHO) tweets before and during the coronavirus pandemic. Along with the overall sentiment of tweets, the contents of tweets, and the WHO's Twitter use practices before and during the pandemic were assessed in the framework of crisis management and health communication. Within the scope of our study, the WHO's 34.673 tweets between 2018 and 2021 were examined with sentiment and textual analysis. The study also indicates the health policies before and during the covid19 pandemic and crisis management tactics by analyzing and close reading the WHO's tweets. The findings reveal that the WHO posted more tweets to inform the public and minimize infodemic while it deliberately preferred positive messages (words and sentiments) in its tweets during the pandemic.

Key Words: COVID-19, Health Communication, Crisis Communication, Twitter, Sentiment Analysis, Text Analysis

[1] Corresponding Author, Istanbul University, Institute of Social Sciences, Department of Journalism, PhD Candidate
e-mail: sadettindemirel1@gmail.com **ORCID:** 0000-0002-3282-1706
[2] Prof. Dr., Istanbul University, Faculty of Communication, Department of Journalism **e-mail:** ugunduz@gmail.com
ORCID: 0000-0002-6138-6758

Öz: Bir kitlesel öz iletişim biçimi olarak sosyal medya dijital yapısı, erişim imkanı ve zaman mekan bağımsızlığı gibi nitelikleri sayesinde hem kullanıcıların hem de organizasyonların, bilgi alma, yayma, enformasyon ve mesajları yeniden dağıtıma sokması ve izlemesi için büyük potansiyel ve fırsatlar sunmaktadır. Özellikle kriz durumlarında sosyal medyanın bu gücünü kullanabilmek halka doğru bilgi sağlamakla birlikte yanıltıcı iddia ve söylentilerin engellemesinde önemli bir yönetim pratiğidir. Bu varsayımdan hareketle, bu çalışma Dünya Sağlık Örgütü'nün (WHO) Covid-19 pandemisi öncesinde ve pandemi sırasında paylaştığı tweetlerin genel duygu derecelerini ölçmeyi ve karşılaştırmayı amaçlamaktadır. Tweetlerin genel duygu değerleriyle birlikte, tweetlerin içeriği, WHO'nun pandemi öncesinde ve sırasında Twitter kullanımı karşılaştırmalı olarak sağlık iletişimi ve kriz yönetimi çerçevesinde değerlendirilmiştir. Çalışmamız kapsamında R istatistik yazılımı ve ilişkili metin madenciliği kütüphaneleri WHO'nun 2018 ve 2021 yılları arasında paylaştığı 34.673 adet tweet üzerinde kullanılarak duygu analizi ve metin analizi uygulanmıştır. Bu çalışma WHO tweetlerini yakın okumaya, duygu ve metin analizine tabi tutarak aynı zamanda kriz yönetim taktiklerini, pandemi öncesi ve sırasında izlenen sağlık politikalarını göstermektedir. Bulgular, WHO'nun pandemi sırasında tweetlerinde kasıtlı olarak olumlu mesajları (sözler ve duygular) tercih ederken, halkı bilgilendirmek ve infodemiyi en aza indirmek için daha fazla tweet paylaştığını ortaya koymaktadır.

Anahtar Kelimeler: *Covid-19, Sağlık İletişimi, Kriz İletişimi, Twitter, Duygu Analizi, Metin Analizi*

INTRODUCTION

Cooperation on public health in the international arena started with the spread of infectious and epidemic diseases to different countries and different continents. On the one hand, the rapid increase in the population and unhealthy working and living conditions in the cities after the socio-economic changes brought by the industrial revolution (Lee, 2009, p.1), and the development of international trade as a result of the advances in transportation and communication, were effective in the rapid spread of epidemics. The increasing prevalence of infectious diseases has affected the flow of global trade, and as a result, the economic and social conditions of states have deteriorated. Especially in the 1800s, cholera epidemics that killed tens of thousands of people in Europe were one of the triggers for the call to action (Howard-Jones, 1975, p.9).

Today, United Nations (UN) specialized agencies play an important role in ensuring cooperation between states in areas such as economic, social, cultural, education, health, communication, trade and finance, and in directing and coordinating the activities of states in these areas. WHO was officially established in 1948 as the health agency of the United Nations. Established to achieve the highest possible level of health for all, WHO plays a central role in providing direction and cooperation in international health studies. (Burci and Vignes, 2004, p.15; WHO, 1958, p.44).

Working actively in more than 150 countries, the main purpose of WHO is to guide and coordinate the global authority on international health. It describes its aims as providing the necessary support for the implementation of health policy and leading the international community to bring together health issues, assist in technical issues and monitor the health situation in the world. In addition, governments aim to focus on important areas such as health systems, non-communicable and communicable diseases, health promotion of the world population, and institutional services to achieve sustainable and tangible results (McCarthy, 2002, pp. 1111-1112).

Communication has an important place in the field of health. It also plays an important role in health, development and security policies, trade agreements and in general foreign policy. Therefore, reliable communication tools and public authority are needed for the global solution of health problems. With the increase of globalization, the need for health communication in the international arena has increased (Radha, 2021, p.128).

The Covid-19 outbreak highlighted the importance of states being prepared for crises and how societies should respond to epidemics. The panic created by the epidemic, in particular, has led people to seek easily accessible solutions. In addition to the disease-fighting measures, organizations such as the World Health Organization were forced to issue warnings and notices about the spread of myths and false information.

Consequently, the WHO is the number one international health institution when it comes to the global health-related crisis and matters. The policies it followed and the decisions it made during one of the unprecedented health crises in our time create a unique and significant opportunity to study how international or-

ganizations like the WHO instrumentalize social media during the global pandemic in terms of health and crisis communication perspectives. Despite the existing and related studies regarding health organizations' response policies, social media usage, and online presence during the outbreak and pandemic (Guidry et al., 2017; Basch, Hillyer, & Jaime, 2022; Zdunek, 2022; Tahamtan et al., 2022), this paper differs itself by comparing the WHO's social media use before and during the Covid-19 pandemic, a timely subject, and by analyzing the WHO's tweets with computational techniques (text analysis and sentiment analysis) and close readings.

1. Literature Review
When the studies on sentiment analysis and social perceptions of the World Health Organization and health communication are examined, it is seen that studies that mainly include evaluations and future predictions about the relationship between the World Health Organization and health communication are included in the literature. (Lee, 2020; Lee & Morling, 2020; Rudnicka, et al., 2020). The related studies revealed the evaluations of the World Health Organization and its role in Ebola outbreak (Guidry et al.,2017) and Covid-19 pandemic (Gallego, Nishiura, Sah and Rodriguez-Morales, 2020; Sohrabi et al., 2020; Zdunek, 2022; Tahamtan et al., 2022).

The World Health Organization's Twitter engagement during the Ebola outbreak (Guidry et al.,2017), the Covid-19 pandemic (Tahamtan et al., 2022), and TikTok usage to disseminate public health messages (Basch et al., 2022; Zdunek et al., 2022) have been frequently studied in the literature. Along with the immense effect of Covid-19, Twitter's potential to be a health research tool (Sinnenberg et al., 2017) and its use for detecting health-related trends (Parker et al., 2013) further increased relevant research outputs. In addition, studies on the importance of global health governance and the role of the World Health Organization are also included in the literature. (Kickbusch & Reddy, 2015; Milne, 2015; Gostin et al., 2015).

However, comparative analysis of WHO's tweets before and during the Covid-19 pandemic has not yet adequately employed a computational approach, which is a combination of sentiment analysis and text analysis. This study aims to fill the gap in this field in the literature. The article stands out in terms of analyzing the sentiment and text analysis dimension of discussions in the field of health communication, especially on Twitter, and differs from other previous studies since it particularly concentrates on WHO's social media engagements before and during the Covid-19 health crisis.

2. Coronavirus Outbreak and Online Public Opinion on Twitter
"There is growing interest in using social media and other internet resources to conduct disease surveillance." Social media, as opposed to traditional data collection methods, has the potential to allow public health officials to respond to disease outbreaks in real-time" (Broniatowski, Paul, & Dredze, 2013, p.7). "Unlike traditional media, which serves as a gatekeeper of information flows, social media presents opinions that are not primarily shaped by professional journalists and elite users" (Zhang & Fung, 2020, p.2).

