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ORIGINAL ARTICLE

Google Trends search volumes indicate habituation against COVID-19 in Japan

Satoko Minakawa[1, 2, 4], Norihiro Saito[1, 3, 4], Masamichi Itoga[1, 4, 5], and Hiroyuki Kayaba[1, 3, 4]*

Abstract

Purpose: To clarify the association between the coronavirus disease 2019 pandemic curve and Google Trends search volumes for the disease during the three major epidemic waves in Japan.

Method: Correlation between the number of cases of coronavirus disease 2019 in Japan and the internet search volume for "corona" in the period 12th January 2020 to 19th February 2021 was evaluated using the open database provided by the Japan Broadcasting Corporation and Google Trends index data.

Results: The peak search volume for "corona" was highest during the first wave and lowest during the third wave. In contrast, the peak number of new cases per week was lowest during the first wave and highest during the third wave. The search volume and number of new cases per week showed strong correlations in each wave; however, the search volume in each wave decreased remarkably from the first to the third wave.

Conclusion: This study identified evidence of so-called "pandemic fatigue", a habituation reaction against COVID-19, in Japan. Prolonged and repeated waves of the epidemic have made people less sensitive for preventing spread of coronavirus disease 2019. Sustained, clear communication will be required to elicit the cooperation of the population in controlling the pandemic.

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Key words: COVID-19; SARS-CoV-2; Google Trends; pandemic curve; habituation.

Introduction

There were three major waves of the coronavirus disease 2019 (COVID-19) pandemic in Japan between March 2020 and March 2021. Although vaccination against the disease began in February 2021, the most effective way to control the spread of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is still via social measures such as mandated masking, social distancing, air ventilation, and remote working. Modification of our behavior based on keen interest in the disease is key to controlling transmission of SARS-CoV-2. Therefore, we investigated the association between the curve of the pandemic and the trend of people's interest in COVID-19 during the three major waves of the disease in Japan.

Materials and Methods

We evaluated the correlation between the number of cases of COVID-19 and the Google Trends search index for the keyword "corona", which is the Japanese word most commonly used as a search term for news and articles related to

[1] Clinical Laboratory, Hirosaki University Hospital, 53 Honcho, Hirosaki, Aomori 036-8563, Japan
[2] Department of Dermatology, Hirosaki University Graduate School of Medicine, 5 Zaifucho, Hirosaki, Aomori 036-8562, Japan
[3] Department of Clinical Laboratory Medicine, Hirosaki University Graduate School of Medicine, 5 Zaifucho, Hirosaki, Aomori 036-8562, Japan
[4] Infection Control Center, Hirosaki University Hospital, 53 Honcho, Hirosaki, Aomori 036-8563, Japan
[5] Dapartment of Respiroatory Medicine, Hiirosaki University Graduate School of Medicine, 5 Zaifucho, Hirosaki, Aomori 036-8562, Japan

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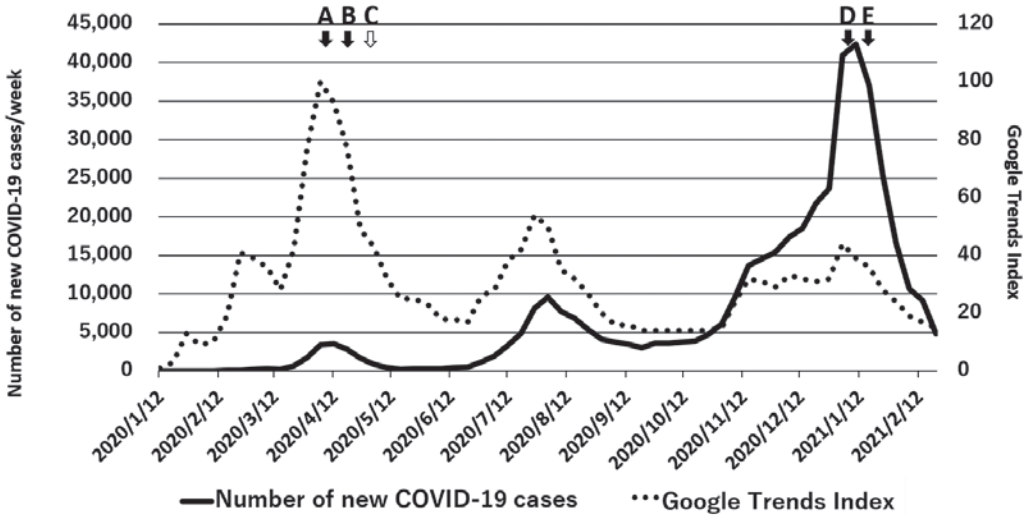

