**Public interest in immunity: justification for intervention in the early stages of COVID-19**

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**Contributions:** JH Lee, MB Park designed the study; conducted the literature review and statistical analysis; and wrote the manuscript. YN.K, and J.Y.L, reviewed related articles and references, and wrote the manuscript, J.I.S. and K.H.L check the statistical analysis and collect the data. And Andreas K., Lee s., Ai K., Louis J., SW.C, and R.A.G check the manuscript as a whole. All authors reviewed and approved the final version of the manuscript.

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**Data availability:** Data can be downloaded with Google trend website. If you need the processed data, please contact the author to request the data.

**Ethical approval:** Not applicable

**Abstract**

Our study aimed to identify the interest and correlation between the proliferation of coronavirus disease 2019(COVID-19), interest in immunity and products that have been discussed to confer an enhancement of immunity, while suggesting the measures of intervention to be undertaken from a health and medical point of view.

To assess the level of public interest in infectious disease during the initial days of the outbreak of COVID-19, we extracted Google search data from the past year based on the date of 15th of March 2020, which is approximately two months after the COVID-19 outbreak. In order to determine whether the public became interested in the immune system, we selected ‘coronavirus’, ‘immune’, ‘vitamin’ as our final search term. The increase in cumulative confirmed cases of coronavirus after January 20 had a strong positive correlation with search volumes for the terms ‘coronavirus’ (R = 0.786, P < .0001), ‘immune’ (R = 0.745, P < .0001) and ‘vitamin’ (R = 0.778, P < .0001), and the variables were all mutually statistically significant. Moreover, these correlations were confirmed on a country-basis when we restricted analyses to the US, the UK, Italy, and Korea. Our findings revealed that increases in search volumes for ‘coronavirus’ and ‘immune’ preceded the actual occurrences of confirmed cases. Our study implicates that during the initial phase of the COVID-19 crisis, the public’s desire and actions to strengthen their own immune systems were enhanced. Further, in the early stage of a pandemic there is a high potential of social media to inform the public about potentially helpful measures to prevent the spread of an infectious disease and provide relevant information about immunity and thereby increase the knowledge.

**Keywords:** COVID-19; Social big-data; immune; vitamin;

**INTRODUCTION**

Following the onset of an infectious pneumonia that can be traced to Wuhan, China, in 2019, the World Health Organisation (WHO) announced that the cause of the pneumonia is a new type of Coronavirus. The International Committee on Taxonomy of Viruses named it SARS-CoV-2 on 11 January, which is now referred to as COVID-19. As of December 2020, the virus has spread globally, and the cumulative number of infected people has reached approximately 67 million, with approximately 1,530,000 having died from the virus[1]

Since the year 2000, there have been attempts to use big data to better understand and solve challenges related to public health. Indeed, in the context of healthcare, the use of big data is an important emerging trend, which is only likely to increase in importance with time. The Pillbox project of the National Laboratory of Medicine is one of the most representative examples of healthcare that uses big data to predict real-world situations. The Pillbox project is a service that provides information such as how to take various pills that are not easily known to the public and their potential side effects. Not only does this improve consumer convenience, it is also known to save healthcare expenditures with regard to economics by gathering information to estimate statistics such as the causes of disease outbreaks, rates of spread, distribution and regional growth [2, 3]. Social big data refers to large volumes of data that relate to people or describe people’s behaviour and technology-mediated social interactions in the digital realm [4]. Internet search volume is a valid and effective tool to identify public attention [5]. One of the most representative examples of disease prediction using social big data is Google’s flu forecast. In 2009, Google predicted the spread of the flu seven to ten days earlier than proposed by the Centers for Disease Control and Prevention (CDC) based on users’ search records for the flu [6]. Prediction was confirmed in countries around the world, including South Korea, India and China [7-9]. Predictive analysis using social big data helps predict real world events, which is not easily accessible in reality, relatively accurately. In recent times, attempts have been made to further increase precision with regard to the prediction [10, 11]. Furthermore, it was also used for real-time monitoring of [severe acute respiratory syndrome](https://www.sciencedirect.com/topics/medicine-and-dentistry/severe-acute-respiratory-syndrome) (SARS), its transmissibility and to identify the natural history of an emerging pathogen as for the Ebola virus outbreak [12, 13].

