

PUBLIC PERCEPTIONS ON TWITTER ABOUT COVID-19 VACCINES IN THAILAND

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Abstract. Twitter is a social media platform in which users express and discuss their opinions regarding public issues, such as COVID-19 vaccination. In this study, we aimed to determine the factors influencing public perceptions regarding COVID-19 vaccination using Twitter in order to inform efforts to improve vaccination rates. We collected tweets mentioning COVID vaccination in the Thai language during 13 January 2020 - 15 June 2021. The tweets were translated into English and the content of the tweets were determined and the number of tweets and likes were recorded. The sentiment of each tweet was classified into three categories: positive, negative and neutral, and the tweet trends were evaluated for the 7-day period before and 7-day period after selected vaccination campaign events. A total of 31,043 tweets were included in the analysis. Sentiment distribution analysis revealed the Thai Prime Minister's vaccination ($p = 0.0007$) and a COVID-19 vaccine promotion campaign in the online media by medical experts ($p < 0.0001$) significantly increased positive sentiment after those events. The day a Thai social media influencer received a COVID-19 vaccine resulted in the greatest number of tweets regarding COVID-19 vaccination ($n = 2,186$) and resulted in a significant increase in positive sentiment regarding COVID-19 vaccination ($p = 0.0280$). In summary, public figure vaccination or promotion of COVID-19 vaccination significantly increased positive sentiment regarding COVID-19 vaccination. We conclude that public figures or medical professionals can improve public sentiment regarding vaccination and should be encouraged to support vaccination campaigns. Further studies are needed to determine if this increase in positive public sentiment will result in increased vaccination uptake.

Keywords: COVID-19, vaccines, Twitter, sentiment analysis, vaccine hesitancy, social media

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INTRODUCTION

Mass vaccination may help in the control of pandemics and hopefully shorten the length of time required to return to a more normal way of living. Despite wide acceptance of vaccination as an effective public health measure, people's reluctance to get vaccinated (vaccine hesitancy), based on a lack of confidence in a vaccine's efficacy and safety as well as other personal beliefs, can hinder vaccination efforts. Vaccine hesitancy is more prevalent in higher-income countries and is related to education level (Wellcome, 2019). In low- and middle-income countries, vaccine acceptance is relatively more common, but the heterogeneity in population socioeconomic statuses, education levels and other local circumstances make it challenging to determine general factors contributing to vaccine acceptance (Wagner *et al*, 2019). Understanding these factors for specific populations may help vaccine programs develop population appropriate methods to improve vaccine acceptance, necessary for the success of mass vaccination programs (Kumar *et al*, 2016).

Twitter is a social media platform that can disseminate information and possibly help better understand public

opinion. Twitter may be used by public health officials to disseminate public health information to a population and encourage vaccinations. This information may improve population knowledge about public health emergencies and reduce vaccine hesitancy (Boon-Itt and Skunkan, 2020; Samuel *et al*, 2020). Studies of the effects of social media on population attitudes toward vaccination have been performed mainly in English-speaking countries (Keelan *et al*, 2007; Keelan *et al*, 2010; Mitra *et al*, 2016).

A modality to monitor potential vaccine hesitancy in a population and enable timely mitigation measures to be instituted could be helpful in reducing the health and economic impacts of a pandemic. Public sentiment regarding public health issues, as gauged by the number of tweets and number of likes of these tweets, has been used to monitor public opinion toward vaccination (Jang *et al*, 2022). A limitation of this type of evaluation is that the tools to make these evaluations are predominantly in the English language. Attempts have been made to develop tools to conduct these types of evaluations in languages other than English (Balahur and Turchi, 2014). These tools translate subject responses into English, where analysis

can be made (Ustaszewski, 2021). This evaluation has been performed successfully in the Arabic language (Mohammad *et al*, 2016). A more recent approach has been to improve the training stage of the evaluation tool by using automatic translation at that stage of developing the tool so that it can more appropriately evaluate the data for the subject language; this has resulted in reasonably good results (Barrière and Balahur, 2020).

In this study, we aimed to determine the factors influencing public perceptions regarding COVID-19 vaccination using Twitter in order to inform efforts to improve vaccination rates.