Figure 1 Number of new weekly cases of COVID-19 and Google Trends index for "corona" in Japan during the study period.

The arrows indicate the date that a state of emergency was declared in the following groups of prefectures: Tokyo, Kanagawa, Chiba, Saitama, Osaka, Hyogo and Fukuoka on 7th April 2020 (A); nationwide declaration of a state of emergency on 15thApr 2020 (B); cancellation of state of emergency on 25thApr 2020 (C); re-declaration of a state of emergency for Tokyo, Kanagawa, Chiba, and Saitama on 7th January 2021 (D); and Tochigi, Gifu, Aichi, Kyoto, Osaka, Hyogo and Fukuoka on 13th January 2021 (E).

COVID-19 (https://trends.google.co.jp/trends/?geo=JP). Our analysis of Google searches was restricted to the country of Japan during the period 12th January 2020 to 19th February 2021. Google Trends was also used to analyze the search volume ranking in all 47 prefectures for the same key word in the same period. The number of cases of COVID-19 in each prefecture was obtained from the Japan Broadcasting Corporation (https://www3.nhk.or.jp/news/special/coronavirus/data/).

Statistical analysis

Data were analyzed using Statcel 3 add-in forms in Excel. Pearson's correlation coefficient was used to determine the degree of relationship between linearly related variables. Spearman's rank correlation coefficient was used to determine the degree of association between two non-normally distributed variables. Steel–Dwass test was used for *post-hoc* multiple comparisons to determine the statistical significance of differences for multiple comparisons. A p value of less than 0.05 was considered significant.

Ethics approval

Ethics approval was not required for this retrospective study as it was based on data that is freely available in the public domain.

Results

The peak Google Trends search volume for "corona" was highest during the first wave and lowest during the third wave of the COVID-19 epidemic period in Japan. In contrast, the peak number of new cases of COVID-19 per week was smallest in the first wave and largest in the third wave (Figure 1). The correlation coefficient between the number of weekly new COVID-19 cases and the Google Trends search volume index for "corona" was 0.93, 0.74, and 0.90 in the first, second, and third epidemic waves, respectively. Although strong correlations were observed in all waves, the regression coefficient showed a remarkable decrease from 0.023 in the first wave to 0.0032 in the second wave, and 0.0007 in the third wave (Figure 2). Statistical

