INTRODUCTION

Governments of several countries worldwide have adopted specific policies to endure the socioeconomic consequences and health impacts of the COVID-19 pandemic. In an attempt to slow the spread of SARS-CoV-2 virus, authorities encouraged or imposed restrictive public health and social measures as mass quarantine, lockdown, self-isolation, and closures of non-essentials services (Hale et al., 2020).

People undergoing this context could experience negative psychological effects. The most frequent mental problems are related to stress, depression, and anxiety (Brooks et al., 2020; Luo et al., 2020; Torales et al., 2020; Vindegaard & Benros, 2020). Loss of routine and daily activities, confinement, and financial difficulty are some of the reported stressors (Brooks et al., 2020). Studies before the COVID-19 outbreak had already shown that stress and the financial crisis hinder the access to oral care, contributing to toothache (Hairon, 2009; Honkala et al., 2001; Lotto et al., 2017; Vujicic & Nasseh, 2014). Routine changes during vacation periods were also associated with greater neglect of oral health care (Hale et al., 2020).

Considering these aspects, there is a requirement to investigate how
social restriction and the current pandemic scenario can impact the
dental needs of populations.

Even after the end of recommendations to postpone routine
dental care, many clinics may remain closed due to government
restrictions, problems with understaffing, appropriate PPE (pro-
tective personal equipment), or difficulties in adapting facilities
(American Dental Association, 2020a, 2020b, 2020c, 2020d; Center
for Disease Control & Prevention, 2020; D’Amico et al., 2020; Dave
et al., 2020; Grossman et al., 2020; Ren et al., 2020), leading to the
sustained impairment of dental care. Also, people may end up ignor-
sing signs of worsening of the dental clinical picture or avoid seeking
treatment even in case of urgency, trying to self-manage their symp-
toms (Guo et al., 2020; NHS Education for Scotland, 2020; Yakubov
et al., 2020), whether by a self-imposed effort to stay at home or
by government impositions of confinement (Guo, Zhou, et al., 2020;
Yakubov et al., 2020). This behavior can lead to a rapid progression
of untreated diseases (American Dental Association, 2020c, 2020d),
causing serious late complications (Dave et al., 2020; Yakubov et al.,
2020), increasing the costs and complexity of future treatments
(American Dental Association, 2020c). This scenario indicates the
importance of studying how populations are dealing with dental
problems in the context of pandemic and social restriction, espe-
cially toothache that is the main cause of dental urgency (American
Dental Association, 2020e).

People with toothache tend to search the Internet seeking for
ways to deal with their pain, such as medication or home solutions. In
this sense, the use of digital and computational Big Data can be help-
ful in understanding impacts caused by COVID-19 (Bragazzi et al.,
2020), enabling the identification of requirements and concerns of
people in distinct communities (Ahlwardt et al., 2014; Cohen et al.,
2008; Cruvinel et al., 2019; Lotto et al., 2017, 2019). Thus, knowing
the current profile of interest of Internet users on toothache would
allow identifying and anticipating the dental needs presented by
the population, in addition to developing health policies and strat-
eggies capable of meeting these demands in the pandemic and post-
pandemic scenarios.

Therefore, the aim of this study was to evaluate the relation-
ship of social restriction measures after the outbreak of COVID-19
pandemic with the volume of searches on toothache-related digital
information in distinct countries. We hypothesized that social re-
striction favors the increase of searches for digital contents toward
self-resolution of dental pain.

2 | MATERIALS AND METHODS

2.1 | Study design

This longitudinal retrospective ecological study evaluated the
toothache-related computational metadata of 21 countries using the
Google Trends. The relative search volume (RSV), the rising and main
related queries were obtained from the topic “Toothache – Disease”
between May 2018 and April 2020. The Years Lived with Disability
(YLDs), Stringency Index (SI), and Google market share were also
determined in each country. The collected data were analyzed qual-
itatively and quantitatively. All data were stored in an open data re-
pository (Rizzato et al., 2021).

2.2 | Countries selection

The countries were selected according to the inclusion crite-
ria: a) at least 50 million inhabitants with 50% of Internet pen-
etration (Hootsuite, 2020), b) available data on Oxford COVID-19
Government Response Tracker (OxCGRT) platform, and c) suffi-
cient accessible data on Google Trends. According to those aspects,
21 countries were included in this study, as follows: Brazil (BRA),
China (CHI), Colombia (COL), Egypt (EGY), France (FRA), Germany
(GER), India (IND), Indonesia (INA), Iran (IRA), Italy (ITA), Japan (JAP),
Mexico (MEX), Philippines (PHI), Russia (RUS), South Africa (RSA),
South Korea (KOR), Thailand (THA), Turkey (TUR), United Kingdom
(GBR), United States (USA) e Vietnam (VIE).