The spread of infectious diseases has led to increased interest in the human immune system among the public. Amidst a pandemic, the public often becomes interested in how to strengthen their immune systems. Furthermore, the act of purchasing products that may strengthen one’s immune system is popular, without a clear evidence that these supplements are effective. However, there is almost no scientific proof which confirms this trend, and there is a need to confirm that this interest results in people actually search more of the Internet for products related to strengthening their immune system. Eventually, people are likely to respond by relying on existing common sense regarding maintaining health and hygiene. In this regard, a health literacy approach is needed during a crisis such as the COVID-19 pandemic. At the beginning of the pandemic, the public’s response to an infectious disease is the most sensitive, with a burgeoning interest during this period. After the passage of a certain period of time, exhaustion and an adjustment to the social situation results in a relative decline in this interest [14].

Our study aims to identify public interest in the global pandemic, and correlated internet search volumes of COVID-19 with the immune system and the interest for vitamins.

**METHOD**

*Data extraction*

To assess the interest in infectious disease during the initial days of the outbreak of COVID-19, we extracted Google Trends™ search was performed data from the past year based on the date of 15 March 2020, which is approximately two months after the COVID-19 outbreak. Apart from a few countries such as China and Japan, Google search engine has an overwhelming dominance of market share [15]. Google® provides data on search word volume through Google Trends™, providing usable data by country and time period. In our research, our unit of data was extracted from data on total worldwide numbers. In addition, to account for trends by country, we selected the United States and the United Kingdom, as these countries are the most representative countries of the English-speaking world that use the Google search engine. Moreover, we also studied Italy, which was the first European country to experience an explosion of COVID-19 cases. The market share of Google in Italy as of January 2020 was 98.9 percent [16]. Finally, we studied South Korea which had the second highest spread of COVID-19 in Asia and fourth in the world at the time the Google Trends™ search was performed. On the date the data was gathered, South Korea was fourth in the world for coronavirus cases with 8,000 cases. Within South Korea, the domestic portal site Naver has a much higher market share than Google. Therefore, additional data supplied by Naver Data Lab was utilised for cross-verification.

*Primary keyword*

We considered the terms ‘covid’, ‘corona’ and ‘coronavirus’ as search terms. In order to determine which words among these were the most commonly used, the search volume of each word was ascertained. According to our preliminary analysis of data provide by Google Trends™, the term ‘coronavirus’ was searched twice more often than ‘corona’ and five times more often than ‘covid’, and therefore, we selected ‘coronavirus’ as our final search term.

*Search for immunity and products that might strengthen immunity*

In order to determine whether the public became interested in the immune system, we selected ‘immune’ as a keyword. The term ‘immune’ is strongly related to the term ‘immunity’ and has an almost two-fold higher search volume. Therefore, for the United States, United Kingdom and Italy, the search term ‘immune’ was studied, and in the case of South Korea, the term ‘*myeonyeok’* meaning ‘immunity’ in Korean was studied.

Following the outbreak of COVID-19, interest in products that can enhance one’s immune system is increasing dramatically. the *Guardian* in the United Kingdom and the *Washington Post* in the United States have both reported on the rising demand for vitamins and other products [17]. Vitamins are most familiar to the public and usually available over the counter and are the most representative product that enhances the immune system. Therefore, in order to confirm the public’s actual interest in immune system strength, we selected the term ‘vitamin’ as a keyword. For the United States and the United Kingdom, the term ‘vitamin’ was used; for Italy, the term ‘vitamina’ was used. Finally, for South Korea, the Korean-language spelling of ‘vitamin’ was used.

*Data and statistical analysis*

Search volumes were calculated for each period (a week), and the search volume of the period with the highest volume was 100, normalizing everything else to 0–100. The unit of extraction was a week. In order to account for the spread of COVID-19, we used the cumulative number of confirmed cases. The official announcements made by the WHO and announcements by each country’s respective government were the most accurate indices for tracking the spread of the virus. The number of cumulative confirmed cases was verified through data downloaded from Our World in Data [18] and additional data from COVID-2019 situation reports issued by the WHO [1]. We undertook an analysis of the correlation between cumulative confirmed cases and search terms. Up until the middle of January, before COVID-19 had begun to spread on a large scale, the figure for actual confirmed cases and search volume was either 0 or 1, and therefore, a correlation analysis for the entire year could lead to errors. Therefore, we selected those countries which experienced some of the earliest COVID-19 outbreaks as target countries; moreover, we analysed approximately two months’ worth of data beginning from when the cases first began to emerge globally during the week of 20 January 2020 up until 15 March 2020.