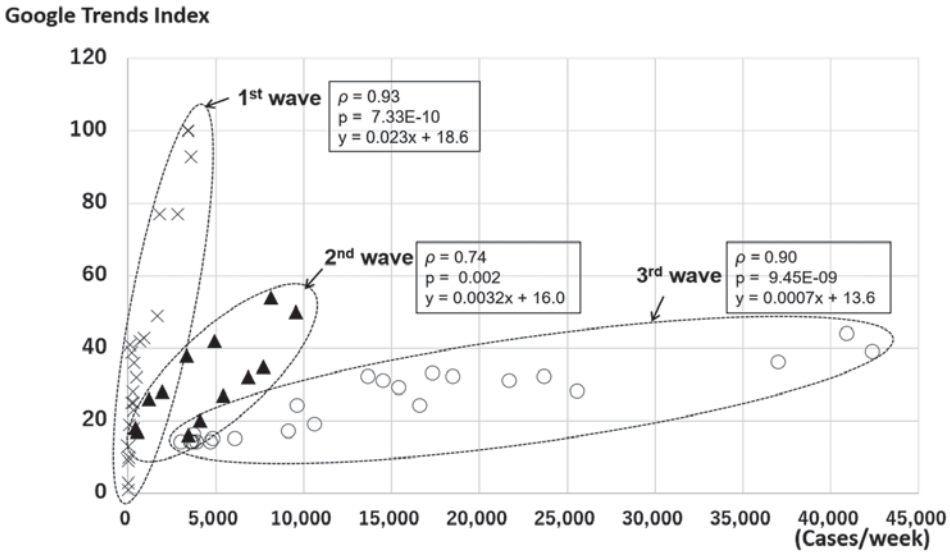

Figure 2 Correlations between the number of weekly new COVID-19 cases and Google Trends search volume index for "corona" during the 1st, 2nd, and 3rd epidemic waves in Japan.

Correlation coefficients and regression coefficients for the 1st (×), 2nd (▲) and 3rd (○) COVID-19 epidemic waves in Japan between March 2020 and March 2021 are shown.

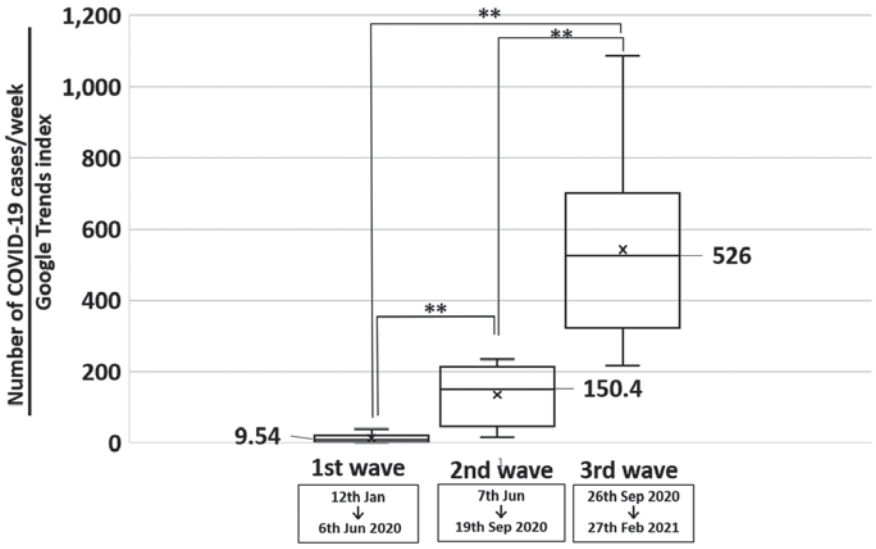

Figure 3 Distribution of ratios of the number of new COVID-19 cases to Google Trends index per week for each of the three epidemic waves in Japan.

The boxplots show the distribution of ratios of the number of weekly COVID-19 cases to the weekly Google Trends index for each epidemic wave in Japan. The horizontal lines in each box denote the 25th, 50th, and 75th percentile values. The error bars denote the 5th and 95th percentile values. The median values were 9.54, 150.4, and 526 in the 1st, 2nd, and 3rd waves, respectively. (*: $p<0.05$, **: $p<0.01$)

difference of the regression coefficients among the three epidemic waves was determined by evaluating the weekly ratios of the number of new COVID-19 cases to the Google Trends search volume index during the three waves of the epidemic. There were statistically significant differences of regression coefficients among the three waves (Figure 3). The Google Trends search volume index and the cumulative number of COVID-19 cases in the 47 prefectures of Japan (as of 11th January 2021) showed a negative correlation, with a correlation coefficient of −0.48