2.3 | Search volume trends

The RSV indicates the proportion between the search volume of a
specific query by the volume of overall queries performed by users
on Google Search, normalized by the maximum value observed in a
timeline (RSV = 100) and presented on a weekly or monthly basis.
The results can be filtered by period, source, location, and category.

On May 11, 2020, the RSV values were collected for each coun-
try between May 2018 and April 2020. These data resulted from the
search by the topic “Toothache – Disease”, including “web search”
and “all categories”. The function “topic” is based on automatic algo-
rithms provided by Google Trends.

2.4 | Top and rising queries

Google Trends also provides a list of top and rising queries, indicating
the main terms that were searched by users interested in a particular
issue. Queries marked as “breakout” stand out once they show an
exponential increase, probably because they are new or previously
there was little or no demand for them.

A list of top and rising queries related to “Toothache – Disease”
was obtained for all countries from May 2018 to April 2020. Then,
the main queries were classified according to the type of information
(“cause/symptom” or “treatment/self-resolution”) and home reme-
dies usage (“yes” or “no”).

2.5 | Stringency index

Oxford COVID-19 Government Response Tracker is an initiative of
the Blavatnik School of Government, University of Oxford (Hale
et al., 2020). This project aims to study the evolution of policies and special measures adopted by governments of several countries after the outbreak of COVID-19. Through data collected and updated in real-time, the developed indexes allow evaluating the extent of government responses in the pandemic period. They are based on 17 indicators that include closure and containment measures, as well as economics and health aspects.

One of these indices is called the Stringency Index (SI), which evaluates the extent and degree of the restrictive order measures, ranging from 0 to 100. It is composed of 1 indicator related to health, which evaluates the existence of public information campaigns on COVID-19, and another 8 related to closure and containment, as follows: a) school closing, b) workplaces closing, c) cancel public events, d) restrictions on gatherings, e) close public transport, f) stay at home requirements (SHR, scores 0–3), g) restrictions on internal movement (RIM, scores 0–2), and h) international travel controls.

On May 12, 2020, the daily scores of SI, SHR, and RIM were collected for each country from January 01, 2020 (since data started to be presented in OxCGRT) to May 02, 2020. Then, mean of SI and medians of SHR and RIM were calculated for each country weekly.

2.6 | YLDs

The YLDs indices for untreated caries in permanent teeth were compiled from the results of the project Global Burden Disease (Institute for Health Metrics & Evaluation, 2017). The data covered the period from 2013 through 2017, considering both genders and all ages.

2.7 | Google market share and internet penetration

The Google market share was retrieved from Search Engine Market Share data, available on StatCounter GlobalStats website (StatCounter GlobalStats, 2020). The Internet penetration of countries was collected from the digital global report of 2020 (Hootsuite, 2020).

2.8 | Data analysis

Data were analyzed with the Statistical Package for Social Sciences (version 21.0; SPSS, Chicago, IL, USA), as follows:

1. The curves of observed RSV values were analyzed heuristically, and the percentage of variation of RSV values was calculated regarding a month (30 days) before and after the beginning of social restriction (SI>0).
2. The normality and homogeneity of data were assessed by Shapiro–Wilk and Levene tests, respectively.
3. Pearson’s cross-correlation test was applied to detect the relationship between the weekly variation of RSV and SI for each country.
4. Spearman cross-correlation test was applied to detect the relationship of the weekly variation of RSV with SHM and RIM for each country.
5. t-Student test was applied for comparisons of RSV, SHR, and Google market share (parametric analysis), while the Mann–Whitney U test was applied for comparison of RIM, SI, YLDs, and Internet penetration (non-parametric) between country-based groups, which were dichotomized according to the cross-correlation between RSV and SI (r<0.6 and r≥0.6), and the percentage variation of RSV values (≤20% and >20%).
6. The differences in the distribution of the main toothache-related queries according to distinct categories were evaluated between distinct countries by Pearson’s Chi-square test.

For all analyses, p values <0.05 were considered statistically significant.

3 | RESULTS

Figure 1 shows the curve of monthly variation of toothache-related digital searches worldwide from May 2018 to April 2020. From the beginning of the social restriction (SI>0), it was observed a sudden and unequivocal trend of increase of RSV values.