**RESULTS**

Up until the middle of January, the number of confirmed cases remained extremely low worldwide. Then, beginning in the week of 26 January, the number of confirmed cases began to ascend rapidly, especially in China. The search volume related to ‘coronavirus’ began to increase earlier form the week of 12 January and the search volume increased rapidly during the week starting 16 February. For the past year, the search volume for ‘immune’ has consistently been between 10 and 20. After 12 January, the search volume increased steadily, and from 16 February, the search volume increased rapidly. Over the past year, the search volume for ‘vitamin’ was at a level slightly exceeding 50. However, it began to increase after February. The increase in cumulative confirmed cases of COVID-19 after January 20 had a strong positive correlation with search volumes for the terms ‘coronavirus’ (R = 0.786, P < .0001), ‘immune’ (R = 0.745, P < .0001) and ‘vitamin’ (R = 0.778, P < .0001), and the variables were all mutually statistically significant (Figure1, Table 1).

In the case of the United States, up until February, the number of cumulative confirmed cases remained low—at 10 people. This number began increasing in the latter half of February and began increasing rapidly in March. The search volume for ‘coronavirus’ began increasing earlier, beginning in the week of 12 January, and it began to increase rapidly in the week of 16 February. Search volume for the term ‘immune’ began rapidly increased on February 16. Over the past year, search volume on ‘vitamin’ was at a level slightly exceeding 50. This figure increased slightly after December of 2019, and increased more rapidly in March 2020. The increase in the number of cumulative confirmed cases after 20 January displayed a strong positive correlation with the search volumes for the terms ‘coronavirus’ (R = 0.921, P < .0001), ‘immune’ (R = 0.890, P < .0001) and ‘vitamin’ (R = 0.913, P < .0001), and the variables were all mutually statistically significant (Figure 2, Table 2).

In the United Kingdom, confirmed cases increased rapidly after March. Increases in search volumes for the terms ‘coronavirus’, ‘immune’ and ‘vitamin’ followed a similar trend than observed for the United States and the rest of the world. The number of cumulative confirmed cases displayed a strong positive correlation to the search terms ‘coronavirus’ (R = 0.931, P < .0001), ‘immune’ (R = 0.962, P < .0001) and ‘vitamin’ (R = 0.801, P < .0001), and all the variables were mutually statistically significant (Figure 3, Table 3).

In Italy, the number of confirmed cases started to rise in the second half of February, with cases increasing dramatically in March. Search volume for the terms ‘coronavirus’ and ‘immune’ began to increase slightly beginning in the week of 26 January, and it began increasing dramatically from the middle of February. Search volume for the term ‘vitamin’ first increased rapidly from the middle of February, but it repeatedly decreased and increased afterward. The number of cumulative confirmed cases displayed a positive correlation with the search terms ‘coronavirus’ (R = 0.600, P < .0001), ‘immune’ (R = 0.763, P < .0001) and ‘vitamin’ (R = 0.474, P < .0001), and the variables were all mutually statistically significant (Figure 4, Table 4).

In South Korea, cumulative confirmed cases increased rapidly from the middle of February. The search volume for ‘coronavirus’ increased before this, beginning in the week of 19 January. After decreasing for a brief period, it again increased rapidly in the week of 9 February and again decreased in March. The search volume for the term ‘immune’ was highest during the first week of March, whereas the search volume for ‘vitamin’ was highest during the week of 15 March. However, unlike in other countries, search volume for these terms did not increase rapidly. The increase in cumulative confirmed cases displayed a statistically positive correlation with the search terms of ‘coronavirus’ (R = 0.359, P < .007) and ‘vitamin’ (R = 0.637, P < .0001); however, its correlation with ‘immune’ (R = 0.254, P= < .058) was not statistically significant. When analysing data from Naver, search volume for the term ‘coronavirus’ increased from the middle of February, and the search volume for ‘immune’ and ‘vitamin’ increased slightly in the beginning of January and increased again in the second half of January and from 16 February. All three search terms reached their peak search volumes in the beginning of March and are trending downward thereafter. When compared with data from Google Trends™ the results are similar, and the increasing trend of search volumes for ‘immune’ and ‘vitamin’ after the occurrence of confirmed cases is slightly clearer (Figure 5, Table 5).