MATERIALS AND METHODS

Data collection and analysis

We searched Twitter for tweets made during 13 January 2020 - 15 June 2021 that included the term "COVID vaccine" in the Thai language and collected the data using Twint (<https://pypi.org/project/twint/>), a tool previously used in some studies to examine people's attitudes about a specific public health issue (Praveen *et al*, 2021; Singh and Wu, 2021). The ending date of the study was one week after the Information Center for COVID-19 Situation Administration (CCSA) for Thailand announced a nationwide immunization program (TAT NEWS, 2021). Non-language characters were removed before the

tweets were translated into English using the Deep-translator tool. Tweets with similar text or short repetitive sentences were excluded from the study in order to eliminate duplicate tweets. We used the Transformers tool in the Python computer language (van Rossum and the Python Development Team, 2018) to assess peoples' emotions (sentiments) in the texts, labeling them as positive, negative or neutral (Samuels and McGonical, 2020; Wolf *et al*, 2020). We divided the sentiment analysis time into four quarters: Q1: 1 March 2020 - 30 June 2020, Q2: 1 July 2020 - 31 October 2020, Q3: 1 November 2020 - 28 February 2021 and Q4: 1 March 2021 - 15 June 2021. The tweets were counted and classified as positive, negative or neutral regarding COVID-19 vaccination and percentages of the total for each of the 3 sentiments were calculated.

In order to determine the effect of specific selected events on subject sentiment, we determined the sentiment 7 days prior to and for 7 days after 3 major public events and compared them: 1) the Thai Prime Minister receiving the COVID-19 vaccine, 2) the release of a video on YouTube featuring Thai medical experts providing factual information about COVID-19 vaccination, and 3) the public release of a photo of a well-known Thai social media influencer being vaccinated.

We used a two-sided Chi-square test with 95% confidence intervals (CI) to assess significant associations with

these 3 events. Significance was set at $p < 0.05$. We used Matplotlib (Hunter, 2007) and Seaborn (Waskom, 2021) tools to create graphic representations of the data using Python, version 3.8.5. We used GraphPad Prism 8 (Software Inc, San Diego, CA) to perform the statistical calculations.

RESULTS

COVID-19 vaccine tweet trends

A total of 31,043 tweets were assessed in this study (Fig 1). During 2020, there were 1-48 tweets daily about COVID-19 vaccination (total for 2020: 875) and during 2021 there