Figure 2 depicts the percentage variation of toothache-related interest of Google users from each country before and after the beginning of restrictive measures. From this analysis, it was observed an increase in toothache-related searches in most countries and worldwide, except for Japan.

Table 1 presents the cross-correlations between RSV and social restriction indices (SHR, RIM, and SI) for each country. A positive cross-correlation ≥0.6 of RSV with all restriction indices was detected in Brazil, Egypt, India, Iran, Philippines, South Africa, Thailand, Turkey, the United Kingdom, and the United States. RSV values from South Korea were positively cross-correlated with SHR and RIM (r≥0.6). Indonesia and Vietnam presented a positive cross-correlation ≥0.6 only between RSV and SHR. Germany was the only country that showed a negative cross-correlation ≥0.6 between RSV and restriction indices. The other countries showed moderate or low cross-correlations between RSV and restriction indices. The differences in the distribution of the main toothache-related queries according to distinct categories were evaluated between distinct countries by Pearson’s Chi-square test.

Table 4 shows the distribution of main toothache-related queries according to distinct categories. In general, the terms were mostly
associated with treatment and self-resolution of toothache, with the observation of a common interest in home remedies to relieve dental pain.

4 | DISCUSSION

In this study, we investigated whether social restriction could influence people’s behaviors in searching for toothache-related contents on the Internet, regarding the first months of the pandemic period. In general, the volume of searches increased after the beginning of restriction measures, except for Japan. Interestingly, the group of countries with cross-correlation $\geq 0.6$ between RSV and SI, and those with RSV variation $\leq 20\%$ presented statistically higher RSV values than other countries. In addition, people preferably conducted their searches for seeking information on self-resolution of toothache, commonly interested in homemade alternative methods, with a sudden growth of searches combining toothache and COVID-19 over time.
### TABLE 1  Cross-correlations between Relative Search Volume (RSV) for toothache-related information and social restriction measures

| Countries   | Stay at home | Restrictions on internal movement | Stringency index |
|-------------|--------------|-----------------------------------|------------------|
| Brazil      | 0.73 (0.027)* | 0.73 (0.027)* | 0.79 (0.011)*    |
| China       | −0.04 (0.889) | 0.23 (0.421) | 0.07 (0.807)     |
| Colombia    | 0.57 (0.027)* | 0.57 (0.027)* | 0.43 (0.113)     |
| Egypt       | 0.61 (0.144)  | 0.61 (0.144) | 0.63 (0.133)     |
| France      | 0.50 (0.060)  | 0.50 (0.060) | 0.46 (0.086)     |
| Germany     | −0.70 (0.004)* | −0.60 (0.019)* | −0.64 (0.011)*   |
| India       | 0.92 (0.001)* | 0.96 (0.001)* | 0.98 (0.001)*    |
| Indonesia   | 0.63 (0.006)* | 0.54 (0.024)* | 0.52 (0.034)*    |
| Iran        | 0.84 (0.001)* | 0.78 (0.005)* | 0.69 (0.019)*    |
| Italy       | 0.35 (0.200)  | 0.20 (0.483) | 0.44 (0.103)     |
| Japan       | −0.23 (0.369) | −0.23 (0.369) | −0.31 (0.225)    |
| Mexico      | −0.25 (0.495) | −0.24 (0.499) | −0.14 (0.697)    |
| Philippines | 0.87 (0.001)* | 0.87 (0.001)* | 0.92 (0.001)*    |
| Russia      | 0.13 (0.657)  | 0.04 (0.903) | 0.07 (0.804)     |
| South Africa| 0.82 (0.001)* | 0.80 (0.001)* | 0.84 (0.001)*    |
| South Korea | 0.64 (0.014)* | 0.64 (0.014)* | 0.54 (0.045)*    |
| Thailand    | 0.83 (0.006)* | 0.90 (0.001)* | 0.82 (0.006)*    |
| Turkey      | 0.89 (0.001)* | 0.89 (0.1)* | 0.88 (0.001)*    |
| United Kingdom | 0.85 (0.001)* | 0.85 (0.001)* | 0.88 (0.001)*    |
| United States | 0.60 (0.030)* | 0.60 (0.030)* | 0.60 (0.032)*    |
| Vietnam     | 0.62 (0.014)** | −0.11 (0.709) | 0.43 (0.109)     |
| Worldwide   | 0.23 (0.001)* | 0.28 (0.001)* | 0.25 (0.001)*    |

Note: *p* values are presented between brackets. Asterisks represent significant correlations (*p* < 0.05).