**DISCUSSION**

In times of the current COVID-19 pandemic and other pandemics, educational approaches to health and healthcare are an important problem from the perspective of public health. This study analysed the increase in the public’s interest in COVID-19 using social media, big data and attempted to gain knowledge concerning what interventions must be taken from a health and healthcare perspective. Our findings revealed that increases in search volumes for ‘coronavirus’ and ‘immune’ preceded the actual occurrences of confirmed cases. Moreover, search volumes increased gradually before increasingly rapidly alongside a rapid increase in the number of confirmed cases was reported. Search volumes for ‘vitamin’ also displayed an increase concomitantly occurring with the increase in confirmed cases of COVID-19. Although there were slight differences in the increasing trends among countries, in general, worldwide trends coincided. In the case of South Korea, although Google search results did correspond with worldwide trends in characteristic ways, the data from domestic portal Naver corresponded more closely with worldwide trends.

Using search records from its search engine, Google was able to predict the 2009 flu pandemic before the CDC. Similarly, this study also found that the increase in the volume of related search terms preceded an increase in confirmed cases, confirming the validity of utilising social big data for predicting real world events. However, there are several possible interpretations concerning the increased volume of certain search terms. First, this may reflect a rising concern about infectious diseases, such as worries about the outbreak of a disease and demands for knowledge. Moreover, the results of this study confirmed that in addition to the search volume for ‘coronavirus’ increasing, the search volume for ‘immune’ and ‘vitamin’ also similarly increased. This can also be interpreted as an act of disease prevention, which reflects a desire to control the situation and prevent disease. During the period of the SARS pandemic, as an act of disease prevention, searches for information on the internet and consultations with experts by people in the United States and Canada who were highly concerned about the disease increased [19]. It is known that increased interest and concern about a disease has a very close relationship with disease prevention measures, and it appears that during a pandemic, an increased concern over disease is intimately related to hand washing, personal hygiene and related activities, mask wearing and avoiding public places [19].

In particular, the fact that an increase in search volume preceded the spread of COVID-19 implies that before the complete outbreak of a pandemic, there is a tendency for public concern over a disease as well as corresponding prevention activities. COVID-19 symptoms do not present until five to six days after infection, and the incubation period can be as long as 14 days [20]. Taking this into account, the results of this study—which show that an increase in search volumes directly precedes a rapid increase in cases—reflects the coping mechanisms of a public that has already been exposed to COVID-19 and is experiencing early warning symptoms. Regardless, before the onset of a full-blown pandemic, supplying prior education and information on healthcare and health should be the central task of public health departments in these situations.

However, it cannot be ruled out that an increase in search volume related to COVID-19 reflects an increase in simple interest. Even if this is the case, it is important to place importance on the dissemination of proper knowledge. The control of a disease’s outbreak cannot rely solely on the efforts of public health specialists. Coping behaviours and prevention measures achieved through an increase in the knowledge of the public is critically needed [21, 22]. In particular, behavioural measures such as social distancing are an effective strategy for coping with an epidemic. However, it is only possible to achieve this through the cooperation of a well-informed public [22]. It is certain that Wuhan residents moving to other cities without knowledge of possible infection contributed to the early spread of COVID-19 [23]. In addition, the homeless and those of similar social classes that have little access to medical information have been identified as potentially dangerous groups that might be transmitters of the disease [24]. Therefore, the propagation of healthcare information through mass communication methods is emerging as a more important issue than ever before. Therefore, in an epidemic or pandemic situation, a variety of strategies are needed to use social media and the internet to alleviate people’s fears and discomfort and increase public awareness of proper health measures.

Alongside the COVID-19 pandemic, not only did the search volumes of ‘immune’ and ‘vitamin’ increase, news reports related to COVID-19 that contained these keywords increased as well (supplementary table 1-a, 1-b, figure 1-a, 1-b). Moreover, in addition to an increase in interest in food products such as elderberry, which are known to be beneficial in enhancing the immune system, because it is related to coronavirus (supplementary figure 2, table 2), it adds to the proof for the increasing interest in immunity following the spread of COVID-19.

The interests of the public are always inextricably tied to the media [25]. As such, rather than supplying sufficient information on the subject that the public is interested in, news outlets have a tendency to instead provide distracting and shocking content [26]. Amidst a pandemic, online media outlets focus reporting on related news, causing worry over the disease to spread rapidly among the public [27]. Such anxious and worried public has a tendency to search for health information that cannot be trusted [28]. In particular, it has already been reported that incorrect rather than accurate health information tends to spread on social networks [29], and this can also cause people to adopt improper health measures [30]. Moreover, despite their being information which is important to understand, in a pandemic and similar emergency situation, it is likely that the public will miss certain important information about disease prevention amidst the flood of information, and the likelihood of people adopting false beliefs or actions also rises. The public’s interests and fears concerning COVID-19 can lead to various negative actions such as panic buying of health products and aggressively excluding a certain racial group, which in the end has a negative effect on preventing the spread of the virus [31, 32]. In contrast, during the SARS pandemic, it is known that a certain amount of worry and panic had a positive effect on preventative actions [33], suggesting that because of knowledge deficiencies and areas of irrational risk perception, mediation was needed [33]. Moreover, research on a section of the United States showed that in 2009, newspaper reporting on the H1N1 flu had a positive effect on people’s desire to seek prevention measures.

