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Global Monitoring of Public Interest in Preventive Measures against COVID-19 via Analysis of Google Trends: An Infodemiology and Infoveillance Study

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4 **Global Monitoring of Public Interest in Preventive Measures against COVID-19 via**
5 **Analysis of Google Trends: An Infodemiology and Infoveillance Study**
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Keywords: COVID-19, infection control, preventive measures, public awareness, Google Trends, global health

Abstract

Introduction: The coronavirus disease 2019 (COVID-19) pandemic has influenced people's concerns regarding infectious diseases and their preventive measures. However, the magnitude of the impact and the difference between countries are unclear. This study aimed to assess the magnitude of the impact of COVID-19 on public interest and people's behaviors globally in preventing infectious diseases while comparing international trends and sustainability.

Methods: The study employed an infodemiological and infoveillance approach to delineate public interest regarding COVID-19 preventive measures through web-based data and analysis using Google Trends. A relative search volume was assigned to a keyword, standardizing it from 0 to 100, with 100 representing the highest share of the term searches. The search terms "coronavirus," "wash hands," "social distancing," "hand sanitizer," and "mask" were investigated across 196 different countries and regions from July 2018 to October 2021 and obtained weekly reports of relative search volume. Persistence of interest was assessed by comparing the first 20 weeks with the last 20 weeks of the study period.

Results: Although the relative search volume of "coronavirus" increased and was sustained at a significantly higher value ($p < 0.05$) globally than before the pandemic declaration, the trends and sustainability on the interest of preventable measures against COVID-19 varied between countries and regions.

Conclusions: The global differences should be taken into consideration for implementing effective interventions against COVID-19. The increased interest in preventive behaviors against COVID-19 may be related to overall infectious disease prevention.

Article Summary

Strengths and limitations of this study

This is the first study to use Google Trends to objectively show the trends in people's interest in COVID-19 and its preventive measures in countries and regions worldwide.

This study revealed the trends and sustainability on the interest of preventable measures against COVID-19 varied between countries and regions around the world.

The global differences should be taken into consideration for implementing effective interventions against COVID-19. The increased interest in preventive behaviors against COVID-19 may be related to overall infectious disease prevention.

This study had some limitations. First, the differences in internet availability may have affected the results. Second, the percentage of Google users may have affected the global-level evaluation of public interest using Google Trends.

INTRODUCTION

The coronavirus disease 2019 (COVID-19) was first reported in Wuhan, China, in November 2019 and was declared a public health emergency of international concern on January 31, 2020. In March 11, 2020, it was declared a pandemic by the World Health Organization (WHO).[1] As of December 6, 2021, there have been 265,194,191 confirmed cases of COVID-19, including 5,254,116 deaths.[2] Considering its widespread relevance, the COVID-19 pandemic may impact people's interest in infectious diseases and their lifestyles.[3] Therefore, the interest in preventive measures against infectious diseases may be growing worldwide at a whole new level. However, the magnitude of the impact on people's preventive behavior is difficult to measure objectively, and the differences in behaviors among countries are unclear. Moreover, with the prolonged pandemic, it is uncertain whether the growing interest in preventive actions against infectious diseases can be sustained.

When faced with rapidly progressing infectious disease outbreaks, such as COVID-19, the assessment of population awareness on infection prevention behaviors needs to be accomplished promptly if the findings are informative in the context of the public health response. However, such an assessment is not an easy task. For instance, population-representative household surveys generally require several months of preparation and data collection; therefore, they do not always provide timely results. Such an effort could be aided using available web search query data, which provide insight into public interests related to such behaviors.

The use of internet search data to draw conclusions on the determinants and delivery of health information is known as infodemiology.[4, 5] Since the first reported use of search engine data to track the 2008 influenza epidemic,[6] several research publications related to behavioral change and public interest in health have utilized the same.[7–11] Google Trends is a web-based tool that analyzes a portion of daily Google searches, generating data on geographical and temporal patterns according to specified keywords. Previous studies showed an accurate prediction and forecasting of current public interests, which allowed for the analysis of various fields.[12–14]

This year, some researchers have investigated the impact of COVID-19 using Google Trends. Effenberger et al.[15] showed a relationship between the highest interest and the peak of newly confirmed cases. Also, Walker et al.[16] reported a correlation between symptom search terms and confirmed case growth. In addition, Sousa-Pinto et al. [17] reported the relationship between media coverage and COVID-19 keywords, whereas Heerfordt et al. [18] evaluated whether COVID-19 was associated with smoking cessation behaviors. Kutlu [19] reported the trends and impacts of dermatologic diseases on public perceptions during the COVID-19 pandemic, and Onchonga [20] reported on the use of the interest in self-medication during the COVID-19 pandemic.

However, the impact of the global COVID-19 pandemic on the long-term interest in preventive measures against infectious diseases has not been studied, and whether such interest can be sustained or is only temporary. Moreover, global differences in public interest regarding COVID-19 and preventive measures have not been objectively monitored.

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3 The purpose of this study was to assess the magnitude of COVID-19's impact on public interest
4 regarding preventive behaviors, by focusing on the pace at which public interest increased due to
5 the COVID-19 pandemic, suitability of the interest, and types of preventive measures preferred by
6 different countries.
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10 **MATERIALS AND METHODS**

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13 Google Trends was used to quantify and measure changes in internet searches regarding the
14 COVID-19 pandemic worldwide and in each country.
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16 **Google trends function**

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18 Google Trends uses a fraction of searches for a specific term (also known as “keyword” or “search
19 term”) and then analyzes the number of Google searches according to a geographical location and
20 defined timeframe. After the examined keyword(s) or topic(s), the region and the period are
21 entered. The region can be a country, a region, or a combined data set of all regions (global). The
22 popularity of a search term in a given week relative to other weeks in the mentioned time period
23 within a geographic region is shown as relative search volume (RSV). The most popular week has
24 an RSV of 100 and all other weeks are reported relative to the most popular week on a scale from
25 0 to 99. For example, an RSV of 50 would indicate that search term was 50% as popular as it was
26 in the most popular week. A score of 0 indicates that there are not enough searches to show for this
27 term in the week. When a sufficient number of searches cannot be confirmed for a search keyword
28 or topic in a specified country, the system displays that the data cannot be retrieved.
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32 For international comparisons among countries that use different languages, topic searches are
33 useful. Topics are a group of terms that share the same concept in any language, and they are
34 displayed below search terms. For example, when we search the topic "London," the search
35 includes results for topics such as: "Capital of the UK" and "Londres," which is "London" in
36 Spanish. This study used topic searches following keywords in 196 countries.
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39 The data are retrieved directly from the Google Trends Explore page in .csv format. If the survey
40 period is long, the values are displayed as weekly values.
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42 **Target country, search term selection, and study term**

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44 For 196 countries and regions around the world, Google Trend's “Topics” was used to show the
45 RSVs of “coronavirus” and typical preventive behaviors, including “wash hand” and “social
46 distancing,” and the supplies needed for prevention, such as “hand sanitizer” and “mask.” These
47 topic terms were mentioned on the CDC site [21] as recommendations for prevention and were
48 listed as related topics in Google Trend's coronavirus.
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51 The specified survey period was set using the following procedures: First, the end of October 2021
52 was set as the study's end period, and the most recent RSV was obtained on November 1, 2021.
53 Second, the study's starting point was set from the same interval period between the WHO
54 pandemic declaration and the study's end period. It was 85 weeks before and 85 weeks after the
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3 week of March 11, 2020. [1] Therefore, the date range was from the week of July 22, 2018, to that
4 of October 24, 2021. Assessing the timing of raising interest of each topic term
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6 For each country's topic term, the week in which RSV exceeded 50 (RSV50) after the beginning
7 of 2020 was defined as the timing of the rise in RSV in each country. In Google Trends, RSV50
8 means 50% of search activity of the peak (RSV100) was performed in particular countries and
9 regions using the defined term. Assessing the sustainability of people's interest
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11
12 In this study, the sustainability of interest was assessed by comparing the last 20 weeks (from the
13 week of June 13, 2021 to that of October 24, 2021) of the survey period with the first 20 weeks
14 (from the week of July 22, 2018 to that of December 2, 2018) for each topic term. This was because
15 all topics used in this study are terms that had been used prior to the COVID-19 pandemic; thus, if
16 the RSV in the latter period, which was more than 1 year after the WHO pandemic declaration,
17 was higher than the RSV in the period before the outbreak, the sustainability on public interest was
18 presented regardless of its magnitude.
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21 **Statistical analysis**

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23 The Mann–Whitney U test was used to compare the RSV during the first 20 weeks at the beginning
24 of the study (from the week of July 22, 2018 to that of December 2, 2018) with the RSV during the
25 last 20 weeks at the end of the study (from the week of June 13, 2021 to that of October 24, 2021)
26 for each topic term. All statistical analyses were performed using SPSS version 25 (IBM, Armonk,
27 NY, USA). All figures were created using Microsoft Excel (Microsoft Inc., Seattle, WA, USA). P
28 < 0.05 was considered statistically significant.
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31 **Ethical considerations**

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33 The study did not require ethics approval because the RSVs obtained from Google Trends were
34 publicly available, fully anonymized, and aggregated data.
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36 **Patient and public involvement**

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38 No patients and no public were involved in setting the research question or the outcome measures,
39 nor were they involved in developing plans for design or implementation of the study. No patients
40 and no public were asked to advise on interpretation or writing up of results. There are no plans to
41 disseminate the results of the research to study participants or the relevant patient community.
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46 **RESULTS**

47 **Global trends (Combined data set of all regions)**

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49 The search terms “coronavirus,” “wash hand,” “social distancing,” “hand sanitizer,” and “mask”
50 reached RSV 50 by the week of the WHO pandemic declaration (March 11, 2020) in global trends
51 (combined data set of all regions). Subsequently, “coronavirus,” “wash hand,” and “hand sanitizer”
52 RSVs peaked (RSV100) in the week of the WHO pandemic declaration. This was followed by the
53 RSV of “social distancing” a week later (the week of March 15, 2020), and that of “mask” 3 weeks
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3 later (the week of April 5, 2020) (Figure 1). In Global Trends, the RSVs of “coronavirus”, “wash
4 hand”, “social distancing”, “hand sanitizer”, and “mask” were significantly higher ($p<0.05$) in the
5 last 20 weeks of the study period (from the week of June 13, 2021 to the week of October 24, 2021)
6 than in the first 20 weeks before the pandemic declaration (from the week of July 22, 2018 to that
7 of December 2, 2018).
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10 **Search word “Coronavirus” trend**