### TABLE 2  Mean (±SD), median (IQR) and *p* value of Relative Search Volume (RSV), Stay at Home, Restrictions on Internal Movement, Stringency Index, Years Lived with Disability (YLDs), internet penetration and Google market share according to distinct criteria of dichotomized country groups

| Criteria                           | Correlation | RSV variation (%) | p       | RSV variation (%) | p       |
|------------------------------------|-------------|-------------------|---------|-------------------|---------|
|                                    | <0.6        | ≥0.6              |         | ≤20%              | >20%    |         |
| Relative search volume (RSV)       | 60.01 ± 2.22| 72.33 ± 1.93      | <0.001  | 67.62 ± 23.69     | 60.86 ± 21.89 | 0.022  |
| Stay at home (SHR)                 | -           | -                 | 0.705   | 0.00 (2.00)       | 1.50 (2.00) | 0.808  |
| Restrictions on internal movement (RIM) | -           | -                 | -       | -                 | -       | -      |
| Stringency index (SI)              | 45.88 ± 2.89| 49.82 ± 3.12      | <0.918  | 47.96 ± 11.01     | 50.75 ± 11.60 | 0.496  |
| Years lived with disabilities (YLDs)| 48.69 (61.45)| 56.50 (68.46)   | 0.705   | 44.84 (19.68)     | 49.01 (10.99) | 0.934  |
| Internet penetration               | 30.42 ± 3.01| 24.43 ± 2.69      | <0.097  | 27.09 ± 7.55      | 27.28 ± 11.42 | 0.934  |
| Google market share                | 29.90 (15.22)| 21.54 (15.23)   | 0.251   | 25.22 (11.63)     | 25.45 (20.99) | 0.934  |
|                                    | 79.40 (4.20)| 69.50 (4.40)      | 0.705   | 79.33 ± 13.67     | 68.44 ± 12.32 | 0.934  |
|                                    | 81.50 (24.50)| 68.50 (17.25) | 0.197   | 82.00 (25.50)     | 69.00 (20.00) | 0.191  |
|                                    | 78.54 ± 9.47| 94.98 ± 1.55      | 0.197   | 80.96 ± 30.46     | 92.20 ± 14.12 | 0.422  |
|                                    | 92.47 (25.69)| 97.17 (6.63)   | 0.115   | 92.95 (20.47)     | 96.99 (4.11) | 0.422  |

*Means and standard deviations are not showed since SHR and RIM are represented by ordinal scales (non-parametric measures).
According to the aim of this study, we selected 2 components of SI that indicates more specifically the level of social constraint, to characterize the difficulties of people in seeking for dental treatment. In this context, the fact that most countries presented at least SHR and RSV correlated moderately (>0.4) demonstrates the relationship between the restriction measures and the interest in toothache-related digital information, since the indicator refers to the degree which people were required to stay at home. The results

| Toothache (Topic) | Region | Queries | Region | Queries |
|------------------|--------|---------|--------|---------|
| Worldwide        | Toothache coronavirus | Philippines | Celecoxib | |
|                  | Toothache spray medicine | | Acupressure for toothache | |
|                  | Home remedy for inflamed tooth pain | Russia | How to remove toothache | |
| Brazil           | How to relieve toothache | | How to relieve toothache | |
|                  | Home remedy for inflamed tooth pain | Russia | How to remove toothache | |
| France           | How to calm a toothache | | How to reduce toothache | |
|                  | Toothache remedy | | Toothache plot | |
|                  | Toothache during pregnancy | Turkey | What is good for toothache | |
| Germany          | Toothache corona | | Prayer for tooth pain | |
|                  | Toothache during pregnancy | Turkey | What is good for toothache | |
| India            | Home remedies for toothache | | What is good for a toothache | |
|                  | Home remedies for toothache | | Toothache while fasting | |
|                  | Dental clinic near me | | Dicloflam | |
| Indonesia        | Cooling 5 | | What does toothache | |
|                  | Toothache spray | | Prayers that are good for toothache | |
|                  | Cooling 5 toothache medication | United Kingdom | Toothache during coronavirus | |
|                  | Toothache medicine spray | | What to do with toothache | |
|                  | Cooling toothache medicine 5 plus | | How to deal with toothache | |
|                  | Toothache medicine spray | | Broken tooth pain | |
|                  | Cooling 5 plus for toothache | | Toothache during lockdown | |
| Iran             | Immediate tooth removal | USA | Toothache coronavirus | |
|                  | Home remedy for toothache | | Home remedies for toothaches | |
|                  | What should be done for toothache? | | How to stop tooth pain fast | |
| Italy            | Home Toothache | | ICD code for tooth pain | |
|                  | Corona toothache | | What to do if your tooth hurts | |
| Japan            | Corona toothache | | How to stop a toothache fast | |
| Mexico           | Causes of toothache | | |
of THA, GER, and EGI showed some peculiarities. The abrupt increase of the interest in toothache-related contents observed in Thailand was linked to an unexpected relative decrease of search volume observed prior to the beginning of restrictions in the country. A possible explanation for this behavior could be the activity of Google users in seeking information on the outbreak of COVID-19 in China, which relatively reduced the significance of searches for other health conditions. In Germany, the negative correlation between restriction measures and search volume can be explained by the decision of the initial milestone of restriction measures in the countries, starting when SI>0, which occurred in the penultimate week of January 2020 with national campaigns warning about the virus. In this period, the SI values remained low with SHR and RIM components equal to zero, while the interest in toothache-related searches increased. As expected, the SI, SHR, and RIM increased after some weeks; however, the relative volume of searches for toothache decreased simultaneously, probably because an overinformed audience sensitized to concern about respiratory symptoms. Finally, Egypt was the only country that showed a positive correlation value higher than 0.6 without statistical significance, which can be attributed to the short-time range selected for data analysis.