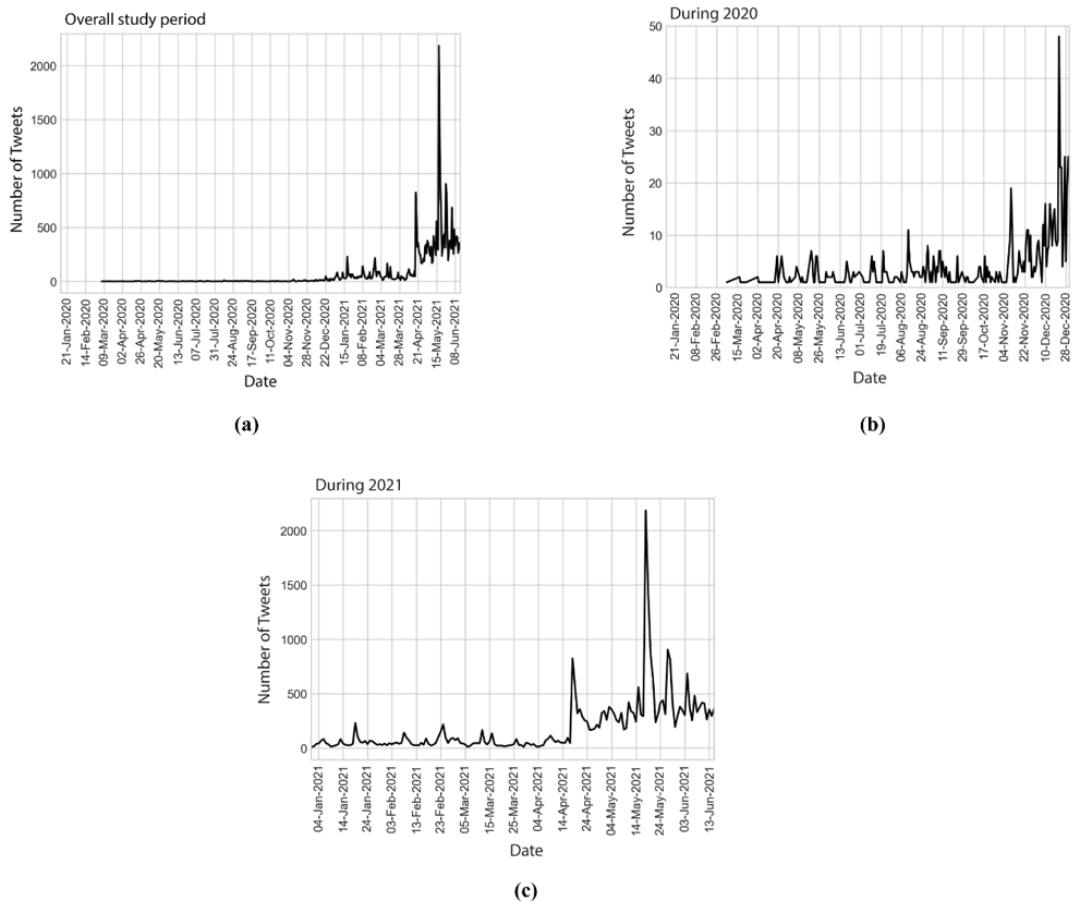


Fig 1 - The number of relevant tweets by time

(a): Tweets during 13 January 2020 - 15 June 2021; (b): Tweets during 13 January - 31 December 2020; (c): Tweets during 1 January - 15 June 2021

were 11-2,186 tweets daily (total for 2021: 30,168). In December 2020, the Pfizer, Moderna, and AstraZeneca vaccines were approved for use by their respective countries of manufacture (Carvalho *et al*, 2021). Singapore was the first Southeast Asian country to receive the COVID-19 vaccine (Idrus, 2021; Reuters *et al*, 2020), mentioned in tweets during 21-23 December 2020 (peak on 22 December 2020 with 48 tweets). During 18-20 January 2021, tweets mostly referred to the death of a person who received the Pfizer vaccine in Norway (Torjesen, 2021). The Thai Food and Drug Administration approved the application for registration of the AstraZeneca vaccine in Thailand. On 16 March 2021 (136 tweets), the Thai Prime Minister received the AstraZeneca vaccine, which was mentioned in tweets. On 11 May 2021 (422 tweets), a video featuring prominent medical experts providing factual information about COVID-19 vaccines was uploaded and shared on YouTube (RAMA Channel, 2021), which was mentioned in tweets. On 18 May 2021 (2,186 tweets), Chompoo Araya, a social media influencer, received the Sinovac COVID-19 vaccine (MGRonline, 2021), which was mentioned in tweets.

Sentiment analysis

Neutral sentiment was the most common sentiment expressed in tweets during the first three quarters of the study (Q1: 60% of tweets with a neutral

sentiment, Q2: 58.5% with a neutral sentiment, Q3: 55.7% with a neutral sentiment). During the fourth quarter of the study, the percentages of tweets changed to similar percentages with both neutral and negative sentiment (Q4: 45.6% with neutral sentiment and 44.6% with negative sentiment). The percentage of tweets with a negative sentiment increased over time (Q1: 19.2%, Q2: 28.4%, Q3: 35%, Q4: 44.6%), and the percentage of tweets with a positive sentiment decreased, except during the fourth quarter (Q1: 20.8%, Q2: 13.1%, Q3: 9.3%, Q4: 9.7%).

We compared pre- and post-event sentiment (Fig 2). The percentages of tweets 7 days after the Thai Prime Minister's vaccination (negative = 26.6%, neutral = 58.6%, positive = 14.8%) changed significantly ($p = 0.0007$) to being more positive than the 7 days prior to his vaccination (negative = 37.6%, neutral = 56%, positive = 6.4%). The percentages of tweets 7 days after the medical expert video (negative = 45.6%, neutral = 42.6%, positive = 11.8%) changed significantly ($p < 0.0001$) to being more positive than the 7 days prior to this event (negative = 41.6%, neutral = 49.3%, positive = 9.2%). The percentages of tweets 7 days after the Thai influencer received a vaccination (negative = 46.6%, neutral = 43.2%, positive = 10.3%) changed significantly ($p < 0.0280$) to being more positive than the 7 days prior to her vaccination (negative = 44%, neutral = 46.4%, positive = 9.5%).