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12 “Coronavirus” RSVs were obtained in 196 countries and territories. All of the target countries and
13 regions had enough searches to show RSVs. In late January 2020, only eight countries (4.1%) in
14 and mainly around China reached RSV50 (Bhutan, China, Laos, Macao, Mongolia, Philippines,
15 Thailand, and Vietnam). However, in the week of the pandemic declaration (the week of March 8,
16 2020), the number of countries that reached RSV50 rose sharply, especially in the Americas and
17 Europe, and by late March, 85% of all the countries and regions, including African countries,
18 reached RSV50. Japan, which was the only G7 country that did not initially have an $RSV \geq 50$, had
19 an $RSV \geq 50$ at this time. In early April, the RSV reached 50 in all targeted regions (Table 1, Figure
20 2).
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23 **Search word “Wash Hand” trend**

24
25 A total of 192 countries and territories had “wash hand” RSVs, and four countries (Central Africa,
26 Commonwealth of Dominica, Eritrea, and Turks and Caicos Islands) did not have enough searches
27 to show RSVs. Six countries (3.1%) reached RSV50 in late January 2020 and included mostly
28 Asian countries around China: Brunei, Vietnam, South Korea, Taiwan, Cambodia, and Singapore.
29 Moreover, Bhutan, Cyprus, Syria, Antigua, and Barbuda were also above RSV50, but this was a
30 temporary increase as it dropped to zero in the following week of late January 2020.
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33
34 In the week after the pandemic was declared (the week of March 8, 2020), 107 countries (54.6%),
35 mainly in North America, Europe, and Asia, had $RSVs \geq 50$, and by late March, 160 countries
36 (81.6%), including most countries in South America, had $RSVs \geq 50$. Japan, which was the only
37 G7 country that did not have an $RSV \geq 50$ in the week of March 8, 2020, had an $RSV \geq 50$ at this
38 time. Conversely, even in early April, the RSV did not exceed 50 in 21 countries (10.7%), including
39 nine countries on the African continent (Algeria, Botswana, Burundi, Cameroon, Mozambique,
40 Republic of Congo, Seychelles, Sudan, and Vanuatu) and countries in other areas (Table 1, Figure
41 2).
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44 **Search word “Social Distancing” trend**

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46 “Social distancing” RSVs were obtained in 174 countries and territories. There were 21 regions
47 and countries that did not have enough searches to show RSVs.
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50 Only 18 countries (9.2%) had an $RSV \geq 50$, even in the week when the pandemic was declared (the
51 week March 8, 2020). In late March, 102 countries (52.0%), mainly in the Americas, Europe, and
52 Asia, had an $RSV \geq 50$. In early April, 125 countries (65.3%) had an $RSV \geq 50$, but 49 countries
53 (25.0%) in various regions, including two G7 countries (France, Italy) in Europe ($n=7$), Asia and
54 Oceania ($n=10$), America ($n=16$), and Africa ($n=16$) did not have an $RSV \geq 50$ (Table 1, Figure 2).
55 The highest number countries did not reach an RSV of 50 and above with respect to the search
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3 term “social distancing” (n=49) by early April when compared with other study terms, such as
4 “coronavirus” (n=0), “wash hand” (n=21), “hand sanitizer” (n=7), and “mask.” n=41).

6 **Search word “Hand Sanitizer” trend**

8 In 193 countries and territories, “hand sanitizer” RSVs were available, and in the three countries
9 (Central Africa, Eritrea, and Liechtenstein), there were not enough searches to show RSVs.

11 In late January 2020, eight countries (4.1%), mainly those around China (Cambodia, China, Macao,
12 Maldives, Singapore, South Korea, Taiwan, and Vietnam), had RSVs ≥ 50 , and in the week of the
13 pandemic declaration, the number of countries with an RSV ≥ 50 increased to 121 (61.7%).
14 Subsequently, the number of countries with an RSV ≥ 50 gradually increased to 187 (95.4%) in
15 early April (Table 1, Figure 2). The countries with RSVs < 50 by early April (Burundi,
16 Commonwealth of Dominica, Liberia, New Caledonia, Suriname, Tajikistan, Turkmenistan) had
17 reached an RSV of 50 at various later times.

21 **Search word “Mask” trend**

23 Valid “mask” RSVs were obtained for 195 countries and regions, and only one country (Eritrea)
24 did not have enough searches to display an RSV. In late January 2020, 27 countries (13.8%) had
25 an RSV ≥ 50 . They consisted mainly of countries around China (Cambodia, China, Japan, Lao
26 PDR, Macao, Malaysia, Mongolia, Myanmar, Philippines, Singapore, South Korea, Taiwan,
27 Thailand, and Vietnam) and some countries in other areas. In late March, there were 130 countries
28 with an RSV ≥ 50 , in contrast, the United States and some European countries still did not have an
29 RSV ≥ 50 . Then, in early April, 154 countries (78.6%) had an RSV ≥ 50 . Forty-one countries
30 including many major European countries (Belgium, Finland, France, Germany, Ireland,
31 Switzerland, and the United Kingdom), African countries, countries on the South American
32 continent, Australia, and New Zealand did not reach RSV ≥ 50 by early April and had reached an
33 RSV of 50 at various later times (Table 1, Figure 2).

37 **Comparison of RSV in ≥ 65 weeks after the declaration of the pandemic and before the 38 COVID-19 pandemic**

40 In 191 countries, the RSV of “coronavirus” was significantly higher ($p < 0.05$) in the last 20 weeks
41 of this study term than in its first 20 weeks before the pandemic declaration. There were five
42 countries (Central Africa, Djibouti, Eritrea, Liberia, and Samoa) that had no significant difference.

44 In 24 countries (12.2%), the RSV of “wash hand” was significantly higher ($p < 0.05$) in the last 20
45 weeks of this study term than in its first 20 weeks before the pandemic declaration. The majority
46 of these countries were from Asia and Oceania (Australia, Bangladesh, India, Indonesia, Japan,
47 Malaysia, Philippines, Singapore, South Korea, Taiwan, Thailand, and Vietnam), followed by
48 those the Americas (Brazil, Chile, Colombia, Ecuador, Nicaragua, USA, and Venezuela), Europe
49 (Netherlands and United Kingdom), and Africa (Kenya and South Africa).

52 The RSV for “social distancing” was significantly higher ($p < 0.05$) in 41 countries (20.9%) in the
53 last 20 weeks than in the first 20 weeks of this study before the pandemic declaration. It was
54 widely distributed among 14 Asian and Oceania countries (Australia, Bangladesh, Fiji, India,
55 Indonesia, Japan, Malaysia, New Zealand, Philippines, Singapore, South Korea, Taiwan,
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3 Thailand, and Vietnam), three Middle Eastern countries (Pakistan, Saudi Arabia, and the UAE)
4 with the above and upper middle income, seven European countries (France, Germany, Ireland,
5 Italy, Spain, Turkey, and the United Kingdom, 14 American countries (Argentina, Bolivia,
6 Brazil, Canada, Chile, Colombia, Dominican Republic, Ecuador, Mexico, Panama, Paraguay,
7 Peru, USA, and Venezuela), and three African countries (South Africa, South Sudan, and
8 Zimbabwe).

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11 In 74 countries (37.8%), “hand sanitizer” was a significantly higher RSV ($p < 0.05$) in the last 20
12 weeks of this study term than in the first 20 weeks before the pandemic declaration. The distribution
13 of countries with statistical significance was widely distributed among 20 Asian and Oceania
14 countries (Australia, Bangladesh, Brunei, Cambodia, China, India, Indonesia, Japan, Kazakhstan,
15 Malaysia, Myanmar, Nepal, New Zealand, Philippines, Singapore, South Korea, Sri Lanka,
16 Taiwan, Thailand, and Vietnam), eight Middle Eastern countries (Iran, Kuwait, Lebanon, Oman,
17 Pakistan, Qatar, Saudi Arabia, and the UAE), 17 European countries (Belgium, Denmark, Finland,
18 France, Georgia, Germany, Ireland, Italy, Netherlands, Norway, Poland, Portugal, Russia, Spain,
19 Turkey, Ukraine, and the United Kingdom), 17 American countries (Argentina, Brazil, Canada,
20 Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Mexico, Paraguay, Peru,
21 Puerto Rico, Trinidad and Tobago, USA, Uruguay, and Venezuela), and 12 African countries
22 (Algeria, Botswana, Ethiopia, Kenya, Libya, Mauritius, Morocco, Nigeria, South Africa, Tunisia,
23 Uganda, and Zimbabwe).

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27 In 98 countries (50.0%), the RSV of “mask” was significantly higher ($p < 0.05$) in the last 20 weeks
28 of this study term than in its first 20 weeks before the pandemic declaration. This was a higher
29 percentage than for any other prevention-related word. Those with significant differences in RSV
30 included 34 European (Albania, Austria, Belarus, Belgium, Bulgaria, Croatia, Denmark, Estonia,
31 Finland, France, Germany, Greece, Hungary, Iceland, Isle of Man, Ireland, Jersey, Kosovo, Latvia,
32 Lithuania, Luxembourg, Malta, Moldova, Netherlands, Poland, Portugal, Romania, Russia,
33 Slovenia, Spain, Switzerland, Turkey, Ukraine, and the United Kingdom), 16 American (Argentina,
34 Bahamas, Barbados, Brazil, Canada, Cuba, Dominican Republic, Guam, Jamaica, Mexico,
35 Panama, Sint Maarten, Saint Helena, Trinidad and Tobago, USA, and Venezuela), 19 Asian and
36 Oceania (Australia, Bangladesh, Bhutan, Brunei, Cambodia, Fiji, India, Indonesia, Japan,
37 Kazakhstan, Macao, Malaysia, Nepal, New Zealand, Philippines, Singapore, Sri Lanka, Taiwan,
38 and Uzbekistan), 12 Middle Eastern (Afghanistan, Bahrain, Iran, Iraq, Israel, Kuwait, Oman,
39 Pakistan, Qatar, Saudi Arabia, the UAE, and Yemen), and 17 African countries (Democratic
40 Republic of the Congo, Egypt, Ethiopia, Ghana, Kenya, Mauritius, Morocco, Nigeria, Reunion,
41 Rwanda, Senegal, Somalia, South Africa, Sudan, Uganda, Zambia, and Zimbabwe) (Figure 3).