The analysis of RSV variation indicates a general trend of increase of toothache-related searches over time, similarly with previous studies (Cruvinel et al., 2019; Kamiński et al., 2020; Lotto et al., 2017, 2019). The onset of restrictions seemed to accelerate this trend, leading to a sudden and significant increase in the volume of searches in most countries, which has also been observed by similar studies (Sofi-Mahmudi et al., 2021; Sycinska-Dziarnowska & Paradowska-Stankiewicz, 2020). With the onset of social and movement restrictions, thousands of people were confined to their homes, in-home offices, which stimulated the access to the Internet and social network for longer periods (Gottlieb & Dyer, 2020; Jo et al., 2020; Rathore & Farooq, 2020; Venegas-Vera et al., 2020). Moreover, in the initial months of the pandemic, little was known about the SARS-CoV-2 virus and its symptoms. This fact, combined with the overexposure of the individuals to media news (Gottlieb & Dyer, 2020; Rathore & Farooq, 2020; Venegas-Vera et al., 2020), contributed to generate a state of cyberchondria (Asmundson & Taylor, 2020; Sofi-Mahmudi et al., 2021), that is, people possibly associated their dental pain with COVID-19, as observed in the rising queries.

The populations that were already more accustomed to search for toothache-related information on the Internet intensified this behavior over the period of restriction measures. However, the activity also increased in countries with lower search volumes before COVID-19. These results seemed to be not influenced by the burden of untreated dental caries, Internet penetration, and Google’s market share, since these characteristics were similar in both country groups, which corroborate with the influence of social restriction measures in boosting online searches for toothache contents.

The increase observed in the volume of searches for toothache-related information probably was related to the increment of this

| Countries       | Searching information | Home remedies |
|-----------------|-----------------------|---------------|
|                 | Causes/Symptoms       | Treatment/Self-resolution | No | Yes |
| Brazil AB       | 230 (3.0%)            | 7330 (97.0%)   | 6820 (93.0%) | 510 (7.0%) |
| France B        | 0 (0%)                | 680 (100%)     | 0 (0%)       | 680 (100%) |
| Germany CD      | 320 (28.1%)           | 820 (71.9%)    | 0 (0%)       | 820 (100.0%) |
| India DE        | 210 (10.0%)           | 1900 (90.0%)   | 0 (0%)       | 1900 (100.0%) |
| Indonesia EF    | 340 (17.1%)           | 1650 (82.9%)   | 0 (0%)       | 1650 (100.0%) |
| Iran DE         | 210 (10.6%)           | 1780 (89.4%)   | 0 (0%)       | 1780 (100.0%) |
| Italy C         | 160 (25.4%)           | 470 (74.6%)    | 0 (0%)       | 470 (100.0%) |
| Japan EF        | 180 (75.0%)           | 60 (25.0%)     | 60 (100%)    | 0 (0%) |
| Mexico E        | 50 (2.2%)             | 2250 (97.8%)   | 0 (0%)       | 2250 (100.0%) |
| Philippines H   | 0 (0%)                | 1850 (100%)    | 0 (0%)       | 1850 (100%) |
| Russia I        | 380 (73.1%)           | 140 (26.9%)    | 0 (0%)       | 140 (100.0%) |
| South Africa J  | 0 (0%)                | 160 (100%)     | 0 (0%)       | 160 (100.0%) |
| Thailand LD     | 70 (10.9%)            | 570 (89.1%)    | 0 (0%)       | 570 (100.0%) |
| Turkey LD       | 370 (10%)             | 3320 (90.0%)   | 0 (0%)       | 3320 (100.0%) |
| United Kingdom K| 60 (3.6%)             | 1620 (96.4%)   | 0 (0%)       | 1620 (100.0%) |
| United States K | 490 (3.4%)            | 13990 (96.6%)  | 0 (0%)       | 13990 (100.0%) |
| Vietnam C       | 130 (28.3%)           | 330 (71.7%)    | 0 (0%)       | 330 (100.0%) |
| Worldwide LJ    | 0 (0%)                | 2950 (100.0%)  | 0 (0%)       | 2950 (100.0%) |