"Twitter is a popular source of health information" (Love, Himelboim, Holton, & Stewart 2013 p.568). "During public health outbreaks, analyzing social media text can provide first responders with useful insights about public fears and trending topics" (Lachlan, Spence, & Lin, 2014, p.556; Yoon, Elhadad, & Bakken, 2013, p.122). "Government and public netizens coexist in a social network. When an emergency occurs, online rumours spread quickly and take diverse forms, thereby affecting decision-making and information dissemination via official media" (McGregor, 2019, p.1071). Tang, Chow, Breen and Prigerson (2019) "argue that to understand the relationship between individuals and the media during the spread of online rumors, it is necessary to construct a simulation model of how public opinion develops"(p.153).

One of the most important features is that people can convey their thoughts and reactions to current events on a global scale in their daily flow. It is an important data and communication source for global crises and epidemic threats (Fung, Tse & Fu, 2015).

New conversation technologies have improved opportunities "for how people can send and receive facts. Social media are one such era that has seen increased utilization as a source of information" (Pepitone, 2010, p.1). "For instance, social media are getting used to seek data about excessive topics, along aspect circulat-

ing up-to-the-minute records approximately cholera outbreaks in Haiti and identifying clean water sources eventually of this outbreak" (Sutter, 2010, p.1). "Similarly, health professions and businesses are seeing the benefits of adopting (McNab, 2009, p.566) social media because it's miles visible as an information supply allowing to get proper entry to health care statistics to populations who, in the past, might not have this right".

This point of view contributes to modern-day's understanding with the aid of displaying how the content of a government member's official Twitter profile all through a worldwide coronavirus outbreak evolves, from a channel of data dissemination approximately a public health risk and its impacts on a venue for mobilizing alleviation and response on a networking scale to an area to where emotions are shared.

Winter and Neubaum (2016) analyze public opinion leaders' characteristics and motivations, identifying "related personality traits to the use of Twitter for influencing others' attitudes on political topics, using status updates and private messages, and the motivations driving them to disseminate information and opinions." They identified three key characteristics of opinion leaders: (1) their role in the communication network, (2) their perceptions of being persuasive, which is at the heart of being influential, and (3) their personality energy" (p. 3).

According to Winter and Neubaum (2016, p.4), "political interest and personality strength are significant predictors of perceived opinion leadership." As a result, in addition to the traditional motivations for information dissemination and persuasion (Katz & Lazarsfeld, 1955), "self-presentation motives are significant in predicting digital influencers, as they have crucial implications for the dynamics of public debates in social media". This is also consistent with Winter and Neubaum's (2016, p.4) "findings on news sharing to feel important or gain higher status among a circle of friends."

According to Funk, Gilad, Watkins, and Jansen (2009), "social media and virtual communities are increasingly being identified as valuable assets of public health alerts." Awareness of a pandemic gained through first-hand observations and word of mouth can influence human behavior and reduce the risk of a pandemic and the number of infected people"(p.6873). According to Holmes (2020, p.1), "crisis communication is an ongoing process associated with the exchange of information on an outbreak and the coordination of sources together with equipment, personnel, and information to avoid or lessen disaster and for coordinating resources during a pandemic." "In addition to providing global coverage of issues, Twitter provides (Öztürk & Ayvaz, 2018, p.137) a media platform that, unlike many other social media platforms, enables easy sharing of opinions using various content forms such as text, images, and links."

According to the OECD (2015) research, "social media can enhance threat and disaster communication in several ways: (1) they are collaborative and participatory, which can improve scenario awareness, (2) they are decentralized, which allows records to circulate quickly, and (3) they are geographically traceable, which allows for disaster tracking" (p.15). According to Denecke and Atique (2016), "social media are internet-based applications that allow people to share their information over the internet. This mode of communication is more common than ever before and has gained unprecedented popularity around the world via social networking websites such as Facebook or microblogging websites such as Twitter"(p.45). "In addition, because politicians' positions are highly public their media presence in traditional media and, increasingly, social media must be carefully considered. That is, the politicians' public stance emphasizes the importance of benefit-seeking action in social media tie formation"(Koiranen, Koivula, Keipi, & Saarinen, 2019, p.120). "According to some of these examples, social media analytics and its benefits may provide immediate data to optimize public health and/or crisis surveillance and response from authorities when communicating and interacting with the vulnerable population" (Hossain, Kam, Kong, Wigand, & Bossomaier, 2016, p.2138). One of the most pressing issues in global health today is the widening information gap and misinformation on social media. According to Pas and Schaik (2014, p.198), "such a barrier to the dissemination of true information has a visible impact on the WHO's unique public interest function".

This article focuses on the WHO's social media usage in relation to its public health and crisis communication practices. It also concerns with whether the WHO utilization of social media during the pandemic was different than its social media engagements pre-covid-19 years. These matters require an analysis of how Twitter messages are worked in connection to WHO's use of social media during and before the Covid-19 pandemic.

The Twitter page of WHO, which constitutes the sample of our study, has been considered an important source of information during the coronavirus pandemic with a verified Twitter account, 11.2 million followers, and fast, current, and effective content. It will be considered a reference point for public health and crisis management with its intimate discourse and intense flow of information that motivates the masses. In the world's fight against the epidemic coronavirus, WHO is one of the most competent organizations possible to examine the role of social media as an effective example in terms of crisis management.

3. Methods & Materials
3.1. Research Aims and Research Questions
This study aims to measure and compare the overall sentiment of the World Health Organization's (WHO) tweets before and during the coronavirus pandemic. Along with the overall sentiment of tweets, the contents of tweets, and WHO's Twitter use practices before and after the pandemic were assessed in the framework of crisis communication and health communication.

RQ1) What were the overall sentiments and prominent messages in the WHO's tweets before and during the Covid-19 pandemic?

RQ2) How did the WHO use Twitter to respond to the Covid-19 crisis from the crisis management and health communication perspective?

3.2. Research Methodology
To answer the research questions, a mixed method, which is consist of sentiment analysis, text analysis, and close readings of the most popular 400 tweets, was preferred. Automated text analysis and sentiment analysis of 34.673 tweets from WHO's official Twitter account constitute the computational and quantitative side of the mixed method research design. Processing and interpreting large volumes of unstructured text data require employing computational techniques (Benoit, 2020), particularly sentiment analysis and automated text analysis. In this way, we simply treated the text as data (Grimmer & Steward, 2013; Benoit 2020) to be able to further structure, summarize and quantify it. Although this provided us with an overview of sentiment characteristics and the frequency of stand-out words or phrases, these automated methods were not expected to replace human judgements for in-depth interpretive analysis (Grimmer & Steward, 2013). Instead, a hybrid approach, a combination of both methods, was suggested to utilize the best features of both research designs (Lewis, Zamith & Hermida, 2013; Lewis & Zamith, 2015). Hence, we preferred to employ a mixed-method research design to further augment the automated findings with the qualitative insights that were derived from close readings of the most popular tweets.

In the first part, VADER (Hutto & Gilbert, 2014), Sentimentr (Rinker, 2018), NRC (Mohammad & Turney, 2013), and Bing (Hu & Liu, 2004) sentiment dictionaries were used to measure the overall sentiment on tweet level and word level. The words and tweets were classified into certain sentiment categories (positive, negative, neutral) to make sense of the tone of the tweets. In the second phase, employing the n-gram text tokenization technique (Silge & Robinson, 2017; Welbers, Van Atteveldt, & Benoit, 2017; Jo, 2019), which is mainly utilized in the studies of text mining and natural language processing (NLP), on WHO's tweets, frequently used keywords, and expressions (unigrams, bigrams, and trigrams) were acquired to determine the standout terms and phrases for each period. Lastly most liked top 100 tweets (50 from own tweets and 50 from quoted tweets) from each year (from 2018 to 2021) were selected for close readings to make an in-depth analysis of WHO's Twitter use before and during the Covid-19 pandemic.

3.2.1. Data Collection & Pre-processing
We retrieved 34.673 tweets that were posted between 2018 and 2021 from the Twitter API by using R statistical software and (R Core Team, 2021) academictwitteR package (Barrie & Ho, 2021). We were able to reach tweets that were posted previous years thanks to the Twitter API service for academics. No sampling was done on tweets, and it was not needed since we included all tweets that were published two years before the pandemic (2018 and 2019) and two years during the pandemic (2020 and 2021) to compare the WHO's Twitter use. Before the analysis, in the pre-processing phase, we removed the unnecessary words (stopwords) to detect the main

themes and terms in textual data. For this process, a List of "stopwords-iso" (Benoit, Muhr, & Watanabe, 2021) that includes unnecessary words in the English language was utilized to filter unnecessary terms in tweets. Also, emojis and links were removed from the data before the text analysis to clarify the textual findings that were derived from tweets.