42 43 44 45 46 47 **DISCUSSION**

48
49 The COVID-19 pandemic has had a significant impact on global public awareness and behavior,
50 including an increased interest in the prevention of infectious diseases. However, the magnitude of
51 the impact and the differences among countries are unclear. To our knowledge, this is the first
52 study to use Google Trends to objectively show the trends in people’s interest in COVID-19 and
53 its preventive measures in countries and regions worldwide. As globalization progresses, it is
54 necessary to consider countermeasures against globally transmitted infectious diseases, such as
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3 COVID-19, from a global perspective. Therefore, understanding the trends in people's interest in
4 preventive measures is important to consider global countermeasures. We noted some interesting
5 observations in the present situation of the global interest in COVID-19 and preventable measures.
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8 First, the global interest in coronaviruses among people with COVID-19 has increased to an
9 unprecedented level after WHO declared a pandemic in March 2020; [1] interest in "coronavirus"
10 has been maintained to a certain extent even now, more than a year and a half after the outbreak.
11 We also noted an increase of interest in preventable measures globally. However, the timings of
12 the increase differed by country and region. Even though most countries also "reacted" to
13 prevention measures at the timing of the WHO pandemic declaration, some countries increased
14 interest in preventable measures much earlier than others. Geographical and political factors may
15 have influenced the timing of the increase. For example, the countries around China, such as (e.g.,
16 Vietnam), increased their public interest much before the WHO's pandemic declaration, when
17 Chinese travelers were banned from the country at a very early phase. [22] Contrastingly, in Japan,
18 the interest in "coronavirus" and preventable measures peaked much later than in other high-
19 income countries after the WHO pandemic declaration; it was when a state of emergency was first
20 declared by the Japanese government on April 7, 2020.
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24 We focused on not only the "increase" in awareness but also how to sustain the interest in measures
25 for preventing infectious diseases. We found that, in most countries and regions, people's interest
26 in COVID-19 and preventive measures increased, but the persistence of interest in these
27 preventable measures was not necessarily maintained; there was also a difference in the
28 sustainability level of interest by country and region. Furthermore, with these differences in each
29 country's characteristics, there are also differences in sustainability between the search words
30 "wash hand," "social distancing," "hand sanitizer", and "mask".
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32
33 The sustainability of people's interest in masks was confirmed in a wide range of countries and
34 regions than other search terms. At the beginning of the outbreak, interest in masks spread mainly
35 in Asian countries relatively quickly, where a mask culture was already present. A report showed
36 the regional difference of wearing masks by region at an early stage of the COVID-19 pandemic.
37 [23] This might be attributed to the geographic differences and the cultural differences that could
38 have enhanced self-protecting habits. [24] However, notably, the sustainability of the other word
39 "impact" of "masks" was confirmed in many countries that are not necessarily familiar with the
40 practice of wearing of masks during winter, such as many Western countries. [25] This implies that
41 familiarity with masks may spread in countries without a mask-wearing culture. Although the
42 effectiveness of facemask use in community settings for COVID-19 prevention has been
43 controversial, [26–28] the COVID-19 pandemic introduced a "new culture" to these countries and
44 regions.
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48 Contrastingly, countries that were able to sustain interest in the search term "wash hand" were
49 relatively limited. Notably, the impact of COVID-19 was confirmed in relatively few European
50 countries with low sustainable interest for the term "wash hand", where the cumulative number of
51 confirmed cases was high. [2] The impact was concentrated in Southeast and East Asian countries,
52 where the number of confirmed cases and death rates were relatively low. [2] This suggests that
53 for the countries that did not sustain the interest of "wash hand," including many European
54 countries, interventions to maintain public interest may be necessary in cases of repeated outbreaks.
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As governments consider effective ways to control infections, they need to consider the fact that they may not be able to sustain the population's interest in preventive actions against infection.

Countries in East and Southeast Asia maintained an interest in “wash hand” and in other preventable measures such as “social distancing” and “hand sanitizer”. Thus, in these regions, the COVID-19 pandemic had a great impact on the public mind's interest and awareness of prevention measures against infectious diseases. Since prevention methods are common to many infectious diseases, the increased awareness of people regarding the prevention measures due to the COVID-19 pandemic can be expected to be reflected in future COVID-19 trends and in the decrease in other infectious diseases. Some previous studies in East Asia reported that the number of seasonal influenza cases in the 2019–2020 season was lower after COVID-19 transmission than in previous years and suggested the positive effects of prevention measures against COVID-19 on seasonal influenza. [29–31] The National Institute of Infectious Diseases in Japan also reported that in 2020 and 2021, mycoplasma pneumonia, respiratory syncytial virus infection, and Group A streptococcal pharyngitis decreased, whereas infectious gastroenteritis significantly decreased and reached its lowest level in a decade. [32] These infections can be effectively prevented by washing hands, social distancing, using hand sanitizers, and wearing masks as discussed in this study. In combination with these trends and the results from this study, it is suggested that the increasing interest in preventive actions in East Asian countries may be associated with the decrease in other infectious diseases.

The other main finding of the difference between the regions is the slower pace of development of interest in countries on the African continent as well as the limited areas where the persistence of interest had been observed, especially in terms that were related to behavior change, such as “wash hand” and “social distancing”. When we interpret data about African countries, it is necessary to consider the level of internet availability because African countries have relatively low internet availability. [33] However, considering that the trend of increased and sustained interest in “coronavirus” was confirmed even in African countries at the same level as other regions, the general interest in preventive measures in the African continent can be evaluated as being relatively lower. Thus, the data can be used as a reference for understanding the present situation in Africa. Some studies also mentioned the issues in attitude toward knowledge and healthy practices, including COVID-19 preventive practices in African countries. [34–36] The low-level interest in preventive measures in African countries needs to be considered in future strategies for expanding preventive measures against infectious disease at the global level. As the pandemic is still unfolding, there is a strong need to continually implement measures such as health promotions to better understand the pandemic and related health behaviors in the African population and the countries with low impact on public interest for preventable measures.

This study had some limitations. First, the differences in internet availability may have affected the results. Second, the percentage of Google users may have affected the global-level evaluation of public interest using Google Trends. For example, a typical case is that Google's share as a web search engine in China is very low because they may have used other search engines and hence, did not use Google. [37] Therefore, Google Trends is not a suitable tool for understanding trends in countries such as China; the results of these countries should be interpreted with this prior knowledge in mind.

CONCLUSION

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3 The COVID-19 pandemic may have impacted the global public interest of prevention measures
4 against infectious diseases. However, there are differences in interest related to preventable
5 measures and sustainability of that interest between countries and regions. The increased interest
6 in preventive behaviors against COVID-19 may be related to overall infectious disease prevention.
7 These global differences should be considered when implementing effective interventions against
8 infectious diseases at the global level.
9

10 11 12 13 14 15 16 17 **Competing Interests**

18
19 The authors declare that the research was conducted in the absence of any commercial or financial
20 relationships that could be construed as a potential conflict of interest.
21

22 23 **Author Contributions**

24
25 Tomoo Ito was involved in the study design, data analysis, interpretation, and creation of
26 tables and figures, and wrote the final report.
27

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31 or not-for-profit sectors.
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35 All work on this paper was done by Tomoo Ito alone, and there were no other collaborators on this
36 paper.
37

38 39 **Data Availability Statement**

40 The data that support the findings of this study are available from the author upon reasonable
41 request.
42

43 44 **References**

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Tables

Table 1. Number of countries with an RSV ≥ 50

	Week of January 26, 2020	Week of February 23, 2020	Week of March 8, 2020	Week of March 22, 2020	Week of April 5, 2020
RSV “coronavirus”					
Number of countries with RSV > 50, N (%)	8 (4.1%)	18 (9.2%)	118 (60.2%)	189 (86.4%)	196 (100%)
Number of countries without valid data, N (%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
RSV “wash hands”					
Number of countries with RSV \geq 50, N (%)	10 (5.1%)	37 (19.9%)	107 (54.7%)	160 (81.6%)	171 (87.1%)
Number of countries without valid data, N (%)	4 (2.0%)	4 (2.0%)	4 (2.0%)	4 (2.0%)	4 (2.0%)
RSV “social distancing”					
Number of countries with RSV \geq 50, N (%)	0 (0.0%)	0 (0.0%)	19 (9.2%)	102 (52.8%)	125 (62.6%)
Number of countries without valid data, N (%)	22 (11.2%)	22 (11.2%)	22 (11.2%)	22 (11.2%)	22 (11.2%)
RSV “hand sanitizer”					
Number of countries with RSV \geq 50, N (%)	8 (4.1%)	24 (12.2%)	121 (61.4%)	186 (94.4%)	187 (94.9%)
Number of countries	3 (1.5%)	3 (1.5%)	3 (1.5%)	3 (1.5%)	4 (1.5%)

without valid data, N (%)					
RSV "Masks"					
Number of countries with RSV \geq 50, N (%)	27 (13.8%)	65 (33.2%)	77 (39.3%)	130 (66.3%)	154 (83.4%)
Number of countries without valid data, N (%)	1 (0.5%)	1 (0.5%)	1 (0.5%)	1 (0.5%)	1 (0.5%)

Figure captions

Fig 1. RSV of "coronavirus," "wash hand", "social distancing", "hand sanitizer", and "mask" in the combined data for all countries and regions.