Manual analysis of tweets

The top 5 tweets regarding the Sinovac vaccine were determined. The tweet with the most likes (8 May 2021; 3,430 likes) mentioned a Thai politician who was suspected of being a drug dealer and a gay rape case. The second most liked tweet (1 May 2021; 3,246 likes) was about a person vaccinated in Songkhla Province, Thailand who had an adverse reaction after receiving the vaccine.

The third most liked tweet (19 May 2021; 3,145 likes) asked 3 questions: 1) Does a person have the right to choose the most effective COVID-19 vaccine?, 2) Why is there a delay in introducing into Thailand the mRNA vaccines shown to be more effective than the Sinovac vaccine, 3) Is it better to have any vaccine rather than none? The fourth most liked tweet (19 May 2021; 3,102 likes) expressed sarcasm regarding the use

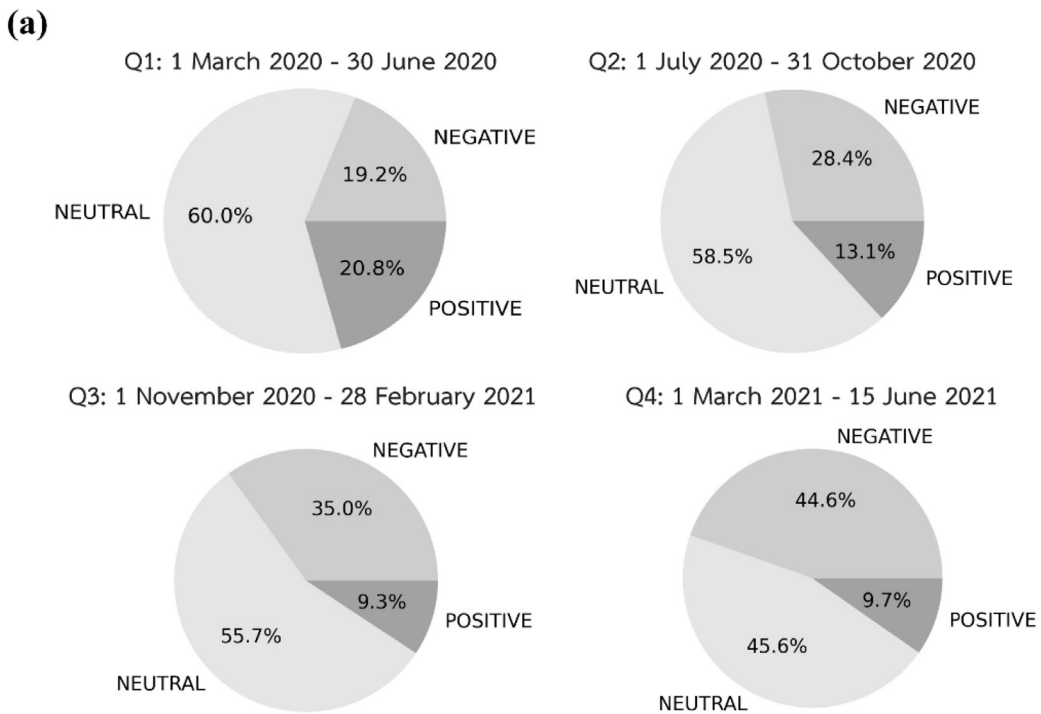


Fig 2 - Tweet sentiments following 3 specific events

(a) Q1: 1 March 2020 - 30 June 2020; Q2: 1 July 2020 - 31 October 2020; Q3: 1 November 2020 - 28 February 2021; Q4: 1 March 2021 - 15 June 2021

(b)