3.2.2. Sentiment Analysis Dictionaries

VADER (Valence Aware Dictionary and sEntiment Reasoner) sentiment dictionary is used to uncover sentiment values of short texts. The VADER dictionary was developed by Hutto and Gilbert (2014) to analyze the polarity in textual data on social media. VADER offers a better way to evaluate sentiments as it considers valence shifters, punctuations, and in-text emojis and gives an adjusted compound value (from -1 to 1) representing each tweet's sentiment value (Hutto & Gilbert, 2014). VADER classifies the positive (compound >= 0.05), negative (compound <= -0.05) and neutral (compound > -0.05 and compound < 0.05) characteristics of tweets. The developers also advise this way of classifying each tweet into sentiment categories of the VADER dictionary. Similar sentiment classifications were also applied in the scholarly works (Akerlund, 2020; Demirel, Kahraman, & Gündüz, 2022; Ribeiro, 2016) that benefited from VADER

Similarly, Sentimentr is designed to calculate text polarity by considering valence shifters, and negators in the text block (Rinker, 2018). Sentimentr differs from VADER because the software package is not peer-reviewed and is exclusively developed for R programming language. However, the software or the library is already used for sentiment detection benchmarks (Naldi, 2019). Also, the Github page of the software shows how sufficient and accurate the package is when it comes to Amazon, Yelp, IMDB reviews, and Trump tweets (Rinker, 2018). Compared to the VADER dictionary, Sentimentr only provides average sentiment scores which can be classified as positive (score > 0), negative (score < 0) and neutral (score = 0).

The NRC (National Research Council) emotions and sentiment lexicon were also used as an additional sentiment dictionary (Mohammad & Turney, 2013). NRC varies from the VADER as it focuses only on words and provides word-level sentiment and emotional results. Therefore, NRC requires tokenization of textual data, which breaks the sentences or paragraphs into words (Silge & Robinson, 2017; Welbers et al., 2017; Jo, 2019). Additionally, per word, the NRC sentiment dictionary produces positive and negative qualitative sentiment results and basic emotions such as anger, fear, anticipation, trust, surprise, sadness, joy, and disgust (Mohammad & Turney, 2013; Naldi, 2019). However, we only include positive and negative words since the other word-level sentiment dictionary, Bing sentiment only offers positive and negative sentiment classifications per word.

Bing is another lexicon-based sentiment analysis dictionary developed for detecting sentiment in customer reviews (Hu & Liu, 2004). The dictionary only offers two sentiment categories (positive and negative and classifies only words as the NRC dictionary does. Employing these sentiment dictionaries helped us to discover and compare the overall mean sentiment scores for each year. Additionally, we calculated the proportions of tweets and words which were classified into sentiment categories to uncover the overall sentiments of each year at the tweet level and word level. By implementing 4 different sentiment dictionaries, we aimed to detect sentiment shifts in the tweets accurately and support our findings with more than one or two sentiment analysis results.

3.2.3. Text Analysis

To uncover frequently used words and hashtags from the tweets, a textual analysis library of Quanteda (Benoit et al., 2018) was utilized by using R statistical software (R Core Team, 2021). Text analysis requires the tokenization and pre-processing of texts to discover the frequency of words used (Silge and Robinson, 2017; Welbers et al., 2017; Jo, 2019). The n-gram tokenization technique makes finding out consecutive words easier. Besides not just one word (unigrams) but also multi-word phrases that consist of two (bigrams), three (trigrams), or more words can be acquired. By using n-grams for further analysis, we could better understand contexts and leading terms in WHO's tweets. With Quanteda library we pre-processed the tweets data and removed unwanted and unnecessary elements (stopwords, emojis, punctuations, etc.) to clarify findings. Later, we implemented a relative frequency analysis on tweets before and during the pandemic to compare most likely standout unigrams and bigrams.

3.3. Research Findings

As can be seen in Table 1 with the coronavirus pandemic, the number of tweets WHO shared in a year increased dramatically. In 2018, the WHO Twitter account retweeted other tweets more than its posts while both figures were nearly equal in 2019. The pattern has changed in 2020 when the coronavirus pandemic spread all over the world.

Table 1: WHO's tweet types by year

Year	Tweets	Own tweets	Retweeted	Quoted
2021	8973	6180 (68.8%)	1680 (18.7%)	1113 (12.4%)
2020	11626	8161 (70.1%)	2786 (23.5%)	729 (6.2%)
2019	7532	3927 (51.7%)	3510 (46.2%)	95 (1.2%)
2018	6542	2882 (44%)	3599 (55%)	61 (0.9%)

The difference between 2018, 2019, and 2020 is not just a matter of quantity. We can see that WHO posted its unique tweets more than other types when the pandemic hit. While quoted tweets rose with the total number of posts, the number of retweeted tweets dropped to 23.5 and 18.7 per cent in 2020 and 2021 respectively.

Moreover, we found that the WHO Twitter account mostly retweeted its tweets, the WHO's president Dr Tedros and WHO's branches (WHO Europe, WHO Yemen, WHO Syria, and other international organizations (UN, UN Women, UN Geneva, etc.). Also, before the pandemic the WHO retweets its tweets the most, whereas the president's tweets were retweeted the most during the pandemic. In quoted tweets, we saw the same pattern. The WHO's Twitter account mostly quoted its unique tweets, the president's tweets. It is sufficient to say that the change in post types tells many things in terms of the WHO's social media strategy from the crisis communication and health communication perspective.

3.3.1. Sentiment Analysis

As is already mentioned in the method section, the application of sentiment analysis provided the tweet level and word level results regarding the WHO tweets before and during the Covid-19 pandemic. We found that the overall polarity of the tweets shifted toward the positive side with the start of the pandemic, while the proportion of the positive tweets and words with positive sentiment likewise increased.

Tweet level sentiment by VADER and SentimentR dictionaries

Mean sentiments of each year draw two different pictures between before and during the pandemic. Before the pandemic crisis, the VADER's mean polarity of tweets was nearly 0.10, while the mean polarity of the posts increased by 100% in the following 2 years.

Table 2: Total mean polarity of WHO tweets

Year	Tweets	VADER Mean Polarity	SentimentR Mean Polarity
2021	8973	0.206	0.096
2020	11626	0.209	0.093
2019	7532	0.091	0.038
2018	6542	0.088	0.040

Table 3: Sentiment classification of WHO tweets

Year	Tweets	VADER			SentimentR		
		Positive	Negative	Neutral	Positive	Negative	Neutral
2021	8973	5215 (58.1%)	2102 (23.4%)	1656 (18.4%)	5690 (63.4%)	2672 (29.7%)	611 (6.8%)
2020	11626	6722 (57.8%)	2698 (23.2%)	2206 (18.9%)	7361 (63.3%)	3410 (29.3%)	855 (7.3%)
2019	7532	3547 (47%)	2359 (31.3%)	1626 (21.5%)	4135 (54.8%)	2939 (39%)	458 (6%)
2018	6542	3132 (47.8%)	2094 (32.1%)	1316 (20.1%)	3657 (55.9%)	2536 (38.7%)	349 (5.3%)

Like VADER's results, SentimentR mean polarity scores indicate that before the pandemic crisis WHO tweets polarity was 0.04 on average, whereas tweets polarity went up by 125% during the Covid-19 crisis. In addition to the overall mean polarity score, we saw that the disparity between the proportions of positive tweets and negative tweets during the pandemic is wider than in prior years. Even though one might expect otherwise, we can see that compared to the negative tweets, WHO posted more tweets with positive sentiment during the coronavirus crisis. In other words, WHO shared more and more tweets with positive sentiment from 2018 to 2021 while the proportion of tweets with negative sentiment decreased gradually during this period.

Word-level sentiment by NRC and Bing word-level sentiment dictionaries
NRC classification of words into positive and negative sentiment categories also highlighted the same pattern we saw in the sentiment classification of the tweets. Before the pandemic, the proportion of the words in positive and negative sentiment categories were about 56% and 45% respectively, whereas the gap among the categories shifted in the favor of positive words during the pandemic. The gap went from approximately 11% to 27%.