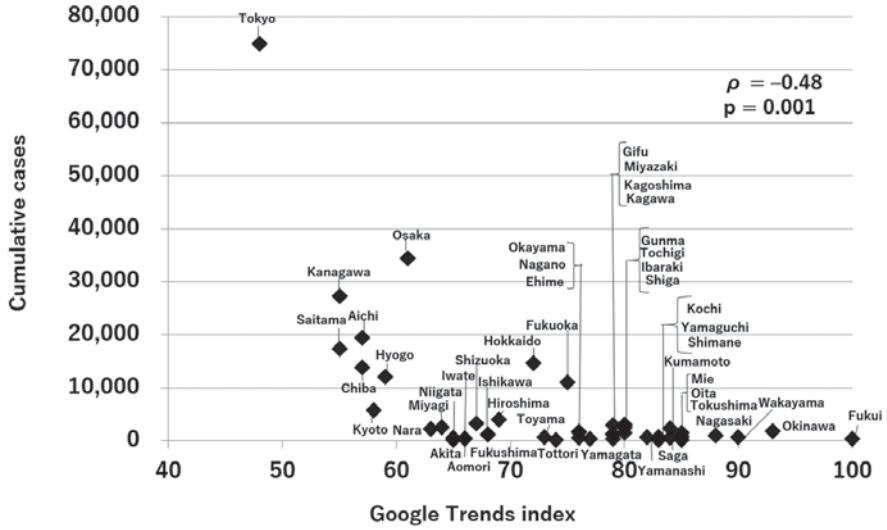

Figure 4 Correlation between Google Trends search volume index and cumulative number of COVID-19 cases in all prefectures in Japan (as of 11th January 2021).

There was a negative correlation of Google Trends search volume index for "corona" as of 11th January 2021 and the cumulative number of COVID-19 cases in the 47 prefectures.

($p<0.001$) (Figure 4).

Discussion

Frequent hand sanitization, physical distancing, face masks, cough etiquette, and eye protection are basic and essential social measures for preventing person-to-person SARS-CoV-2 transmission[1]. In modern society, a huge number of people travel internationally, enabling the spread of new pathogens in a short period of time. Behavioral modification of citizens through education is essential for controlling SARS-CoV-2 transmission. The Google Trends search volume index reflects people's current interests and has been utilized to monitor and predict epidemics of transmissible infectious diseases such as seasonal influenza[2,3] and COVID-19[4]. The search volumes for COVID-19 correlated with the cases of COVID-19 in each of the three waves, but the search volume for the number of new cases decreased from the first wave to the third wave. Furthermore, there was a negative correlation of Google Trends search volume index and the cumulative number of COVID-19 cases in all 47 prefectures. These results may indicate the influence of so-called "pandemic fatigue", which reduces people's willingness to modify their behavior and care in avoiding SARS-CoV-2 infection. For example, many cases were infected in bars, restaurants and other places or situations known to have a high risk of infection[5,6]. Prolonged and repeated waves of the pandemic decrease people's sensitivity to alerts provided by the media. The longer the pandemic period, the harder it becomes to focus people's attention on preventing SARS-CoV-2 transmission. The successful elimination of SARS-CoV-2 in Taiwan and New Zealand at the early stage of the COVID-19 pandemic indicates the importance of an aggressive approach at the early phase of an epidemic[7,8].

Conclusion: Sustained, clear messaging for the population may be required to control the coronavirus disease 2019 pandemic. Long-lasting and repeated waves of the pandemic have reduced people's diligence towards avoiding transmission.

Conflict of interest: None of the authors has any conflicts of interest to declare.

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Study limitations: This study analyzed only the Google Trends search volume index as an indicator of interest in COVID-19 in the general population. Other factors influencing the spread of SARS-CoV-2 were not taken into account.

Authorship: Minakawa S analyzed the data and wrote the manuscript. Saito N provided advice to Minakawa S regarding the statistical analysis and interpretation. Itoga M and Kayaba H designed and collected the data. Kayaba H checked the final version of the manuscript.

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