Horizontal axis: depicts the time period. The week of March 11, 2020, when WHO declared a pandemic, is set to 0 and increases hence. The weeks following the week of the pandemic declaration are numbered 1, 2, 3, and so on, until the 85th week (85 depicts the 85th week). The week before the pandemic declaration (0) is numbered -1 for the week one week before, -2 for the week two weeks before, and so on, until the 85th week (-85 means 85 weeks before the declaration of the pandemic).

Vertical axis: RSV value

Fig 2. Distribution trend of countries with "coronavirus" "wash hand" "social distancing" "hand sanitizer" and "mask" RSV \geq 50 after the COVID-19 outbreak

Area colored orange: countries with RSV "coronavirus" \geq 50

Area colored blue: countries without "coronavirus" \geq 50

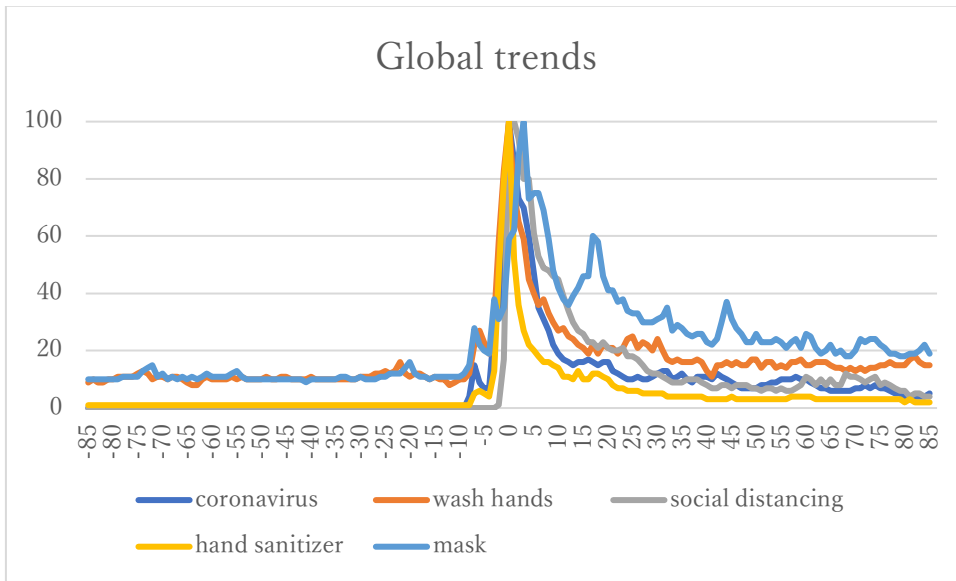
Area colored gray: countries without valid data

Fig 3. Distribution of countries with statistically significant RSV of "coronavirus", "wash hand", "social distancing", "hand sanitizer", and "mask" in the last 20 weeks compared with that before the COVID-19 pandemic.

Area colored red: countries with statistical significance in the last 19 weeks versus before the COVID-19 pandemic.

Area colored white: countries without statistical significance in the last 19 weeks versus before the COVID-19 pandemic.

Area colored gray: countries without valid data



peer review only

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	P1 P2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	P2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	P3-4
Objectives	3	State specific objectives, including any prespecified hypotheses	P3-4
Methods			
Study design	4	Present key elements of study design early in the paper	P4-5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	P4-5
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants	P4-5
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case	N/A
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	P4-5
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	P4-5
Bias	9	Describe any efforts to address potential sources of bias	P4-5
Study size	10	Explain how the study size was arrived at	P4-5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	P4-5
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	P4-5
		(b) Describe any methods used to examine subgroups and interactions	P4-5
		(c) Explain how missing data were addressed	P4-5
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	P4-5
		(e) Describe any sensitivity analyses	N/A

Continued on next page

Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	P4-5
		(b) Give reasons for non-participation at each stage	P4-5
		(c) Consider use of a flow diagram	P4-5
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	P4-5
		(b) Indicate number of participants with missing data for each variable of interest	P4-5
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	N/A
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	N/A
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	N/A
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	P5-8
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	P5-8
		(b) Report category boundaries when continuous variables were categorized	P5-8
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	P5-8
Discussion			
Key results	18	Summarise key results with reference to study objectives	P8
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	P10
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	P8-10
Generalisability	21	Discuss the generalisability (external validity) of the study results	P8-10
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	P11

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Global Monitoring of Public Interest in Preventive Measures against COVID-19 via Analysis of Google Trends: An Infodemiology and Infoveillance Study

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47 17 **Word count: 4511**

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3 20 Keywords: COVID-19, infection control, preventive measures, public awareness, Google
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5 21 Trends, global health
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11 23 **Abstract**
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14 24 **Objectives:** The coronavirus disease 2019 (COVID-19) pandemic has influenced people's
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16 25 concerns regarding infectious diseases and their preventive measures. However, the magnitude
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18 26 of the impact and the difference between countries are unclear. This study aimed to assess the
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20 27 magnitude of the impact of COVID-19 on public interest and people's behaviors globally in
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22 28 preventing infectious diseases while comparing international trends and sustainability.
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26 29 **Design:** An infodemiology and infoveillance study
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28 30 **Setting:** The study employed a web-based data collection to delineate public interest regarding
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30 31 COVID-19 preventive measures using Google Trends.
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33 32 **Primary and secondary outcome measures:** A relative search volume was assigned to a
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35 33 keyword, standardizing it from 0 to 100, with 100 representing the highest share of the term
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37 34 searches. The search terms "coronavirus," "wash hand," "social distancing," "hand sanitizer,"
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39 35 and "mask" were investigated across 196 different countries and regions from July 2018 to
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41 36 October 2021 and weekly reports of the relative search volume were obtained. Persistence of
42
43 37 interest was assessed by comparing the first 20 weeks with the last 20 weeks of the study period.
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46 38 **Results:** Although the relative search volume of "coronavirus" increased and was sustained at a
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48 39 significantly higher level ($p < 0.05$) than before the pandemic declaration, globally, the trends and
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50 40 sustainability of the interest in preventable measures against COVID-19 varied between
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52 41 countries and regions.
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3 42 **Conclusions:** Sustained interest in preventive measures differed globally, with regional
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5 43 differences noted among Asia, Europe, Africa, and the Americas. The global differences should
6
7 44 be considered for implementing effective interventions against COVID-19. The increased
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9 45 interest in preventive behaviors against COVID-19 may be related to overall infectious disease
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11 46 prevention.
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22 50 **Strengths and limitations of this study**
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- 26 52 • This study used Google Trends to objectively show the trends in people's interest in
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28 53 COVID-19 and its preventive measures worldwide.
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- 33 55 • The study monitors people's interest in preventive measures over a long period of time
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35 56 to assess the sustainability of the interest in preventable measures.
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- 40 58 • The differences in internet availability and the percentage of Google users may have
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42 59 affected the global-level evaluation of public interest using Google Trends.
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65 **INTRODUCTION**

66 The coronavirus disease 2019 (COVID-19) was first reported in Wuhan, China, in November 2019
67 and was declared a public health emergency of international concern on January 31, 2020. On
68 March 11, 2020, it was declared a pandemic by the World Health Organization (WHO).[1] As of
69 December 6, 2021, there have been 265,194,191 confirmed cases of COVID-19, including
70 5,254,116 deaths.[2] Considering its widespread relevance, the COVID-19 pandemic may impact
71 people's interest in infectious diseases and their lifestyles.[3] Therefore, the interest in preventive
72 measures against infectious diseases may be growing worldwide at a whole new level. However,
73 the magnitude of the impact on people's preventive behavior is difficult to measure objectively,
74 and the differences in behaviors among countries are unclear. Moreover, with the prolonged
75 pandemic, it is uncertain whether the growing interest in preventive actions against infectious
76 diseases can be sustained.

77 When faced with rapidly progressing infectious disease outbreaks, such as COVID-19, the
78 assessment of population awareness on infection prevention behaviors needs to be accomplished
79 promptly if the findings are informative in the context of the public health response. However,
80 such an assessment is not an easy task. For instance, population-representative household surveys
81 generally require several months of preparation and data collection; therefore, they do not always
82 provide timely results. Such an effort could be aided using available web search query data, which
83 provide insight into public interests related to such behaviors.

84 The use of internet search data to draw conclusions on the determinants and delivery of health
85 information is known as infodemiology.[4, 5] Since the first reported use of search engine data to

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3 86 track the 2008 influenza epidemic,[6] several research publications related to behavioral change
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5 87 and public interest in health have utilized the same.[7–11] Google Trends is a web-based tool that
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7 88 analyzes a portion of daily Google searches, generating data on geographical and temporal patterns
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10 89 according to specified keywords. Previous studies have demonstrated accurate prediction and
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12 90 forecasting of current public interests, allowing for analysis in various fields.[12–14]
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16 91 Since the Pandemic Declaration by the WHO in 2020, some researchers have investigated the
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18 92 impact of COVID-19 using Google Trends. The very first studies reported that Google Trends
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20 93 could forecast the rise of new cases.[15–17] Since then, studies on various COVID-19 topics have
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22 94 been conducted using Google Trends. Effenberger et al.[18] showed a relationship between the
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24 95 highest interest and the peak of newly confirmed cases. Walker et al.[19] reported a correlation
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26 96 between symptom search terms and confirmed case growth. Further, Sousa-Pinto et al.[20]
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28 97 reported a relationship between media coverage and COVID-19 keywords, whereas Heerfordt and
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30 98 Heerfordt[21] evaluated whether COVID-19 was associated with smoking cessation behaviors.
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32 99 Kutlu[22] reported the trends and impacts of dermatologic diseases on public perceptions during
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34 100 the COVID-19 pandemic, Springer et al.[23] reported the people's interest in the medical
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36 101 therapeutic direction, and Onchonga[24] reported on the use of the interest in self-medication
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38 102 during the COVID-19 pandemic.
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44 103 However, the impact of the global COVID-19 pandemic on the long-term interest in preventive
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46 104 measures against infectious diseases has not been studied, and whether such interest can be
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48 105 sustained or is only temporary. Moreover, global differences in public interest regarding COVID-
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50 106 19 and preventive measures have not been objectively monitored.
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3 107 This study aimed to assess the magnitude of COVID-19's impact on public interest regarding
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5 108 preventive behaviors by focusing on the pace at which public interest increased due to the COVID-
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8 109 19 pandemic, the suitability of the interest, and types of preventive measures preferred by different
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10 110 countries.