Table 4: NRC sentiment classification of words in WHO tweets

Year	Number of words	Positive	Negative
2021	23256	14936 (64.2%)	8320 (35.7%)
2020	28505	18032 (63.2%)	10473 (36.7%)
2019	16451	9255 (56.2%)	7196 (43.7%)
2018	12727	7036 (55.2%)	5691 (44.7%)

Bing sentiment classification results also indicate that the WHO used more positive words than negative words in its tweets during the coronavirus pandemic. While the number of negative words in the tweets was predominant before the pandemic, the WHO Twitter account preferred more positive words at the start of the Covid-19 pandemic.

Table 5: Bing sentiment classification of words in WHO tweets

Year	Number of words	Positive	Negative
2021	13295	6927 (52.1%)	6368 (47.8%)
2020	17926	9136 (50.9%)	8790 (49 %)
2019	10487	4356 (41.5%)	6131 (58.4%)
2018	8087	3497 (43.2%)	4590 (56.7%)

3.3.2. Text Analysis

Textual analysis of WHO tweets yielded unique words that belong to before and during the coronavirus pandemic. Relative frequency analysis (keyness) of texts is mainly concerned with discerning frequent words in the text but compared to the simple frequency analysis it requires a target and reference groups within the textual data. In our case, we divide the tweets into tweets that were published before (reference) and during (target) the Covid-19 pandemic to identify the most likely used words in two periods. As can be seen in Fig. 1, "pandemic", "vaccines", "solidarity", "covid-19", "transmission", "covax", "virus", "mask", and "variant" words were among the top 20 words that are most likely used during the pandemic. Considering the context of the Covid-19 pandemic, highlighted words in Fig. 1 accurately demonstrate the main agenda of WHO tweets, which mostly cover Covid-19 related topics, issues, and questions. Before the pandemic, WHO mostly tweeted about general health issues: heart, women, children, antibiotics, health coverages, and dyk (do you know?) contents.

Figure 1: Relative frequency analysis of tweets before and during the pandemic.
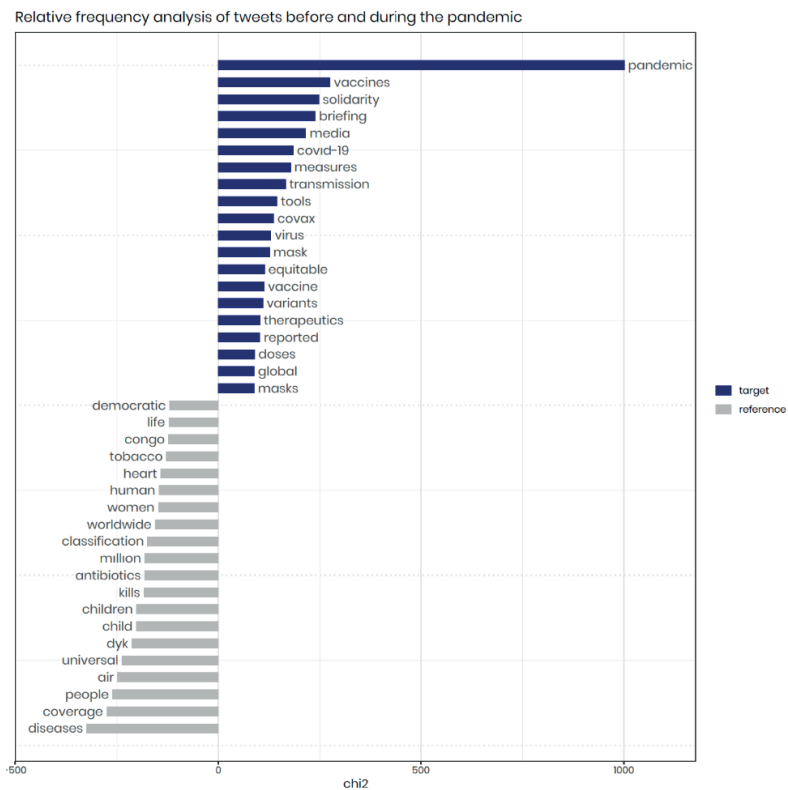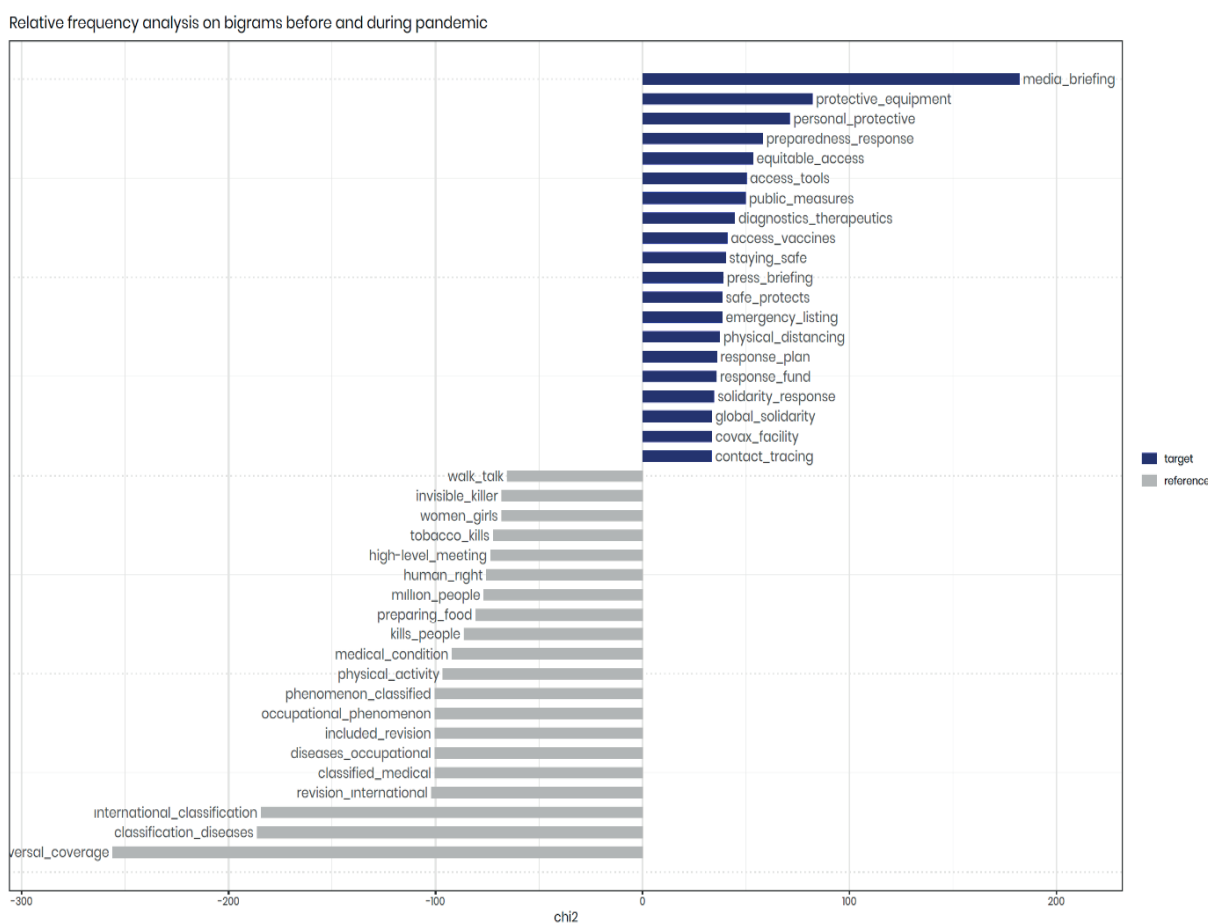

Note: Target represents most likely expressions during the pandemic while reference indicates the most likely words before the coronavirus pandemic.

The words in Fig. 1 showed only most likely used unigram words relative to the tweets during the pandemic (target) and tweets before the pandemic (reference). Like unigram results, relative frequency analysis of bigram words presents that as expected Covid-19 related terms dominated the tweets during the pandemic. Of course, we saw more context regarding the issues that were conveyed via Twitter: "media briefing", "protective equipment", "public measures", "staying safe", "physical distancing", "response plan", "response fund", "covax facility," "contact tracing".