The internet can disseminate information across the globe and supplies individually tailored and interactive information. As such, it is an extremely appropriate platform for undertaking public health interventions [34, 35]. In fact, it is known that information searches through social networks such as Google, YouTube and Facebook have a positive effect on gaining knowledge on how to prevent infectious diseases, leading people to take preventative measures [36]. However, as mentioned earlier, the chances are very high that current internet culture will be applied negatively to the COVID-19 pandemic. Within this context, interventions that can assist people in finding information through search word matching that help in actually preventing and coping with the spread of the disease is a key issue in regard to the expansion of proper health literacy. Although such measures can be considered to be beyond the scope of public health science, in a disaster situation, health authorities must make active interventions to prevent the spread of the disease and do so from a public health science and health information perspective. It is clear that doctors and healthcare workers must strive to provide accurate information to the public.

It is a known fact that products such as vitamins are helpful for one’s immune system, and they may have a positive effect on decreasing infections and deaths caused by COVID-19 [37, 38]. However, although a lack of vitamins can become a medical problem, there is no evidence that an over consumption of vitamins prevents transmission of COVID-19. It is known that in cases of seriously ill patients, high doses of vitamin C can be helpful for treatment [39]. However, whereas it has medical uses, it does not mean that the public should be taking vitamin C to prevent COVID-19. The interests of the public, including the media, are not necessarily based on accurate medical science. When coronavirus emerged, the media undertook a high volume of reporting on immunity and vitamins. The main reason for articles on immunity and vitamins (the word with the highest correlation) was coronavirus. However, although these articles may increase knowledge regarding self-care related to COVID-19, they can also increase incorrect health literacy. There is also a possibility that such articles will be used for commercial purposes. In the initial stages of the COVID-19 outbreak, the public’s interest in how to protect themselves from infectious diseases, such as by strengthening one’s immune system, grew rapidly. Moreover, an infodemic [40] of misinformation spread through various media became an obstacle to managing public health [41].

Amidst the current pandemic, delivering accurate information to the public and correcting false information is the responsibility of experts. Our study confirmed that during the initial phase of the COVID-19 crisis, the public’s desire and actions to strengthen their own immune systems strengthened. Therefore, when considering our results in conjunction with earlier findings, it is clear that the initial stage of the spread of an infectious disease is the most effective period during which to strengthen accurate knowledge regarding the disease. Moreover, these results also verify the importance of intervention strategies meant to prevent the spread of an infectious disease during the early stages.

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| Figure 1. Worldwide: Trends in search volume of coronavirus, immune, vitamin, and COVID-19 cumulative confirmed case in the past year (2019.03.18~2020.03.15) | |  |  |  |  |  | | --- | --- | --- | --- | --- | | **N=56 (days)** | **Cummulative-case** | **Coronavirus** | **Immune** | **Vitamin** | | **Cummulative-case** | 1 | 0.786 | 0.745 | 0.778 | |  | <.0001 | <.0001 | <.0001 | | **Corona** | 0.786 | 1 | 0.979 | 0.932 | | <.0001 |  | <.0001 | <.0001 | | **Immune** | 0.745 | 0.979 | 1 | 0.943 | | <.0001 | <.0001 |  | <.0001 | | **Vitamin** | 0.778 | 0.932 | 0.943 | 1 | | <.0001 | <.0001 | <.0001 |  |   Table 1. Worldwide: Correlation between search volume for coronavirus, immune and vitamin, and actual COVID-19 cumulative confirmed case |

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|  | |  |  |  |  |  | | --- | --- | --- | --- | --- | | **N=56 (days)** | **Cummulative-case** | **Coronavirus** | **Immune** | **Vitamin** | | **Cummulative-case** | 1 | 0.921 | 0.890 | 0.913 | |  | <.0001 | <.0001 | <.0001 | | **Corona** | 0.921 | 1 | 0.983 | 0.952 | | <.0001 |  | <.0001 | <.0001 | | **Immune** | 0.890 | 0.983 | 1 | 0.946 | | <.0001 | <.0001 |  | <.0001 | | **Vitamin** | 0.913 | 0.952 | 0.946 | 1 | | <.0001 | <.0001 | <.0001 |  | |
| Figure 2. U.S : Trends in search volume of coronavirus, immune, vitamin, and COVID-19 cumulative confirmed case in the past year (2019.03.18~2020.03.15) | Table 2. U. S: Correlation between search volume for coronavirus, immune and vitamin, and actual COVID-19 cumulative confirmed case |