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14 15 16 112 **MATERIALS AND METHODS**

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20 113 Google Trends was used to quantify and measure changes in internet searches regarding the
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22 114 COVID-19 pandemic worldwide and in each country.

23 24 25 115 **Google Trends' function and data collection method**

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29 116 Google Trends uses a fraction of searches for a specific term (also known as "keyword" or "search
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31 117 term") and then analyzes the number of Google searches according to a geographical location and
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33 118 defined timeframe. After examining the keyword(s) or topic(s), the region and the period are
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36 119 entered. The region can be a country, a region, or a combined data set of all regions (global). The
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38 120 popularity of a search term in a given week relative to other weeks in the mentioned time period
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40 121 within a geographic region is shown as the relative search volume (RSV). The most popular week
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42 122 has a RSV of 100, while all other weeks are reported relative to the most popular week on a scale
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44 123 from 0 to 99. For example, a RSV of 50 would indicate that the search term was 50% as popular
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47 124 as it was in the most popular week. A score of 0 indicates insufficient searches to show for this
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50 125 term in the week. When a sufficient number of searches cannot be confirmed for a keyword or
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52 126 topic in a specified country, the system display indicates that the data cannot be retrieved.

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3 127 For international comparisons among countries using different languages, topic searches are
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5 128 useful. Topics are a group of terms that share the same concept in any language, and they are
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7 129 displayed below search terms. For example, when we searched the topic "London," the search
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9 130 provided results for topics such as the "Capital of the UK" and "Londres"(Spanish), which is
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11 131 "London." This study used topic searches using keywords in 196 countries, and the results of the
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13 132 topic searches are reported as the frequency of searches for all included keywords that refer to the
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15 133 same concept, regardless of the language in the specific countries. This method allowed us to
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17 134 understand the situation on a global level, including in countries where English is not the native
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19 135 language.

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25 136 The data are retrieved directly from the Google Trends Explore page in .csv format. If the survey
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27 137 period is long, the values are displayed as weekly values.

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30 138 In this study, first, the RSV of one topic in one country was obtained for a defined period on a
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32 139 weekly basis. This work was repeated for all the topics. Second, the same process was repeated
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34 140 for the 196 countries and regions. Finally, differences between countries and regions in the
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36 141 trends and sustainability of the topics were examined. Data for global trends (combined data set
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38 142 of all regions) were obtained by changing the location setting on Google Trends to "Worldwide"
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40 143 for a defined period for each topic.

41 42 43 44 45 144 **Target country, search term selection, and study term**

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48 145 For the 196 countries and regions around the world, Google Trend's "Topics" was used to show
49
50 146 the RSVs of "coronavirus" and typical preventive behaviors, including "wash hand" and "social
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52 147 distancing," and the supplies needed for prevention, such as "hand sanitizer" and "mask." These

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3 148 topic terms were mentioned on the Centers for Disease Control and Prevention (CDC) site [25] as
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5 149 recommendations for prevention and were listed as related topics in Google Trend's coronavirus.
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9 150 The specified survey period was set using the following procedures: First, the end of October 2021
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11 151 was set as the study's end period, and the most recent RSV was obtained on November 1, 2021.
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13 152 Second, the study's starting point was set from the same interval period between the WHO
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15 153 pandemic declaration and the study's end period. It was 85 weeks before and 85 weeks after the
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17 154 week of March 11, 2020. [1] Therefore, the date range was from the week of July 22, 2018, to that
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19 155 of October 24, 2021. Assessing the timing of raising the interest in each topic term
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23 156 For each country's topic term, the week in which RSV exceeded 50 (RSV50) after the beginning
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25 157 of 2020 was defined as the timing of the rise in RSV in each country. In Google Trends, RSV50
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27 158 means 50% of the search activity of the peak (RSV100) was performed in particular countries and
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29 159 regions using the defined term.
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33 160 **Assessing the sustainability of people's interest**

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37 161 In this study, the sustainability of interest was assessed by comparing the last 20 weeks (from the
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39 162 week of June 13, 2021, to that of October 24, 2021) of the survey period with the first 20 weeks
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41 163 (from the week of July 22, 2018, to that of December 2, 2018) for each topic term. This was
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43 164 because all topics used in this study are terms that had been used before the COVID-19 pandemic;
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45 165 thus, if the RSV in the latter period, which was more than 1 year after the WHO pandemic
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47 166 declaration, was higher than the RSV in the period before the outbreak, the sustainability on public
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49 167 interest was presented regardless of its magnitude.
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53 168 **Statistical analysis**

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3 169 The Mann–Whitney U test was used to compare the RSV during the first 20 weeks at the beginning
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5 170 of the study (from the week of July 22, 2018, to that of December 2, 2018) with the RSV during
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7 171 the last 20 weeks at the end of the study (from the week of June 13, 2021, to that of October 24,
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9 172 2021) for each topic term. All statistical analyses were performed using IBM SPSS Statistics for
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11 173 Windows, version 25 (IBM Corp., Armonk, NY, USA). $P < 0.05$ was considered statistically
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13 174 significant.
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18 175 **Ethical considerations**

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21 176 The study did not require ethics approval because the RSVs obtained from Google Trends were
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23 177 publicly available, fully anonymized, and aggregated data.
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27 178 **Patient and public involvement**

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30 179 No patients and/or general public were involved in setting the research question or the outcome
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32 180 measures, nor were they involved in developing plans for the study design or implementation.
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34 181 They were not asked to advise on the interpretation or writing of results. There are no plans to
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36 182 disseminate the research results to study participants or the relevant patient community.
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45 184 **RESULTS**

46 185 **Global trends (combined data set of all regions)**

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50 186 The search terms “coronavirus,” “wash hand,” “social distancing,” “hand sanitizer,” and “mask”
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52 187 reached RSV 50 by the week of the WHO pandemic declaration (March 11, 2020) in global trends
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54 188 (combined data set of all regions). Subsequently, “coronavirus,” “wash hand,” and “hand sanitizer”
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3 189 RSVs peaked (RSV100) in the week of the WHO pandemic declaration. This was followed by the
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5 190 RSV of “social distancing” a week later (the week of March 15, 2020) and that of “mask” 3 weeks
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8 191 later (the week of April 5, 2020) (Figure 1). In Global Trends, the RSVs of “coronavirus,” “wash
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10 192 hand,” “social distancing,” “hand sanitizer,” and “mask” were significantly higher ($p < 0.05$) in the
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12 193 last 20 weeks of the study period (from the week of June 13, 2021, to the week of October 24,
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14 194 2021) than in the first 20 weeks before the pandemic declaration (from the week of July 22, 2018,
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17 195 to that of December 2, 2018).

196 **Search word “coronavirus” trend**

197 “coronavirus” RSVs were obtained in 196 countries and territories. All of the target countries and
198 regions had enough searches to show RSVs. In late January 2020, only eight countries (4.1%) in
199 and mainly around China reached RSV50 (Bhutan, China, Laos, Macao, Mongolia, Philippines,
200 Thailand, and Vietnam). However, in the week of the pandemic declaration (the week of March 8,
201 2020), the number of countries that reached RSV50 rose sharply, especially in the Americas and
202 Europe, and by late March, 96.4% of all the countries and regions, including African countries,
203 reached RSV50. Japan, which was the only G7 country that did not initially have a $RSV \geq 50$, had
204 a $RSV \geq 50$ at this time. In early April, the RSV reached 50 in all targeted regions (Table 1, Figure
205 2).

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207 **Table 1. Number of countries with a $RSV \geq 50$**

	Week of January 26, 2020	Week of February 23, 2020	Week of March 8, 2020	Week of March 22, 2020	Week of April 5, 2020
RSV “coronavirus”					
Number of countries with RSV > 50, N (%)	8 (4.1%)	18 (9.2%)	118 (60.2%)	189 (96.4%)	196 (100%)
Number of countries without valid data, N (%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
RSV“wash hand”					
Number of countries with	10 (5.1%)	37 (18.9%)	107 (54.6%)	160 (81.6%)	171 (87.2%)

RSV \geq 50, N (%)					
Number of countries without valid data, N (%)	4 (2.0%)	4 (2.0%)	4 (2.0%)	4 (2.0%)	4 (2.0%)
RSV“social distancing”					
Number of countries with RSV \geq 50, N (%)	0 (0.0%)	0 (0.0%)	18 (9.2%)	102 (52.0%)	125 (63.8%)
Number of	22 (11.2%)	22 (11.2%)	22 (11.2%)	22 (11.2%)	22 (11.2%)

countries without valid data, N (%)					
RSV “hand sanitizer”					
Number of countries with RSV \geq 50, N (%)	8 (4.1%)	24 (12.2%)	121 (61.7%)	186 (94.9%)	187 (95.4%)
Number of countries without valid data, N (%)	3 (1.5%)	3 (1.5%)	3 (1.5%)	3 (1.5%)	3 (1.5%)

RSV “mask”					
Number of countries with RSV \geq 50, N (%)	27 (13.8%)	65 (33.2%)	77 (39.3%)	130 (66.3%)	154 (78.6%)
Number of countries without valid data, N (%)	1 (0.5%)	1 (0.5%)	1 (0.5%)	1 (0.5%)	1 (0.5%)

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209 Search word “wash hand” trend

210 In total, 192 countries and territories had “wash hand” RSVs, and four countries (Central Africa,
 211 Commonwealth of Dominica, Eritrea, and Turks and Caicos Islands) did not have enough searches
 212 to show RSVs. Six countries (3.1%) reached RSV50 in late January 2020 and included mostly