On the other hand, WHO tweets more about general healthcare issues before the pandemic as expected. Most likely used bigram phrases were "universal coverage", "classification of disease", "physical activity", "medical condition", "tobacco kills", "human right", "woman girls" etc.

We obtained similar results after mapping the frequently used hashtags with a comparison word cloud (see Fig. 3). In Fig. 3, akin to the relative frequency analysis, we divided the most used hashtags into before and during pandemic sub-groups.

Figure 2: Relative frequency analysis of bigrams before and during the pandemic.

Relative frequency analysis on bigrams before and during pandemic

Note: Target represents most likely bigram expressions during the pandemic while reference indicates the most likely bigram words before the coronavirus pandemic

Figure 3: Comparison word cloud of top 100 hashtags before and during the coronavirus pandemic.
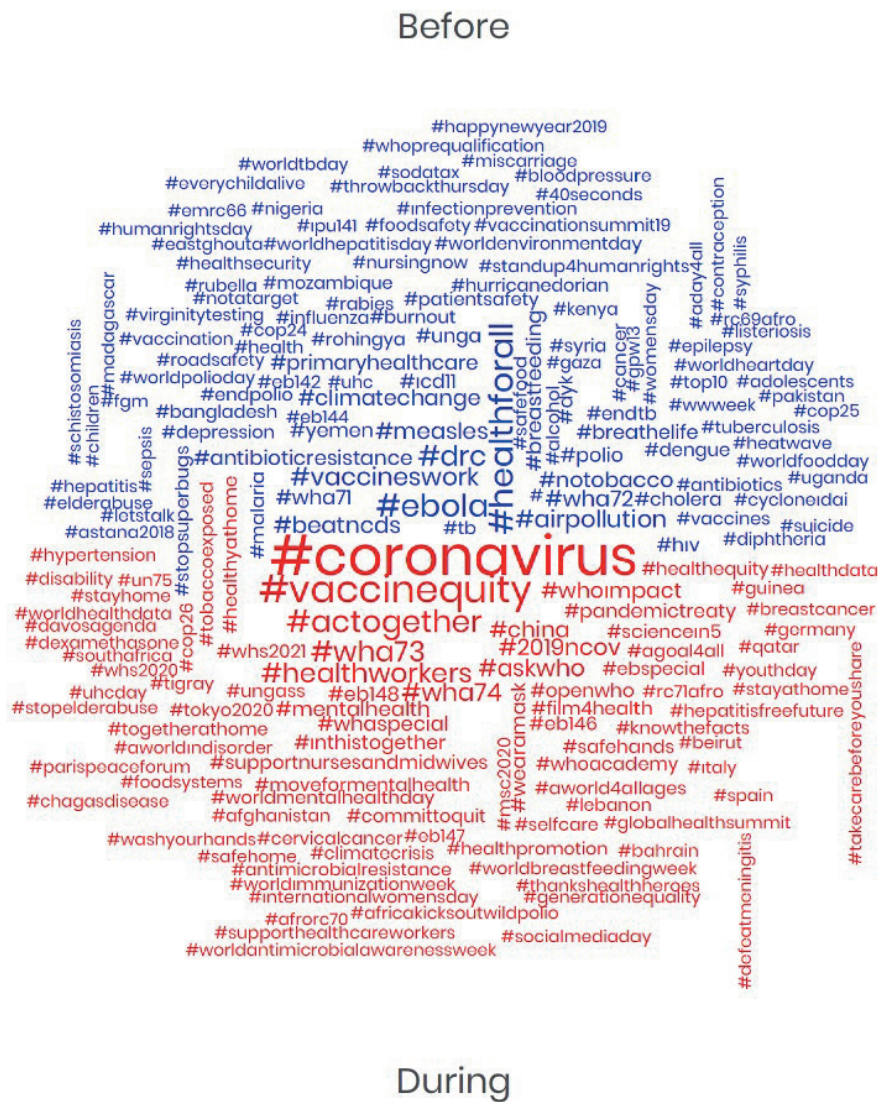
Before the pandemic, WHO predominantly tweeted on health policies such as #healthforall, #primary-healthcare, #vaccineswork to promote vaccines and health coverages, upcoming problems for health which are #airpollution, #climatechange, existing issues and diseases such as #antibioticresistance, #depression, #suicide, #ebola, #measles, #endpolio, #hepatitis, #influence. Along with these, WHO also posted tweets with hashtags that related to humanitarian and political crises: #yemen, #rohingya, #bangladesh, #syria, #gaza. Considering that WHO is the number one international health authority, promoting healthcare policies, having standings on humanitarian and political crises that might impact human health, informing people on health issues and increasing awareness of healthcare problems are among its missions.

As the pandemic hits, we found that hashtags with general health issues that dominated WHO's tweets in 2018 and 2019 were replaced by Covid-19 related hashtags. This is an expected finding since Covid-19 is one of the worst and most unprecedented health crises we experienced. As a top international institution, WHO tweeted about #coronavirus, #vaccineequity, #2019ncov, #stayathome, #inthistogether, #safehands, #healthyathome. We also saw other hashtags that are non-related to the pandemic: #afghanistan, #whoimpact, #international-womensday, #hypertension, #socialmediaday, and #worldbreastfeedingday.

Figure 4: Comparison word cloud of top 50 mentions before and during the coronavirus pandemic.

Twitter handles in the tweets also indicate that the WHO mentions more diverse accounts during the pandemic than it used before the Covid-19 crisis. As the president of WHO, Dr Tedros is the most mentioned Twitter account in WHO tweets, but we also see other health experts (drmikryan, Jnkengasong, mvankerkhove), politicians (Macron, Von der Leyen, Jens Spahn, Erna Solberg), tech and video games brands (Tencent, Google, Fifacom), social networks (Instagram, Youtube, Facebook, Twitter, Linkedin, Pinterest, Viber, Whatsapp). Compared to the mentions during the pandemic, WHO largely mentioned its sub-branches or branches in other countries (who Europe, whowpro, whosearo, pahowho, whoafghanistan, etc.), other international organizations (UN, UN Geneva, UN Woman, etc.).

We also examined some of the WHO tweets that mentioned tech companies and social networks and found that WHO cooperated with these companies and initiatives to respond and to debunk Covid-19 related infodemic, which can be explained as the rapid circulation of misinformation or disinformation about pandemics on the web and social media.

"We are also engaging with search, social and digital companies such as @Facebook, @Google, @TencentGlobal, Baidu, @Twitter, @tiktok_uk, Weibo, @Pinterest & others"- @DrTedros

"@Facebook @Google @TencentGlobal @Twitter @tiktok_uk @Pinterest @instagram @YouTube "In essence, to fight the flood of misinformation, we are building a band of truth-tellers that disperse fact and debunk myths"-@DrTedros #2019nCoV

"To fight the #COVID19 infodemic, we've worked with multiple tech partners, including @Facebook, @Google, @instagram, @LinkedIn, @messenger, @Pinterest, @Snapchat, @TencentGlobal, @tiktok_uk/@tiktok_us, @Twitter, @Viber, @WhatsApp, @YouTube and more"-@DrTedros #EB147

3.3.3. Close Readings on WHO's 400 Popular Tweets

As we already explained in the method section, in this close reading of WHO's most popular 100 tweets each year, we selected 50 from WHO's normal tweets and 50 from the quoted tweets. In this way, we aimed to do an in-depth examination of WHO's Twitter use before and during the pandemic.

The most popular tweets posted before the Covid-19 pandemic focused on a variety of health-related issues such as vaccine hesitancy, violence against health workers, universal health coverage for all people, clean water, climate change, air pollution, Ebola, violence against women, antibiotic resistance, mental health, unwanted pregnancies, physical activity, etc. Additionally, the WHO president's quotes and tweets that were published on special days were among the most popular tweets too. We saw that WHO specified some health issues to tackle and increase awareness and used Twitter to amplify its messages. One of its tweets in 2019 shared the 10 issues that WHO aim to tackle: air pollution & climate change, non-communicable diseases, influenza, vulnerable settings, antimicrobial resistance, Ebola, primary health care, vaccines, dengue, and HIV. Hence it can be said that WHO's tweets were systematically designed to augment its messages regarding WHO's health policies.