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| Figure 3. U. K: Trends in search volume of coronavirus, immune, vitamin, and COVID-19 cumulative confirmed case in the past year (2019.03.18~2020.03.15) | |  |  |  |  |  | | --- | --- | --- | --- | --- | | **N=56 (days)** | **Cummulative-case** | **Coronavirus** | **Immune** | **Vitamin** | | **Cummulative-case** | 1 | 0.931 | 0.962 | 0.801 | |  | <.0001 | <.0001 | <.0001 | | **Corona** | 0.931 | 1 | 0.984 | 0.842 | | <.0001 |  | <.0001 | <.0001 | | **Immune** | 0.962 | 0.984 | 1 | 0.847 | | <.0001 | <.0001 |  | <.0001 | | **Vitamin** | 0.801 | 0.842 | 0.847 | 1 | | <.0001 | <.0001 | <.0001 |  |   Table 3. U. K: Correlation between search volume for coronavirus, immune and vitamin, and actual COVID-19 cumulative confirmed case |

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| Figure 4. Italy: Trends in search volume of coronavirus, immune, vitamin, and COVID-19 cumulative confirmed case in the past year (2019.03.18~2020.03.15) | |  |  |  |  |  | | --- | --- | --- | --- | --- | | **N=56 (days)** | **Cummulative-case** | **Coronavirus** | **Immune** | **Vitamin** | | **Cummulative-case** | 1 | 0.931 | 0.962 | 0.801 | |  | <.0001 | <.0001 | <.0001 | | **Corona** | 0.931 | 1 | 0.984 | 0.842 | | <.0001 |  | <.0001 | <.0001 | | **Immune** | 0.962 | 0.984 | 1 | 0.847 | | <.0001 | <.0001 |  | <.0001 | | **Vitamin** | 0.801 | 0.842 | 0.847 | 1 | | <.0001 | <.0001 | <.0001 |  |   Table 4. Italy: Correlation between search volume for coronavirus, immune and vitamin, and actual COVID-19 cumulative confirmed case |

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| Figure 5. South Korea: Trends in search volume of coronavirus, immune, vitamin, and COVID-19 cumulative confirmed case in the past year (2019.03.18~2020.03.15) | |  |  |  |  |  | | --- | --- | --- | --- | --- | | **N=56 (days)** | **Cummulative-case** | **Coronavirus** | **Immune** | **Vitamin** | | **Cummulative-case** | 1 | 0.359 | 0.254 | 0.637 | |  | 0.007 | 0.058 | <.0001 | | **Corona** | 0.359 | 1 | 0.157 | 0.242 | | 0.007 |  | 0.247 | 0.072 | | **Immune** | 0.254 | 0.157 | 1 | 0.368 | | 0.058 | 0.247 |  | 0.005 | | **Vitamin** | 0.637 | 0.242 | 0.368 | 1 | | <.0001 | 0.072 | 0.005 |  |   Table 5. South Korea: Correlation between search volume for coronavirus, immune and vitamin, and actual COVID-19 cumulative confirmed case |
|  | |  |  |  |  |  | | --- | --- | --- | --- | --- | | **N=56 (days)** | **Cummulative-case** | **Coronavirus** | **Immune** | **Vitamin** | | **Cummulative-case** | 1 | 0.482 | 0.223 | 0.629 | |  | 0.000 | 0.099 | <.0001 | | **Corona** | 0.482 | 1 | 0.742 | 0.563 | | 0.000 |  | <.0001 | <.0001 | | **Immune** | 0.223 | 0.742 | 1 | 0.652 | | 0.099 | <.0001 |  | <.0001 | | **Vitamin** | 0.629 | 0.563 | 0.652 | 1 | | <.0001 | <.0001 | <.0001 |  | |
| Figure 6. South Korea (Naver portal) : Trends in search volume of coronavirus, immune, vitamin, and COVID-19 cumulative confirmed case in the past year (2019.03.18~2020.03.15) | Table 6. South Korea (Naver portal): Correlation between search volume for coronavirus, immune and vitamin, and actual COVID-19 cumulative confirmed case |

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