Note: Distinct superscript lowercase letters indicate significant statistical differences between countries in relation to the category of searching information, while distinct superscript uppercase letters indicate significant statistical differences between countries in relation to the home remedies usage.
symptom over time (Lotto et al., 2017). The state of pandemic and social restriction brought changes and new demands to the general population, such as the universalized scenario of fear and uncertainty before the disease, related psychosocial burden, changes in routine and daily habits, socioeconomic impacts, financial crisis, and decrease in family income (Matsuyama et al., 2021; Nicola et al., 2020; Perry et al., 2021). These factors may lead individuals to reschedule their priorities, triggering negligence in seeking treatment and oral health care (Aguirre et al., 2018; Alradhawi et al., 2020; Cruvinel et al., 2019; Lotto et al., 2017; Matsuyama et al., 2021), influencing people to try solving their problems by themselves, for instance, using home remedies as painkillers (Lotto et al., 2017, 2019).

It is noteworthy that the imposed restrictive and closing measures, the economic crisis and recession can amplify the previously existing barriers to dental care (Harrell et al., 2017; Matsuyama et al., 2021; United Nations, 2020; Watt, 2020). Problems related to urban mobility and transportation, lack of resources, difficult access to public and private dental care, unemployment, poverty, and social inequality are some of the difficulties that may have been aggravated with the imposition of restriction measures, service closure, and lockdown (Kawachi, 2020; Matsuyama et al., 2021; Perry et al., 2021; United Nations, 2020; World Health Organization, 2020). Faced with the intensification of these already existing barriers, the population would have a greater tendency to search the Internet for ways of self-resolution of toothache, especially in developing countries (United Nations, 2020), which presented significantly higher RSV values than developed ones (data not shown).

These findings are important to the encouragement and development of public policies focused on the production of quality health contents, avoiding misinformation, delays in treatment, inadequate palliative solutions, and irreversible damage (Fiorillo et al., 2020; Lotto et al., 2020; Lotto, Strieder, et al., 2020). In a situation of pandemic and confinement, it may be interesting to widely disseminate information about the opening and operation of available public dental emergency services. Similarly, it may be relevant to make available dental screening services or health care and information online or by phone (Beauquis et al., 2021; da Costa et al., 2020; Guo et al., 2020; Maret et al., 2020), solving questions, warning about the risk or ineffectiveness of home remedies, and determining the need for immediate face-to-face care in advance, reducing the flow of patients and the risk of contamination in dental clinics. The outbreak of a pandemic seems to lead to an increased demand for dental services (Bai et al., 2020), either due to the existence of a previously repressed situations or the emergence of new needs for oral health care in the populations. Thus, our results can contribute to health planning (Aguirre et al., 2018; Cruvinel et al., 2019; Lotto et al., 2017), since they indirectly indicate the burden imposed on dental services. Our study also seems to be useful for the identification of the interests and concerns about issues and themes related to dentistry, such as the observed desire to know about the existence of a relationship between toothache and COVID-19.

There are some aspects of this study that must be considered with caution. The data collected is limited to toothache-related searches performed in Google Search platform, not including unstructured data or other search engines; however, Google presents a market share above 90% in most countries (Sycinska-Dziarnowska & Paradowska-Stankiewicz, 2020). Also, it is still necessary to consider that data collected from Google Trends may be subjected to the interference from national policies that restrict free access to the Internet, as occurs in Thailand, China, Egypt, Iran, Russia, and Vietnam (Freedom House, 2020). The period considered for data collection, although short, allowed us to obtain a sufficient volume of information to generate relevant analysis for this field of knowledge. In fact, this interval was chosen to evaluate the primary impact of the pandemic context and social restrictions on people's search behavior. Moreover, although it is not possible to state categorically that people are seeking toothache-related information only when they are experiencing pain, previous studies demonstrated that those search trends were associated with national statistics related to the symptom (Lotto et al., 2017).