With coronavirus spreading in 2020 and 2021, we can say that WHO's tweets covered pandemic-related issues for the most part. The close readings of 200 popular tweets in 2020 and 2021 showed that the WHO Twitter account used Twitter to answer Covid-19 related questions and rumors with Q&A threads. As we saw in Fig. 4 WHO collaborated with social networks and tech companies to debunk the myths and misleading information regarding the Covid-19. In one example Twitter's formal account answered users' questions about the pandemic by quoting the WHO official account (Twitter [@Twitter], 2020). Another one is that the WHO created a Whatsapp Health Alert account to inform people about how to protect themselves against the Covid-19 and virus symptoms (World Health Organization [@WHO], 2020). Apart from utilizing different media channels, we saw that #stayathome virtual concerts with celebrities (Lady Gaga, John Legend) from the music industry, messages from famous NBA players, and instructive videos on staying safe, staying active with movie characters (Gru and Minions) were among the many communication tactics used during the pandemic. Along with these, we saw that daily media briefings were arranged to inform the media and public regarding the Covid-19 developments. It can be said that these media briefings became the common postings during the pandemic since we found that the "media briefing" bigram word is the most likely term used in Fig. 2. One of the media briefings on February 11th, 2020, was broadcasted via Periscope (Twitter streaming service) and the statements from media briefings were tweeted with a thread. One tweet among them is one of the most popular tweets we examined:

> "🔺BREAKING🔺"We now have a name for the #2019nCoV disease: COVID-19. I'll spell it: C-O-V-I-D hyphen one nine – COVID-19" -@DrTedros #COVID19"

Naming the pandemic might be one of the best decisions of the WHO's leadership for better communication purposes and preventing other harmful discourses regarding the name and the origin of the virus since along with Donald Trump's statements, there was another naming that identify and associate this virus with China at the time due to the China being the epicentre of the Covid-19.

4. DISCUSSION

In this study, we examined WHO's tweets before and during the pandemic in terms of their sentiment scores, sentiment categories, and frequent words. Also, we delved into WHO's Twitter use by close reading the most popular tweets posted before and during the Covid-19 crisis.

Considering the quantitative findings we obtained, first, WHO used its functions of health-related authority and information source and diffusor by posting more tweets in the middle of the pandemic to manage information needs and minimize the rumors, and infodemic regarding the pandemic, but we also found that proportion of unique or original tweets (no retweeted or quoted) during the pandemic is higher than the proportion of unique tweets before the Covid-19. As Table 1 shows 70% of the tweets in 2020 consisted of unique posts while the rate of retweeted tweets decreased to below 20% and the proportion of quoted tweets within the total tweets rose to 12% in 2021. Additionally, before and during the pandemic the accounts that were retweeted and quoted by WHO were mostly WHO's own accounts, the president's account, and WHO's other branches all over

the world. Hence, we interpreted that WHO tried to amplify its messages by retweeting and quoting its tweets and its president's account. This might be a common social media practice but in a crisis like the Covid-19 pandemic, repeating messages and developments is imperative to manage the crisis by supplying people and media with accurate information.

Second, overall sentiments in the tweets shifted in favour of the positive side as the pandemic started (see Table 2). After performing sentiment analysis on tweet level and word level with 4 different sentiment dictionaries, we saw that the shares of positive tweets and positive words raised with the start of the Covid-19 pandemic. The growing disparity between the positive and negative sentiment categories can only be explained by WHO's intentional language use and word choices during the pandemic. Since Covid-19 is one of the unprecedented and most pervasive pandemics we experienced in these modern times, plus considering the psychological and physical tolls of the pandemic (Torales, O'Higgins, Castaldelli-Maia, & Ventriglio, 2020) the sentiment shift in tweets before the Covid-19 and during the Covid-19 is due to the deliberate choices of the WHO communication experts.

Third, relative frequency analysis of WHO tweets show a clear difference between tweets before and during the pandemic. Most likely words from the two periods indicated that Covid-19 was the focus of WHO's communication activities. The leading unigram and bigram words from Fig. 1 and Fig. 2, the most used hashtags and mentions from Fig. 3 and Fig. 4 show not only the significance of the pandemic in the coverage of WHO's tweets but also WHO's social media practices to respond Covid-19 related matters. As the most prominent health organization in the world, WHO has various challenges and issues to address. In a global health crisis like Covid-19, managing the circulation of accurate information, debunking myths, and rumours, and addressing infodemic in the ever-growing online spheres might be one of the most important tasks. Therefore, WHO collaborated with tech companies, and social networks and tried to address the infodemic and information need by arranging media briefings and sharing Q&A content via social media channels. Additionally, WHO tried to keep the moods of its followers up by arranging virtual concerts and live sessions, sharing tips, and recommendations regarding protection against the pandemic, and staying at home healthy. With these communication tactics, the WHO certainly became more than just an information source.

Recently, we live in times where information pollution increases the most. As an important public tool and a common meeting place for people from all walks of life, Twitter is open to manipulation by people who are not experts in the field of health. It is important to raise awareness about health literacy to be a society that investigates and questions whether the information obtained from social media and mass media is correct.

Today, in light of increasing globalization and technological developments, the perspective on health, health diagnosis and policies has changed. Increasing interaction between countries as a result of globalization with industrial growth; Worldwide problems such as climate change, chronic diseases and epidemics have begun to be examined in public policies and made international cooperation mandatory. As a result, it will be thanks to Global Health Communication that brings individuals together in society in line with their common interests and provides an opportunity to develop their values, thus providing a safer environment for future generations.

The Covid-19 pandemic has shown that the world is a small place. Pandemics can spread globally in a short time and people may not quite ready for pandemics. In addition, it has shown the importance of the use of social media tools in global pandemics and the role played by global health institutions such as the World Health Organization in the effective and efficient use of social media tools in pandemics. Our study emphasizes the importance of global health authorities and the effective use of social media tools by global health organizations during pandemics. The World Health Organization, as an international health authority, uses social media tools effectively. The findings of this social network analysis about the World Health Organization as a reliable health authority in this field confirm this function.

5. CONCLUSION

In light of our findings derived from the WHO's tweets, during the Covid-19 pandemic, the World Health Organization effectively used Twitter to inform the public and keep in touch with its followers. We found that the WHO followed systematic agendas to promote before the pandemic while during the pandemic the WHO mainly focused on informing the public about Covid-19 and responding to the growing disinformation by posting more tweets and collaborating with tech and social media companies and arranging frequent media brief. The WHO was careful with the sentiments and words that were conveyed in tweets. More and more positive tweets and positive words were posted during the pandemic. The WHO also utilized many crisis management and health communication tactics to inform and entertain its followers.

Considering the magnitude of the Covid-19 public health crisis and its adversarial effects on people's livelihood, this exploratory longitudinal study offers a unique way to analyze WHO's Twitter engagements to understand and further show how health and crisis communication specialists harness the power of social networks. The empirical evidence from WHO's tweets from pre-pandemic years and during pandemic times yields plenty of insights regarding what health organizations should do in troubled times.

Today, thanks to developing new communication technologies, people turn to social media platforms to obtain information. In particular, the information provided by people who are accepted as opinion leaders in society and public health authorities through social media plays an important role in obtaining information in times of crisis. However, while developing technologies have increased the spread of information, they have also provided an increase in false and manipulative information. Disaster periods are the processes in which society's interest and need for news reach their highest level. Psychologically, the tendency to 'be aware', which stems from the human instinct to feel safe, turns into a basic and primary need in negative times. By intentionally posting more tweets during the Covid-19 and systematically selecting words and tweets with positive sentiment and emotion, WHO's effectively utilized Twitter to provide its followers with accurate information and latest developments.

This study shows that important mass self-communication channels and tools such as Twitter can be an effective source of information in times of crisis and disaster, in a period when digital mass media and social network platforms are becoming ubiquitous, and information is circulating at a dizzying speed through social networks without any hindrance. In this ever-growing virtual public sphere, the unsupervised use of social media allows users to share their health experiences directly and the messages of health-oriented companies to be sent and disseminated without any control. For this reason, correct and incorrect health information can be shared on social media without filtering through an official and knowledgeable source in the field of health, and in some cases, social media users are exposed to false information or health messages from other users that are designed and published only for the political and commercial gain of companies. False health-themed content mixed with political and business goals, commercial interests, and false personal thoughts can cause disinformation and misinformation on the internet and may adversely affect the decisions of individuals who are unstable or in difficult health situations and who are in search of a solution to their health problems.