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3 213 Asian countries around China: Brunei, Cambodia, Singapore, South Korea, Taiwan, and Vietnam.
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5 214 Moreover, Antigua and Barbuda, Bhutan, Cyprus, and Syria were also above RSV50, but this was
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8 215 a temporary increase as it dropped to zero in the following week of late January 2020.
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11 216 In the week after the pandemic was declared (the week of March 8, 2020), 107 countries (54.6%),
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13 217 mainly in North America, Europe, and Asia, had RSVs ≥ 50 , and by late March, 160 countries
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15 218 (81.6%), including most countries in South America, had RSVs ≥ 50 . Japan, which was the only
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17 219 G7 country that did not have a RSV ≥ 50 in the week of March 8, 2020, had a RSV ≥ 50 at this
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19 220 time. Conversely, even in early April, the RSV did not exceed 50 in 21 countries (10.7%),
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21 221 including nine countries on the African continent (Algeria, Botswana, Burundi, Cameroon,
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23 222 Mozambique, Republic of Congo, Seychelles, Sudan, and Vanuatu) and countries in other areas
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25 223 (Table 1, Figure 2).
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30 224 **Search word “social distancing” trend**

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34 225 “social distancing” RSVs were obtained in 174 countries and territories. There were 22 regions
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36 226 and countries that did not have enough searches to show RSVs.
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39 227 Only 18 countries (9.2%) had a RSV ≥ 50 , even when the pandemic was declared (the week of
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41 228 March 8, 2020). In late March, 102 countries (52.0%), mainly in the Americas, Europe, and Asia,
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43 229 had a RSV ≥ 50 . In early April, 125 countries (63.8%) had a RSV ≥ 50 , but 49 countries (25.0%)
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45 230 in various regions, including two G7 countries (France, Italy) in Europe (n=7), Asia and Oceania
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47 231 (n=10), America (n=16), and Africa (n=16) did not have a RSV ≥ 50 (Table 1, Figure 2). The
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49 232 highest number of countries did not reach a RSV ≥ 50 with respect to the search term “social
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51 233 distancing” (n=49) by early April compared with that noted for other study terms, such as
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53 234 “coronavirus” (n=0), “wash hand” (n=21), “hand sanitizer” (n=7), and “mask.” n=41).
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235 **Search word “hand Sanitizer” trend**

236 In 193 countries and territories, “hand sanitizer” RSVs were available, and in the three countries
237 (Central Africa, Eritrea, and Liechtenstein), there were not enough searches to show RSVs.

238 In late January 2020, eight countries (4.1%), mainly those around China (Cambodia, China,
239 Macao, Maldives, Singapore, South Korea, Taiwan, and Vietnam), had RSVs ≥ 50 , and in the week
240 of the pandemic declaration, the number of countries with a RSV ≥ 50 increased to 121 (61.7%).
241 Subsequently, the number of countries with a RSV ≥ 50 gradually increased to 187 (95.4%) in
242 early April (Table 1, Figure 2). The countries with RSVs < 50 by early April (Burundi,
243 Commonwealth of Dominica, Liberia, New Caledonia, Suriname, Tajikistan, Turkmenistan) had
244 reached a RSV of 50 at various later times.

245 **Search word “mask” trend**

246 Valid “mask” RSVs were obtained for 195 countries and regions, and only one country (Eritrea)
247 did not have enough searches to display a RSV. In late January 2020, 27 countries (13.8%) had a
248 RSV ≥ 50 . They consisted mainly of countries around China (Cambodia, China, Japan, Lao PDR,
249 Macao, Malaysia, Mongolia, Myanmar, Philippines, Singapore, South Korea, Taiwan, Thailand,
250 and Vietnam) and some countries in other areas. In late March, there were 130 countries with a
251 RSV ≥ 50 ; in contrast, the United States and some European countries still did not have a RSV
252 ≥ 50 . Then, in early April, 154 countries (78.6%) had a RSV ≥ 50 . Forty-one countries, including
253 many major European countries (Belgium, Finland, France, Germany, Ireland, Switzerland, and
254 the United Kingdom), African countries, countries on the South American continent, Australia,
255 and New Zealand had not reached RSV ≥ 50 by early April but had reached RSV of 50 at various
256 later times (Table 1, Figure 2).

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3 257 **Comparison of RSV ≥ 65 weeks after the declaration of the pandemic and before the**
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5 258 **COVID-19 pandemic**
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9 259 In 191 countries, the RSV of “coronavirus” was significantly higher ($p < 0.05$) in the last 20 weeks
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11 260 of this study term than in its first 20 weeks before the pandemic declaration. There were five
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13 261 countries (Central Africa, Djibouti, Eritrea, Liberia, and Samoa) with no significant difference.
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17 262 In 24 countries (12.2%), the RSV of “wash hand” was significantly higher ($p < 0.05$) in the last 20
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19 263 weeks of this study term than in its first 20 weeks before the pandemic declaration. The majority
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21 264 of these countries were from Asia and Oceania (Australia, Bangladesh, India, Indonesia, Japan,
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23 265 Malaysia, Philippines, Singapore, South Korea, Taiwan, Thailand, and Vietnam); followed by
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25 266 those of the Americas (Brazil, Chile, Colombia, Ecuador, Nicaragua, USA, and Venezuela);
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27 267 Europe (the Netherlands and the United Kingdom); and Africa (Kenya and South Africa).
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31 268 The RSV for “social distancing” was significantly higher ($p < 0.05$) in 41 countries (20.9%) in the
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33 269 last 20 weeks than in the first 20 weeks of this study before the pandemic declaration. It was
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35 270 widely distributed among 14 Asian and Oceania countries (Australia, Bangladesh, Fiji, India,
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37 271 Indonesia, Japan, Malaysia, New Zealand, Philippines, Singapore, South Korea, Taiwan,
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39 272 Thailand, and Vietnam); three Middle Eastern countries (Pakistan, Saudi Arabia, and the UAE);
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41 273 seven European countries (France, Germany, Ireland, Italy, Spain, Turkey, and the United
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43 274 Kingdom); 14 American countries (Argentina, Bolivia, Brazil, Canada, Chile, Colombia,
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45 275 Dominican Republic, Ecuador, Mexico, Panama, Paraguay, Peru, USA, and Venezuela); and
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47 276 three African countries (South Africa, South Sudan, and Zimbabwe).
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53 277 In 74 countries (37.8%), “hand sanitizer” had a significantly higher RSV ($p < 0.05$) in the last 20
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55 278 weeks of this study term than in the first 20 weeks before the pandemic declaration. The countries
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3 279 with statistical significance were widely distributed among 20 Asian and Oceania countries
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5 280 (Australia, Bangladesh, Brunei, Cambodia, China, India, Indonesia, Japan, Kazakhstan, Malaysia,
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7 281 Myanmar, Nepal, New Zealand, Philippines, Singapore, South Korea, Sri Lanka, Taiwan,
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9 282 Thailand, and Vietnam); eight Middle Eastern countries (Iran, Kuwait, Lebanon, Oman, Pakistan,
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11 283 Qatar, Saudi Arabia, and the UAE); 17 European countries (Belgium, Denmark, Finland, France,
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13 284 Georgia, Germany, Ireland, Italy, Netherlands, Norway, Poland, Portugal, Russia, Spain, Turkey,
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15 285 Ukraine, and the United Kingdom); 17 American countries (Argentina, Brazil, Canada, Chile,
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17 286 Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Mexico, Paraguay, Peru,
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19 287 Puerto Rico, Trinidad and Tobago, USA, Uruguay, and Venezuela); and 12 African countries
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21 288 (Algeria, Botswana, Ethiopia, Kenya, Libya, Mauritius, Morocco, Nigeria, South Africa, Tunisia,
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23 289 Uganda, and Zimbabwe).

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29 290 In 98 countries (50.0%), the RSV of “mask” was significantly higher ($p < 0.05$) in the last 20 weeks
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31 291 of this study term than in its first 20 weeks before the pandemic declaration. This was a higher
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33 292 percentage than for any other prevention-related word. Those with significant differences in RSV
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35 293 included 34 European (Albania, Austria, Belarus, Belgium, Bulgaria, Croatia, Denmark, Estonia,
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37 294 Finland, France, Germany, Greece, Hungary, Iceland, Isle of Man, Ireland, Jersey, Kosovo, Latvia,
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39 295 Lithuania, Luxembourg, Malta, Moldova, Netherlands, Poland, Portugal, Romania, Russia,
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41 296 Slovenia, Spain, Switzerland, Turkey, Ukraine, and the United Kingdom); 16 American
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43 297 (Argentina, Bahamas, Barbados, Brazil, Canada, Cuba, Dominican Republic, Guam, Jamaica,
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45 298 Mexico, Panama, Sint Maarten, Saint Helena, Trinidad and Tobago, USA, and Venezuela); 19
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47 299 Asian and Oceania (Australia, Bangladesh, Bhutan, Brunei, Cambodia, Fiji, India, Indonesia,
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49 300 Japan, Kazakhstan, Macao, Malaysia, Nepal, New Zealand, Philippines, Singapore, Sri Lanka,
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51 301 Taiwan, and Uzbekistan); 12 Middle Eastern (Afghanistan, Bahrain, Iran, Iraq, Israel, Kuwait,
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3 302 Oman, Pakistan, Qatar, Saudi Arabia, the UAE, and Yemen); and 17 African countries
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5 303 (Democratic Republic of the Congo, Egypt, Ethiopia, Ghana, Kenya, Mauritius, Morocco, Nigeria,
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7 304 Reunion, Rwanda, Senegal, Somalia, South Africa, Sudan, Uganda, Zambia, and Zimbabwe)
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10 305 (Figure 3).
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16 307 **DISCUSSION**

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20 308 The COVID-19 pandemic has had a significant impact on global public awareness and behavior,
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22 309 including an increased interest in the prevention of infectious diseases. However, the magnitude
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24 310 of the impact and the differences among countries are unclear. To our knowledge, this is the first
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26 311 study to use Google Trends to objectively show the trends in people's interest in COVID-19 and
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28 312 its preventive measures in countries and regions worldwide. As globalization progresses, it is
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30 313 necessary to consider countermeasures against globally transmitted infectious diseases, such as
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32 314 COVID-19, from a global perspective. Therefore, understanding the trends in people's interest in
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34 315 preventive measures is important to consider global countermeasures. We noted some interesting
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36 316 observations in the present situation of the global interest in COVID-19 and preventable measures.
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41 317 First, the global interest in coronaviruses among people with COVID-19 has increased to an
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43 318 unprecedented level after the WHO declared a pandemic in March 2020;^[1] interest in
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45 319 "coronavirus" has been maintained to a certain extent even now, more than a year and a half after
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47 320 the outbreak. We also noted an increase in interest in preventable measures globally. However, the
48
49 321 timings of the increase differed by country and region. Even though most countries also "reacted"
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51 322 to prevention measures at the time of the WHO pandemic declaration, some countries increased
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53 323 interest in preventable measures much earlier than others. Geographical and political factors may
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3 324 have influenced the timing of the increase. For example, the countries around China, such as (e.g.
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5 325 Vietnam), increased their public interest much before the WHO's pandemic declaration, when
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7 326 Chinese travellers were banned from the country at a very early phase. [26] Contrastingly, in Japan,
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10 327 the interest in "coronavirus" and preventable measures peaked much later than in other high-
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12 328 income countries after the WHO pandemic declaration. This occurred when the Japanese
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14 329 government first declared a state of emergency on April 7, 2020.