In conclusion, the restrictive measures imposed by governments of several countries due to coronavirus seemed to influence the increase of people's interest in toothache-related digital information in different countries, with a sudden increase of queries that combined the terms toothache and COVID-19. In general, the searches were mainly related to treatment and self-resolution of pain, frequently employing home strategies. These outcomes permit the identification of possible demands of populations for dental care services, that is, they assist in planning public health decisions, directing the development of specific policies and health educational contents to be applied during and after this pandemic period.

ACKNOWLEDGEMENTS
This study was supported by the Conselho Nacional de Desenvolvimento Científico e Tecnológico – CNPq (grant #133232/2019-0) and by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brasil (CAPES) (grant # 001).

CONFLICT OF INTEREST
None to declare.

AUTHOR CONTRIBUTIONS
Veridiana Lopes Rizzato: Conceptualization; Investigation; Methodology; Visualization; Writing-original draft. Matheus Lotto: Data curation; Formal analysis; Investigation; Methodology; Writing-review & editing. Natalino Lourenço-Neto: Writing-review & editing. Thais Marchini Oliveira: Writing-review & editing. Thiago Cruvinel: Conceptualization; Formal analysis; Investigation; Methodology; Project administration; Supervision; Writing-review & editing.

PEER REVIEW
The peer review history for this article is available at https://publons.com/publon/10.1111/odi.14012.
Jo, W., Lee, J., Park, J., & Kim, Y. (2020). Online information exchange and anxiety spread in the early stage of the novel coronavirus (COVID-19) outbreak in South Korea: Structural topic model and network analysis. *Journal of Medical Internet Research, 22*(6), e19455. https://doi.org/10.2196/19455

Kamiński, M., Loniewski, I., & Marlicz, W. (2020). “Dr. Google, I am in Pain”—Global Internet searches associated with pain: A retrospective analysis of Google Trends data. *International Journal of Environmental Research and Public Health, 17*(3), 954. https://doi.org/10.3390/ijerph17030954

Kawachi, I. (2020). COVID-19 and the ‘rediscovery’ of health inequities. *International Journal of Epidemiology, 49*(5), 1415–1418. https://doi.org/10.1093/ije/dya1159

Lotto, M., Aguirre, P. E. A., Lourenço-Neto, N., Cruvinel, A. F., & Cruvinel, T. (2020). Is the quality of toothache-related information published in Brazilian websites adequate to assist people in seeking dental treatment? *Oral Health & Preventive Dentistry, 18*(1), 301–309. https://doi.org/10.3290/j.ohpd.a44142

Lotto, M., Aguirre, P. E. A., Rios, D., Machado, M. A. A. M., Cruvinel, A. F. P., & Cruvinel, T. (2017). Analysis of the interests of Google users on toothache information. *PloS One, 12*(10), e0186059. https://doi.org/10.1371/journal.pone.0186059

Lotto, M., Aguirre, P. E. A., Strieder, A. P., Cruvinel, A. F. P., & Cruvinel, T. (2019). Levels of toothache-related interests of Google and YouTube users from developed and developing countries over time. *PeerJ, 7*, e7706. https://doi.org/10.7717/peerj.7706

Lotto, M., Strieder, A. P., Aguirre, P. E. A., Oliveira, T. M., Machado, M. A. A. M., Rios, D., & Cruvinel, T. (2020). Parental-oriented educational mobile messages to aid in the control of early childhood caries in low socioeconomic children: A randomized controlled trial. *Journal of Dentistry, 101*, 103456. https://doi.org/10.1016/j.jdent.2020.103456

Luo, M., Guo, L., Yu, M., Jiang, W., & Wang, H. (2020). The psychological and mental impact of coronavirus disease 2019 (COVID-19) on medical staff and general public – A systematic review and meta-analysis. *Psychiatry Research, 291*, 113190. https://doi.org/10.1016/j.psychres.2020.113190

Maret, D., Peters, O. A., Vayssie, F., & Vigarijos, E. (2020). Integration of telemedicine into the public health response to COVID-19 must include dentists. *International Endodontic Journal, 53*(6), 880–881. https://doi.org/10.1111/iej.13312

Matsuyama, Y., Aida, J., Takeuchi, K., Koyama, S., & Tabuchi, T. (2021). Dental pain and worsened socioeconomic conditions due to the COVID-19 pandemic. *Journal of Dental Research, 100*(6), 591–598. https://doi.org/10.1177/00220345211005782