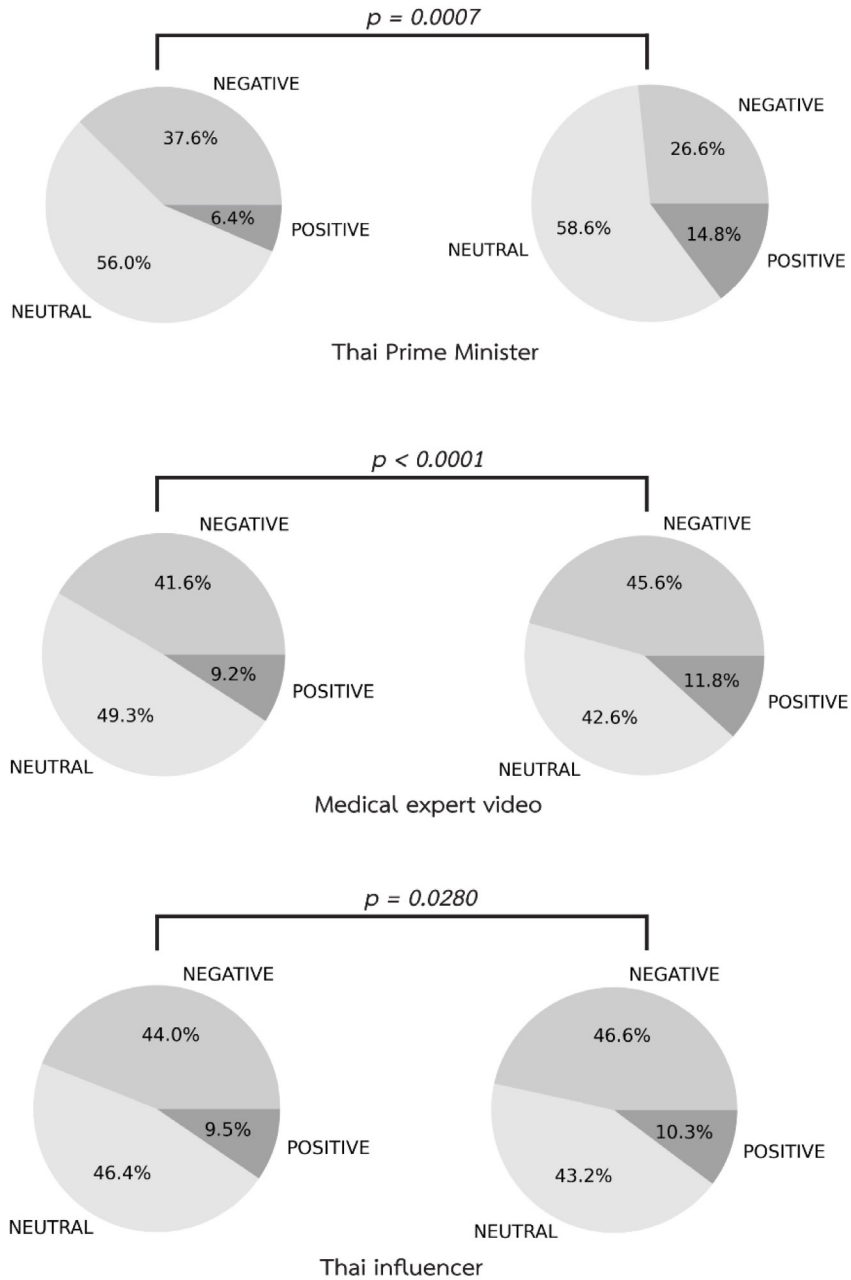


Fig 2 - (cont)

(b) from 7 days before until 7 days after the Thai Prime Minister received the COVID-19 vaccine (Thai Prime Minister), after a YouTube video regarding COVID-19 vaccinations by medical experts was released (Medical expert video) and after a Thai non-medical social media influencer was vaccinated (Thai influencer)

of the well-known Thai influencer to promote the Sinovac vaccine and suggested the Thai government hire more reputable influencers to promote vaccination. The fifth most liked tweet (30 April 2021; 2,272 likes) mentioned the efficacy of Moderna mRNA vaccine and a collaboration between a Thailand government agency and a pharmaceutical company that would import the vaccine. The author of the tweet questioned the necessity of importing an additional 10 million doses of the Sinovac vaccine instead of the more effective Moderna vaccine.