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18 330 The "increase" in awareness and how to sustain the interest in measures for preventing infectious
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20 331 diseases were focused on. In most countries and regions, I found that people's interest in COVID-
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22 332 19 and preventive measures increased, but the persistence of interest in these preventable measures
23
24 333 was not necessarily maintained; there was also a difference in the sustainability level of interest
25
26 334 by country and region. Furthermore, with these differences in each country's characteristics, there
27
28 335 are also differences in sustainability between the search words "wash hand," "social distancing,"
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30 336 "hand sanitizer," and "mask."

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35 337 The sustainability of people's interest in masks was confirmed in a wide range of countries and
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37 338 regions than other search terms. At the beginning of the outbreak, interest in masks spread mainly
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39 339 in Asian countries relatively quickly, where a mask culture was already present. A report showed
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41 340 the regional difference in wearing masks by region at an early stage of the COVID-19 pandemic.
42
43 341 [27] This might be attributed to geographic and cultural differences that could have enhanced self-
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45 342 protecting habits. [28] However, notably, the sustainability of the other word "impact" of "mask"
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47 343 was confirmed in many countries that are not necessarily familiar with the practice of wearing
48
49 344 masks during winter, such as many Western countries. [29] This implies that familiarity with
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51 345 masks may spread in countries without a mask-wearing culture. Although the effectiveness of
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3 346 facemask use in community settings for COVID-19 prevention has been controversial, [30–32] the
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5 347 COVID-19 pandemic introduced a “new culture” to these countries and regions.
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9 348 Contrastingly, countries that could sustain interest in the search term “wash hand” were relatively
10
11 349 limited. Notably, the impact of COVID-19 was confirmed in relatively few European countries
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13 350 with low sustainable interest for the term “wash hand,” where the cumulative number of confirmed
14
15 351 cases was high. [2] The impact was concentrated in Southeast and East Asian countries, where the
16
17 352 number of confirmed cases and death rates were relatively low. [2] This suggests that for the
18
19 353 countries that did not sustain the interest of “wash hand,” including many European countries,
20
21 354 interventions to maintain public interest may be necessary in cases of repeated outbreaks. As
22
23 355 governments consider effective ways to control infections, they need to consider that they may not
24
25 356 be able to sustain the population’s interest in preventive actions against infection.
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30
31 357 Countries in East and Southeast Asia maintained an interest in “wash hand” and in other preventive
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33 358 measures such as “social distancing” and “hand sanitizer.” Thus, in these regions, the COVID-19
34
35 359 pandemic greatly impacted the public mind’s interest and awareness of prevention measures
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37 360 against infectious diseases. Since prevention methods are common to many infectious diseases,
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39 361 the increased awareness of people regarding the prevention measures due to the COVID-19
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41 362 pandemic can be expected to be reflected in future COVID-19 trends and in the decrease in other
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43 363 infectious diseases. Some previous studies in East Asia reported that the number of seasonal
44
45 364 influenza cases in the 2019–2020 season was lower after COVID-19 transmission than in previous
46
47 365 years and suggested the positive effects of prevention measures against COVID-19 on seasonal
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49 366 influenza. [33–35] The National Institute of Infectious Diseases in Japan also reported that in 2020
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51 367 and 2021, mycoplasma pneumonia, respiratory syncytial virus infection, and Group A
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53 368 streptococcal pharyngitis decreased, whereas infectious gastroenteritis significantly decreased and
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3 369 reached its lowest level in a decade. [36] These infections can be effectively prevented by washing
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5 370 hands, social distancing, using hand sanitizers, and wearing masks, as discussed in this study. In
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8 371 combination with these trends and the results from this study, it is suggested that the increasing
9
10 372 interest in preventive actions in East Asian countries may be associated with the decrease in other
11
12 373 infectious diseases.

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16 374 The other main finding of the difference between the regions is the slower pace of development of
17
18 375 interest in countries on the African continent as well as the limited areas where the persistence of
19
20 376 interest had been observed, especially in terms that were related to behavior change, such as “wash
21
22 377 hand” and “social distancing.” When interpreting data about African countries, it is necessary to
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24
25 378 consider their relatively low level of internet availability. [37] However, considering that the trend
26
27 379 of increased and sustained interest in “coronavirus” was confirmed even in African countries at
28
29 380 the same level as other regions, the general interest in preventive measures in the African continent
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32 381 can be considered relatively lower. Thus, the data can be used as a reference for understanding the
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34 382 present situation in Africa. Some studies also mentioned the issues of attitude toward knowledge
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36 383 and healthy practices, including COVID-19 preventive practices in African countries. [38–40] The
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39 384 low-level interest in preventive measures in African countries needs to be considered in future
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41 385 strategies for expanding preventive measures against infectious diseases at the global level. As the
42
43 386 pandemic is still unfolding, there is a strong need to continually implement health promotion
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45 387 measures to better prevent the pandemic and improve related-health behaviors in African
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48 388 populations and countries with low impact of public interest on preventable measures.

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50
51 389 The COVID-19 pandemic caused damage and impacted people’s lives worldwide. The study
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53 390 results showed that people's interest in preventable measures against infectious diseases
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56 391 increased in most countries. This unprecedented opportunity should be maximized by
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3 392 policymakers, and appropriate policies should be implemented to maintain the increased interest
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5 393 in preventable measures, which will lead to future infectious disease control.
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9 394 This study had some limitations. First, differences in the levels of internet availability may have
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11 395 affected the results. Second, the percentage of Google users may have affected the global-level
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13 396 evaluation of public interest using Google Trends. A typical example is the extreme low share of
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15 397 Google as a web search engine in China, given that they may have used other search engines and
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17 398 hence did not use Google.[41] Therefore, Google Trends is not a suitable tool for understanding
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19 399 trends in countries such as China; the results of these countries should be interpreted based on
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21 400 this prior knowledge. Although it is necessary to consider these differences to interpret the
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23 401 results globally, the sustainability of the search term “coronavirus” was uniform in almost all
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25 402 countries because of the consistent volume of internet searches from almost all countries and
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27 403 regions throughout the study period. This suggests that the global spread of the tools used in this
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29 404 study was sufficient to grasp global trends.
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38 406 **CONCLUSION**

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41 407 The COVID-19 pandemic may have impacted the global public interest in prevention measures
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43 408 against infectious diseases. However, there are differences in interest related to preventable
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45 409 measures and sustainability of that interest between countries and regions. The increased interest
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47 410 in preventive behaviors against COVID-19 may be related to overall infectious disease prevention.
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49 411 These global differences should be considered when implementing effective interventions against
50
51 412 infectious diseases at the global level.
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56 414 **Competing Interests**7
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10 415 The author declares that the research was conducted in the absence of any commercial or financial
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12 416 relationships that could be construed as a potential conflict of interest.
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1415 417 **Author Contributions**16
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18 418 Tomoo Ito was involved in the study design, data analysis, interpretation, and creation of
19
20 419 tables and figures and wrote the final report.
21
2223 420 **Funding**24
25 421 This research did not receive any specific grant from funding agencies in the public, commercial,
26
27 422 or not-for-profit sectors.
28
2930
31 423 **Ethical Approval**32
33
34 424 The study did not require ethics approval because the RSVs obtained from Google Trends were
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36 425 publicly available, fully anonymized, and aggregated data.
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38
3940 426 **Acknowledgments**41
42
43 427 All work on this paper was done by Tomoo Ito alone, and there were no other collaborators on this
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45 428 paper.
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4849 429 **Data Availability Statement**50
51
52 430 The data that support the findings of this study are available from the author upon reasonable
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54 431 request.
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12 553 **Figure captions**

13
14
15 554 **Fig 1.** RSV of “coronavirus,” “wash hand,” “social distancing,” “hand sanitizer,” and “mask” in
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17 555 the combined data for all countries and regions.

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20 556 Horizontal axis: depicts the time period. The week of March 11, 2020, when the WHO declared a
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22 557 pandemic, is set to 0 and increases thereafter. The weeks following the week of the pandemic
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24 558 declaration are numbered as 1, 2, 3, and so on, until the 85th week (85 depicts the 85th week). The
25
26 559 week before the pandemic declaration (0) is numbered -1 for the week before, -2 for two weeks
27
28 560 before, and so on, until the 85th week (-85 means 85 weeks before the declaration of the pandemic).