NHS Education for Scotland (2020). *Management of Acute Dental Problems*. Scottish Dental Clinical Effectiveness Program. Retrieved from https://www.sdcnp.org.uk/published-guidance/acute-dental-problems-covid-19/

Nicola, M., Aksafi, Z., Sohrabi, C., Kerwan, A., Al-Jabir, A., Iosifidis, C., Agha, M., & Agha, R. (2020). The socio-economic implications of the coronavirus pandemic (COVID-19): A review. *International Journal of Surgery, 78*, 185–193. https://doi.org/10.1016/j.ijsu.2020.04.018

Perry, B. L., Aronson, B., & Pescoisolido, B. A. (2021). Pandemic precarity: COVID-19 is exposing and exacerbating inequalities in the American heartland. *Proceedings of the National Academy of Sciences of the United States of America, 118*(8), e2020685118. https://doi.org/10.1073/pnas.2006851118

Rathore, F., & Farooq, F. (2020). Information overload and infodemic in the COVID-19 pandemic. *The Journal of the Pakistan Medical Association, 70*(Suppl 3), S162–S165. https://doi.org/10.5455/JPMA.38

Ren, Y. F., Rasubala, L., Malmstrom, H., & Elav, E. (2020). Dental care and oral health under the clouds of COVID-19. *JDR Clinical and Translational Research, 5*(3), 202–210. https://doi.org/10.1177/2380084420294385

Rizzato, V. L., Lotto, M., & Cruvinel, T. (2021). Raw data of the manuscript: “Digital surveillance: The interests in toothache-related information after the outbreak of COVID-19.” Figshare. Collection. https://doi.org/10.6084/m9.figshare.c.5428572.v2

Sofi-Mahmudi, A., Shamsoddin, E., Ghasemi, P., Bahar, A. M., Azad, M. S., & Sadeghi, G. (2021). Association of COVID-19-imposed lockdown and online searches for toothache in Iran. *BMC Oral Health, 21*(1), 69. https://doi.org/10.1186/s12903-021-01428-z

StatCounter GlobalStats (2020). *Search Engine Market Share*. Retrieved from https://gs.statcounter.com/search-engine-market-share

Sycinska-Dziarnowska, M., & Paradowska-Stankiewicz, I. (2020). Dental challenges and the needs of the population during the Covid-19 pandemic period. Real-time surveillance using Google Trends. *International Journal of Environmental Research and Public Health, 17*(3), 8999. https://doi.org/10.3390/ijerph17128999

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

United Nations (2020). *World Economic Situation and Prospects*. Retrieved from https://www.un.org/development/desa/dpad/wp-content/uploads/sites/45/publication/WESP2021_FullReport-optimized.pdf

Venegas-Vera, A. V., Colbert, G. B., & Lerma, E. (2020). Positive and negative impact of social media in the COVID-19 era. *Reviews in Cardiovascular Medicine, 21*(4), 561–564. https://doi.org/10.31083/jrcm.2020.04.195

Vindegaard, N., & Benros, M. E. (2020). COVID-19 pandemic and mental health consequences: Systematic review of the current evidence. *Brain, Behavior, and Immunity, 89*, 531–542. https://doi.org/10.1016/j.bbi.2020.05.048

Vujicic, M., & Nasseh, K. (2014). A decade in dental care utilization among adults and children (2001–2010). *Health Services Research, 49*(2), 460–480. https://doi.org/10.1111/1475-6773.12130

Watt, R. G. (2020). COVID-19 is an opportunity for reform in dentistry. *Lancet, 396*(10249), 462. https://doi.org/10.1016/S0140-6736(20)31529-4

World Health Organization (2020). *Considerations for quarantine of individuals in the context of containment for coronavirus disease (COVID-19)*. Retrieved from https://www.who.int/publications/i/item/considerations-for-quarantine-of-individuals-in-the-context-of-containment-for-coronavirus-disease-(covid-19)

Yakubov, D., Ward, M., Ward, B., Raymond, G. F., & Paskhover, B. (2020). Opinion: An increase in severe, late dental complications might result from reliance on home dental remedies during the COVID-19 pandemic. *Journal of Oral and Maxillofacial Surgery, 78*(8), 1232–1233. https://doi.org/10.1016/j.joms.2020.05.016

How to cite this article: Rizzato, V. L., Lotto, M., Lourenço Neto, N., Oliveira, T. M., & Cruvinel, T. (2021). Digital surveillance: The interests in toothache-related information after the outbreak of COVID-19. *Oral Diseases, 00*, 1–10. https://doi.org/10.1111/odi.14012