We believe we only scratched the surface regarding the WHO's response to Covid-19 pandemic by only focusing on its Twitter activity. For further and following studies may choose the WHO's use of other social media activities (particularly Facebook, TikTok, Instagram, etc.) traditional media channels. Also, WHO's social media followers could be a subject of examination to measure how the organization responded to the pandemic-related issues and to what extent response plans worked. Additionally, further studies might be interested in the social media activity of other health institutions to compare their social media presence with the WHO.

REFERENCES

Åkerlund, M. (2020). The importance of influential users in (re)producing Swedish far-right discourse on Twitter. *European Journal of Communication, 35*(6), 613–628. https://doi.org/10.1177/0267323120940909

Barrie, C., & Ho, J. (2021). academictwitteR: An R package to access the Twitter Academic Research Product Track v2 API endpoint. *Journal of Open Source Software, 6*(62), 3272. https://doi.org/10.21105/joss.03272

Basch, C., Hillyer, G. & Jaime, C. (2022). COVID-19 on TikTok: harnessing an emerging social media platform to convey important public health messages. *International Journal of Adolescent Medicine and Health, 34*(5), 367-369. https://doi.org/10.1515/ijamh-2020-0111

Benoit, K. (2020). *Text as data: an overview.* (Vols. 1-2). SAGE Publications Ltd. https://dx.doi.org/10.4135/9781526486387

Benoit, K., Muhr, D., & Watanabe, K. (2021). Multilingual Stopword Lists (2.3) [Computer software]. http://stopwords.quanteda.io/

Benoit, K., Watanabe, K., Wang, H., Nulty, P., Obeng, A., Müller, S., & Matsuo, A. (2018). quanteda: An R package for the quantitative analysis of textual data. *Journal of Open Source Software, 3*(30), 774. https://doi.org/10.21105/joss.00774

Broniatowski, D.A, Paul M.J., & Dredze, M. (2013). National and Local Influenza Surveillance through Twitter: An Analysis of the 2012-2013 Influenza Epidemic. *PLoS ONE, 8*(12) e83672, 1-8. https://10.1371/journal.pone.0083672

Burci, G. L., & Vignes, C. H. (2004). *World Health Organization.* The Hague: Kluwer Law International

Demirel, S., Kahraman, E., & Gündüz, U. (2022). A text mining analysis of the change in status of the Hagia Sophiaon Twitter: the political discourse and its reflections on the public opinion. *Atlantic Journal of Communication,* 1-28. https://doi.org/10.1080/15456870.2022.2093354

Denecke, K., & Atique S. (2016). *Social Media and Health Crisis Communication During Epidemics.* (Eds.) Shabbir S., Gabarron, E., & Annie Y.S. L., Participatory Health Through Social Media. Academic Press. 42-66. https://doi.org/10.1016/B978-0-12-809269-9.00004-9

Fung, I. C., Tse, Z. T., & Fu, K. W. (2015). The use of social media in public health surveillance. *Western Pacific surveillance and response journal : WPSAR, 6*(2), 3–6. https://doi.org/10.5365/WPSAR.2015.6.1.019

Funk, S., Gilad, E., Watkins, C., & Jansen, V.A. (2009). The spread of awareness and its impact on epidemic outbreaks. *Proceedings of the National Academy of Sciences, 106*(16), 6872-6877. https://doi.org/10.1073/pnas.0810762106

Gallego, V., Nishiura, H., Sah, R., & Rodriguez-Morales, A. J. (2020). The COVID-19 outbreak and implications for the Tokyo 2020 Summer Olympic Games. *Travel Medicine and Infectious Disease, 34,* 101604. https://doi.org/10.1016/j.tmaid.2020.101604

Gostin, L. O., Sridhar, D., & Hougendobler, D. (2015). The normative authority of the World Health Organization. *Public Health, 129*(7), 854-863. http://dx.doi.org/10.1016/j.puhe.2015.05.002

Grimmer, J., & Stewart, B. (2013). Text as Data: The Promise and Pitfalls of Automatic Content Analysis Methods for Political Texts. *Political Analysis, 21*(3), 267-297. doi:10.1093/pan/mps028

Guidry, J. P. D., Jin, Y., Orr, C. A., Messner, M., & Meganck, S. (2017). Ebola on Instagram and Twitter: How health organizations address the health crisis in their social media engagement. *Public Relations Review, 43*(3), 477–486. https://doi.org/10.1016/j.pubrev.2017.04.009

Holmes, W. (2020). Crisis communications and social media: advantages, disadvantages and best practices. *CCISymposium.* Retrieved from http://trace.tennessee.edu/cgi/viewcontent.cgi?article51003&context5ccisymposium (Accessed 29.04.2020).

Hossain, L., Kam, D., Kong, F., Wigand, R. T., & Bossomaier, T. (2016). Social media in Ebola outbreak. *Epidemiology & Infection, 144*(10), 2136-2143. https://10.1017/S095026881600039X

Howard-Jones, N. (1975). The Scientific Background of The International Sanitary Conferences 1851-1938. Geneva: World Health Organization. http://apps.who.int/iris/bitstream/handle/10665/62873/14549_eng.pdf?sequence=1

Hu, M., & Liu, B. (2004). Mining and summarizing customer reviews. *Proceedings of the ACM SIGKDD International Conference on Knowledge Discovery & Data Mining.*

Hutto, C., & Gilbert, E. (2014). Vader: A parsimonious rule-based model for sentiment analysis of social media text. *Eighth International AAAI Conference on Weblogs and Social Media.* 8(1), 216-225.

Jo, Taeho. (2019). *Text Mining—Concepts, Implementation, and Big Data Challenge* (1st ed.). Springer, Cham.

Katz, E. & Lazarsfeld, P.F. (1955). *Personal Influence: The Part Played by People in the Flow of Mass Communications.* Free Press.

Kickbusch, I., & Reddy, K. S. (2015). Global health governance–the next political revolution. *public health, 129*(7), 838-842. http://dx.doi.org/10.1016/j.puhe.2015.04.014

Koiranen, I., Koivula, A., Keipi, T., Saarinen, A. (2019). Shared contexts, shared background, shared values–Homophily in Finnish parliament members' social networks on Twitter. *Telematics and Informatics, 36*,117-131. https://doi.org/10.1016/j.tele.2018.11.009

Lachlan, K. A., Spence, P. R. & Lin, X. (2014). Expressions of risk awareness and concern through Twitter: On the utility of using the medium as an indication of audience needs. *Computers in Human Behavior, 35,* 554-559. https://doi.org/10.1016/j.chb.2014.02.029

Lee, K. (2009). *The World Health Organization (WHO).* London: Routledge.

Lee, A. (2020). Wuhan novel coronavirus (COVID-19): why global control is challenging? *Public health, 179,* A1. https://doi.org/10.1016/j.puhe.2020.02.001

Lee, A. & Morling, J. (2020). COVID-19: The need for public health in a time of emergency. *Public Health, 182,* 188. https://doi.org/10.1016/j.puhe.2020.03.027

Lewis, S. C., Zamith, R., & Hermida, A. (2013). Content Analysis in an Era of Big Data: A Hybrid Approach to Computational and Manual Methods. *Journal of Broadcasting & Electronic Media, 57*(1), 34–52. https://doi.org/10.1080/08838151.2012.761702

Love, B., Himelboim, I., Holton, A., & Stewart, K. (2013). Twitter as a source of vaccination information: content drivers and what they are saying. *American Journal of Infection Control, 41*(6), 568-570. http://dx.doi.org/10.1016/j.ajic.2012.10.016

McCarthy, M. (2002). A brief history of the World Health Organization. *The Lancet, 360*(9340), 1111-1112. https://doi.org/10.1016/S0140-6736(02)11244-X

McGregor, S. C. (2019). Social media as public opinion: How journalists use social media to represent public opinion. *Journalism, 20*(8), 1070-1086. https://doi.org/10.1177/1464884919845458

McNab, C. (2009). What social media offers to health professionals and citizens. *Bulletin of the World Health Organization, 87,* 566-567.