29
30 561 Vertical axis: relative search volume (RSV) value
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34 562 Figure 1 was created using Microsoft Excel (Microsoft Inc., Seattle, WA, USA).
35
36 563

37
38 564 **Fig 2.** Distribution trend of countries with “coronavirus,” “wash hand,” “social distancing,” “hand
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40 565 sanitizer,” and “mask” with relative search volume (RSV) ≥ 50 after the coronavirus disease 2019
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42 566 (COVID-19) pandemic

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44 567 Area colored red: countries with RSV “coronavirus” ≥ 50

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46 568 Are colored gray: countries without valid data

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48 569 Figure 2 was created using QGIS version 3.24 with background map data obtained from

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50 570 OpenStreetMap contributors (www.openstreetmap.org).
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52 571

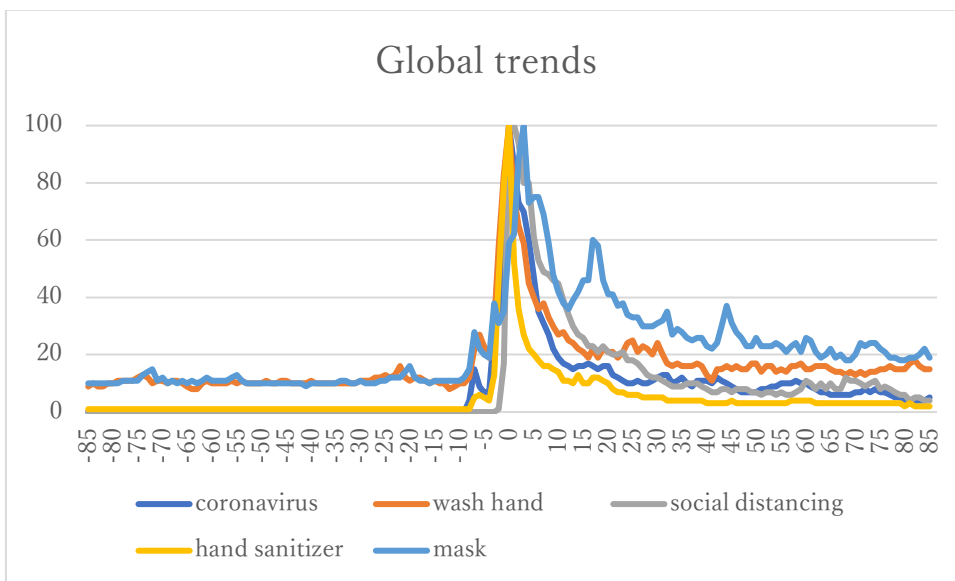
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3 572 **Fig 3.** Distribution of countries with statistically significant relative search volume (RSV) of
4
5 573 “coronavirus,” “wash hand,” “social distancing,” “hand sanitizer,” and “mask” in the last 20 weeks
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8 574 compared with that before the coronavirus disease 2019 (COVID-19) pandemic.

9
10 575 Area colored red: countries with statistical significance in the last 20 weeks versus before the
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12 576 COVID-19 pandemic.

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14 577 Area colored gray: countries without valid data

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17 578 Figure 3 was created using QGIS version 3.24 with background map data obtained from

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19 579 OpenStreetMap contributors (www.openstreetmap.org).



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“coronavirus” RSV trends

(A) “coronavirus” RSV for the week of January 26, 2020



(B) “coronavirus” RSV for the week of February 23, 2020



(C) “coronavirus” RSV for the week of March 8, 2020



(D) “coronavirus” RSV for the week of March 22, 2020



(E) “coronavirus” RSV for the week of April 5, 2020



“wash hand” RSV trends

(A) “Wash hand” RSV for the week of January 26, 2020



(B) “wash hand” RSV for the week of February 23, 2020



(C) “wash hand” RSV for the week of March 8, 2020



(D) “wash hand” RSV for the week of March 22, 2020



(E) “wash hand” RSV for the week of April 5, 2020



“social distancing” RSV trends

(A) “social distancing” RSV for the week of January 26, 2020



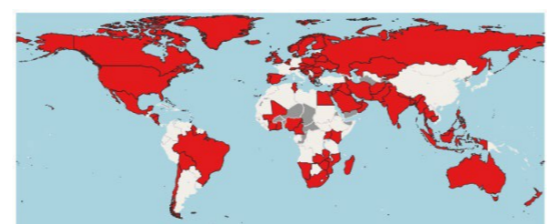
(B) “social distancing” RSV for the week of February 23, 2020



(C) “social distancing” RSV for the week of March 8, 2020



(D) “social distancing” RSV for the week of March 22, 2020

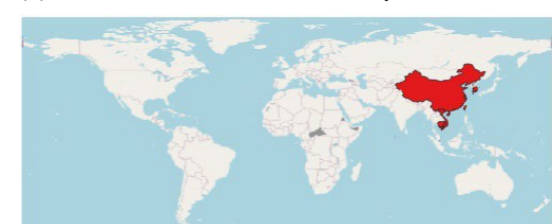


(E) “social distancing” RSV for the week of April 5, 2020



“hand sanitizer” RSV trends

(A) “hand sanitizer” RSV for the week of January 26, 2020



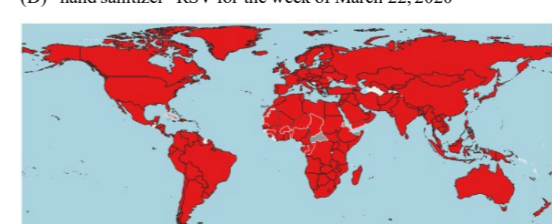
(B) “hand sanitizer” RSV for the week of February 23, 2020



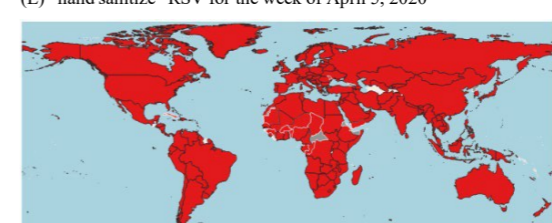
(C) “hand sanitizer” RSV for the week of March 8, 2020



(D) “hand sanitizer” RSV for the week of March 22, 2020



(E) “hand sanitizer” RSV for the week of April 5, 2020



“mask” RSV trends

(A) “mask” RSV for the week of January 26, 2020



(B) “mask” RSV for the week of February 23, 2020



(C) “mask” RSV for the week of March 8, 2020



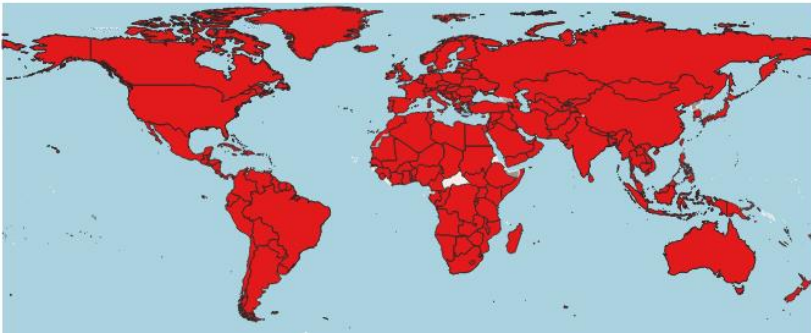
(D) “mask” RSV for the week of March 22, 2020



(E) “mask” RSV for the week of April 5, 2020



1 (A) Countries with significant difference of 'coronavirus' RSV in the first 20 weeks and the last 20 weeks



12 (B) Countries with significant difference of 'wash hand' RSV in the first 20 weeks and the last 20 weeks



24 (C) Countries with significant difference of 'social distancing' RSV in the first 20 weeks and the last 20 weeks



36 (D) Countries with significant difference of 'hand sanitizer' RSV in the first 20 weeks and the last 20 weeks



48 (E) Countries with significant difference of 'mask' RSV in the first 20 weeks and the last 20 weeks



STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Page No.	Relevant text from manuscript
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	1, 2	Line 2 and line 29. Design: An infodemiology and infoveillance study
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2,3	Lines 23-46, Abstract
Introduction				
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4,5	Introduction (lines 66-102).
Objectives	3	State specific objectives, including any prespecified hypotheses	5.6	Introduction (lines 103-110).
Methods				
Study design	4	Present key elements of study design early in the paper	6	MATERIALS AND METHODS (lines 113-114). Google Trends was used to quantify and measure changes in internet searches regarding the COVID-19 pandemic worldwide and in each country.
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6-8	MATERIALS AND METHODS (lines 115-167)
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants	7	Line 145: 196 countries and regions around the world

		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed	N/A	N/A
		<i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case		
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7.8	Lines 144-167.
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-8	Lines 115-167
Bias	9	Describe any efforts to address potential sources of bias	7	Line 127-135 This method allowed us to understand the situation on a global level, including in countries where English is not the native language.
Study size	10	Explain how the study size was arrived at	7	Line 145: 196 countries and regions around the world
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8	Lines 156-167
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	8-9	Lines 168-174
		(b) Describe any methods used to examine subgroups and interactions	N/A	N/A
		(c) Explain how missing data were addressed	6	Lines 125-126 When a sufficient number of searches cannot be confirmed for a search keyword or topic in a specified country, the system displays that the data cannot be retrieved.
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed	N/A	N/A
		<i>Case-control study</i> —If applicable, explain how matching of cases and controls		

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was addressed

Cross-sectional study—If applicable, describe analytical methods taking account of sampling strategy

(e) Describe any sensitivity analyses

N/A

N/A

Continued on next page

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Results

Participants	13*	(a) Report numbers of individuals at each stage of study—e.g. numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	10,14,15,16	Lines 197, 210, 225, 236, 246
		(b) Give reasons for non-participation at each stage	6	Lines 125-126 When a sufficient number of searches cannot be confirmed for a search keyword or topic in a specified country, the system displays that the data cannot be retrieved.
		(c) Consider use of a flow diagram	N/A	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7	Line 145: 196 countries and regions around the world
		(b) Indicate number of participants with missing data for each variable of interest	10,14,15,16	Lines 197, 210, 225, 236, 246
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	N/A	N/A
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	N/A	N/A
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	N/A	N/A
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	9-19	Lines 185-305
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	N/A	N/A
		(b) Report category boundaries when continuous variables were categorized	N/A	N/A
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A	N/A
Discussion				
Key results	18	Summarise key results with reference to study objectives	23	Lines 406-412

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Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	23	Lines 394-404
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	19-23	Lines 317-404
Generalisability	21	Discuss the generalisability (external validity) of the study results	23	Lines 394-404

Other information

Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	24	Lines 421-423
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*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.