The top 5 tweets regarding the AstraZeneca vaccine were also determined. The tweet with the most likes (11 June 2021; 1,402 likes) described a neutral experience when receiving the first dose of the AstraZeneca vaccine. The second most liked tweet (1 May 2021; 1,243 likes) discussed the government's lack of transparency regarding obtaining other vaccines besides the AstraZeneca and Sinovac vaccines and mentioned vaccine adverse events. The third most liked tweet (18 May 2021; 1,154 likes) stated only one Thai social media had no hidden agenda regarding employment. The fourth most liked tweet (26 April 2021; 1,089 likes) mentioned the vaccines approved by WHO for emergency use were the Pfizer, AstraZeneca and Johnson & Johnson vaccines and soon-to-be-approved Sinovac, Sinopharm and Moderna vaccines. The fifth most

liked tweet (9 May 2021, 1,076 likes) stated AstraZeneca would release a progress report indicating that the trial batch of vaccine produced in Thailand had now met the quality standards at AstraZeneca laboratories in Europe and the United States.

DISCUSSION

In our study, the majority of Thai Twitter users had either a negative or neutral sentiment about the COVID-19 vaccine, similar to a previous study of Twitter uses in the United States and the United Kingdom (Hussain *et al*, 2021) and in contrast to the results of a study from the Philippines where the majority of Twitter users had a positive sentiment (Villavicencio *et al*, 2021). The reasons for this difference are unclear but could be due to cultural, educational, and political differences by country. Distrust of the government was reported to contribute to vaccine hesitancy in a study from 19 countries (Lazarus *et al*, 2021). Distrust of the government and the vaccine were reported to be the reasons for vaccine hesitancy in a study from Austria (Schernhammer *et al*, 2022). Whether or not a person trusts the government was reported to be a reason for vaccine uptake or not in a study from England (Jennings *et al*, 2021). People with vaccine hesitancy were found to have different sociodemographic, cognitive, and affective preferences than those without it in a study from the United States (Tram *et al*, 2022). The reason

cited for their hesitancy was distrust of the vaccine development process. This suggests a way for the government to earn trust is to always tell the truth in all areas. Consequently, during the crisis, the previously developed trust in the government in other areas will lead to trust in the vaccine.

In our study, the vaccination of the Thai Prime Minister resulted in a significant increase in positive sentiment regarding COVID-19 vaccination, similar to a study from India that reported an increase in positive tweets about COVID-19 vaccination after the Indian Prime Minister was vaccinated (Mudassir *et al*, 2021).

In our study, the information given by medical experts resulted in an increase in positive tweets about COVID-19 vaccination. This is in agreement with a previous study on vaccine hesitancy that reported healthcare providers are a trusted source of information regarding vaccines, thereby reducing the concerns of those who were initially hesitant about vaccines through person-to-person communication (Troger and Pirofski, 2021).

In our study, the number of tweets after the Thai social influencer received the COVID-19 vaccine was greater than after the Thai Prime Minister received the vaccine and after the medical expert video. A previous study reported finding social media influencers stimulate conversation, give

new information and set the agenda for public conversations (Lutkenhaus *et al*, 2019). That study proposed health care providers collaborate with influencers to deliver important health-related messages to the population. However, on sentiment analysis, the Thai social media influencer resulted in a less significant effect on positive tweets about the vaccines than the physician video or the Thai Prime Minister's vaccination. This suggests the importance of the type of public figure to be invited to assist with vaccination promotion.

To our knowledge, this is the first study using Twitter to explore the public perceptions toward COVID-19 vaccine in the Thai population. A strength of our study was that using Twitter to explore public opinion was quick and convenient. A weakness of our study was that those who use Twitter are only a small segment of the population and do not represent the general population.

In summary, public figure vaccination or promotion of COVID-19 vaccination significantly increased positive sentiment regarding COVID-19 vaccination. We conclude that public figures or medical professionals can improve public sentiment regarding vaccination and should be encouraged to support vaccination campaigns. Further studies are needed to determine if this increase in positive public sentiment will result in increased vaccination uptake.

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CONFLICT OF INTEREST
DISCLOSURE

The authors declare no conflict of interests.

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