Milne, E. M. (2015). Governance for health-grasping at the levers of glocal health. *Public health, 129*(7), 870-871. http://dx.doi.org/10.1016/j.puhe.2015.06.004

Mohammad, S., & Turney, P. (2013). Crowdsourcing a Word-Emotion Association Lexicon. *Computational Intelligence, 29*(3), 436-465. https://doi.org/10.1111/j.1467-8640.2012.00460.x

Naldi, M. (2019). A review of sentiment computation methods with R packages. *ArXiv, abs/1901.08319.* https://doi.org/10.48550/arXiv.1901.08319

OECD. (2015). The changing face of strategic crisis management. Paris: *OECD Publishing.* Retrieved from http://dx.doi.org/10.1787/9789264249127-en.(Accessed 29.03.2020)

Öztürk, N., Ayvaz, S. (2018). Sentiment analysis on Twitter: A text mining approach to the Syrian refugee crisis, *Telematics and Informatics, 35*(1), 136-147. https://doi.org/10.1016/j.tele.2017.10.006

Parker, J., Wei, Y., Yates, A., Frieder, O., & Goharian, N. (2013). A framework for detecting public health trends with Twitter. *Proceedings of the 2013 IEEE/ACM International Conference on Advances in Social Networks Analysis and Mining,* 556–563. https://doi.org/10.1145/2492517.2492544

Pas, de van R., & Schaik, van L. G. (2014). Democratizing the World Health Organization. *Public Health, 128*(2),195-201. https://doi.org/10.1016/j.puhe.2013.08.023

Pepitone, J. (2010). Twitter users not so social after all. CNNMoney.com. Retrieved from http://money.cnn.com/2010/03/10/technology/twitter_users_active/index.htm?hpt=Mid. (Accessed 29.03.2020).

Radha, R. (2021). Sağlık diplomasisinin dış politika ve küresel halk sağlığı bağlamında değerlendirilmesi. *Journal of Academic Value Studies, 7*(2), 127-137. https://doi.org/10.29228/javs.51375

R Core Team. (2021). R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing. https://www.R-project.org/

Ribeiro, F. N., Araújo, M., Gonçalves, P., André Gonçalves, M., & Benevenuto, F. (2016). SentiBench—A benchmark comparison of state-of-the-practice sentiment analysis methods. *EPJ Data Science, 5*(1), 23. https://doi.org/10.1140/epjds/s13688-016-0085-1

Rinker, T. (2018). Sentimentr (2.6.1) [R]. https://github.com/trinker/sentimentr (Original work published 2015)

Rudnicka, E., Napierała, P., Podfigurna, A., Męczekalski, B., Smolarczyk, R., & Grymowicz, M. (2020). The World-Health Organization (WHO) approach to healthy ageing. *Maturitas, 139,* 6-11. https://doi.org/10.1016/j.maturitas.2020.05.018

Silge, J., & Robinson, D. (2017). *Text mining with R: A tidy approach.* O'Reilly Media, Inc.

Sinnenberg, L., Buttenheim, A. M., Padrez, K., Mancheno, C., Ungar, L., & Merchant, R. M. (2017). Twitter as a Tool for Health Research: A Systematic Review. *American Journal of Public Health, 107*(1), e1–e8. https://doi.org/10.2105/AJPH.2016.303512

Sohrabi, C., Alsafi, Z., O'neill, N., Khan, M., Kerwan, A., Al-Jabir, A., ... & Agha, R. (2020). World Health Organization declares global emergency: A review of the 2019 novel coronavirus (COVID-19). *International Journal of Surgery, 76*, 71-76. https://doi.org/10.1016/j.ijsu.2020.02.034

Sutter, J. D. (2010). Texts, maps battle Haiti cholera outbreak. Retrieved from http://www.cnn.com/2010/TECH/innovation/10/29/haiti.cholera.tech/index.html?hpt=Sbin (Accessed 30.03.2020).

Tahamtan, I., Potnis, D., Mohammadi, E., Singh, V., & Miller, L. E. (2022). The Mutual Influence of the World Health Organization (WHO) and Twitter Users During COVID-19: Network Agenda-Setting Analysis. *J Med Internet Res, 24*(4), e34321. https://doi.org/10.2196/34321

Tang, S., Chow, A. Y., Breen, L. J., & Prigerson, H. G. (2020). Can grief be a mental disorder? An online survey on public opinion in mainland China. *Death Studies, 44*(3), 152-159. https://doi.org/10.1080/07481187.2018.1527415

Torales, J., O'Higgins, M., Castaldelli-Maia, J. M., & Ventriglio, A. (2020). The outbreak of COVID-19 coronavirus and its impact on global mental health. *International Journal of Social Psychiatry, 66*(4), 317–320. https://doi.org/10.1177/0020764020915212

Twitter [@Twitter]. (2020, April 7). Over the past few weeks, there have been more than 6 million questions Tweeted about coronavirus/COVID-19. For #WorldHealthDay, we partnered with the @WHO to provide answers to some of your most asked questions. See the answers👇 [Tweet]. Twitter. https://twitter.com/Twitter/status/1247542368514887690

Welbers, K., Van Atteveldt, W., & Benoit, K. (2017). Text Analysis in R. *Communication Methods and Measures, 11*(4), 245–265. https://doi.org/10.1080/19312458.2017.1387238

WHO. (1958). *The First Ten Years of the World Health Organization.* Geneva: WHO Press.

Winter, S. & Neubaum, G. (2016). Examining Characteristics of Opinion Leaders in Social Media: A Motivational Approach. *Social Media + Society. 2*(3), 1–12. https://www.doi.org/10.1177/2056305116665858

World Health Organization (WHO) [@WHO]. (2020, March 20). WHO Health Alert brings COVID-19 facts to billions via WhatsApp http://bit.ly/who-covid19-whatsapp https://t.co/uiDbPTHKZa [Tweet]. Twitter. https://twitter.com/WHO/status/1241134713575800834

Yoon, S., Elhadad, N., & Bakken, S. (2013). A practical approach for content mining of tweets. *American Journal of Preventive Medicine, 45*(1), 122-129. https://doi.org/10.1016/j.amepre.2013.02.025

Zamith, R., & Lewis, S. C. (2015). Content Analysis and the Algorithmic Coder: What Computational Social Science Means for Traditional Modes of Media Analysis. *The ANNALS of the American Academy of Political and Social Science, 659*(1), 307–318. https://doi.org/10.1177/0002716215570576

Zdunek, R. M. (2022). Qualitative and quantitative social media content analysis: TikTok usage by the World Health Organization during the first wave of the COVID-19 pandemic. In Katarzyna Kopecka-Piech & Bartłomiej Łódzki (Eds.), *The Covid-19 Pandemic as a Challenge for Media and Communication Studies.* Routledge.

Zhang, L. & Fung, A.Y. (2020). Opinion Dynamics Research on Social Media: Breakthroughs and Challenges. *Telematics and Informatics,46,* 1-4. https://doi.org/10.1016/j.tele.2019.101314

➤ **Etik kurul onayı:** Etik kurul onayına ihtiyaç bulunmamaktadır.

➤ **Yazar katkı oranları:** "World Health Organization's Twitter Use Before and During Covid19 Pandemic: Sentiment and Textual Analysis of Tweets" başlıklı bu makalede yazarlardan Sadettin Demirel sentiment analizi, metin analizi, tablo ve şekillerin hazırlanması ve bulguların analizi aşamasında % 50 oranında katkıda bulunduğunu beyan etmektedir. Diğer yazar Uğur Gündüz literatür taraması, giriş ve bulguların yorumlanması ve metnin düzenlenmesi aşamasında %50 oranında katkıda bulunmuştur.

➤ **Çıkar çatışması:** Çıkar çatışması bulunmamaktadır.

➤ **Ethics committee approval:** There is no need for ethics committee approval.

➤ **Author contribution rate:** In this article titled "World Health Organization's Twitter Use Before and During Covid-19 Pandemic: Sentiment and Textual Analysis of Tweets", one of the authors, Sadettin Demirel, declares that he contributed 50% in sentiment analysis, text analysis, preparation of tables and figures, and analysis of findings. The other author Uğur Gündüz contributed 50% during the literature review, the introduction and interpretation of the findings, and the editing of the text.

➤ **Conflict of interest:** There is no conflict of interest.

Bu çalışma araştırma ve yayın etiğine uygun olarak gerçekleştirilmiştir.
This study was carried out in accordance with research and publication ethics.