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Digital surveillance: The interests in toothache-related information after the outbreak of COVID-19

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Abstract

Objectives: The aim of this ecological study was to analyze the relationship of social restriction measures and people's interest in searching toothache-related information on the Internet.

Materials and Methods: The following indicators Stringency Index (SI), Years Lived with Disability (YLDs) for untreated caries in permanent teeth, Google market share, Internet penetration, and relative search volume (RSV) for the Topic "Toothache" in Google Trends were determined for 21 countries with available data, from April 2018 to May 2020. Statistical analysis was performed using Mann–Whitney *U* test, *t*-Student test, Pearson's Chi-square test, and Spearman and Pearson's cross-correlation tests ($\alpha = 0.05$).

Results: Relative search volume values increased significantly after restriction measures in all countries, except for Japan. Higher RSV values were found among 11 countries that presented a cross-correlation between RSV and SI with $r \geq |0.6|$. The most common queries were linked to the treatment and self-resolution of toothache, with a sudden increase of searches that combined the symptom with COVID-19.

Conclusions: The interests in toothache-related digital information were associated with social restriction measures. These results allow the identification of dental demands of distinct populations, contributing to the planning of specific public health policies during and after the pandemic period.

KEYWORDS
coronavirus, COVID-19, dental pain, quarantine, social restriction, toothache

1 | 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 (protective 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 ignoring signs of worsening of the dental clinical picture or avoid seeking treatment even in case of urgency, trying to self-manage their symptoms (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, especially 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 helpful 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 strategies capable of meeting these demands in the pandemic and post-pandemic scenarios.

Therefore, the aim of this study was to evaluate the relationship 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 restriction 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 qualitatively and quantitatively. All data were stored in an open data repository (Rizzato et al., 2021).

2.2 | Countries selection

The countries were selected according to the inclusion criteria: a) at least 50 million inhabitants with 50% of Internet penetration (Hootsuite, 2020), b) available data on Oxford COVID-19 Government Response Tracker (OxCGRT) platform, and c) sufficient 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 country 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 algorithms 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 remedies 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 $r\geq|0.6|$), 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 ($r\geq 0.6$). 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 ($r<|0.6|$).

Table 2 presents the comparison of country-based groups according to dichotomized r values and percentage variation of RSV before and after the beginning of restriction (SI>0). Significant statistical differences were observed only for RSV values, with higher values found in countries with $r\geq|0.6|$ and ≤20% of RSV variation.

Table 3 summarizes the toothache-related queries with a sudden increase of interest over time. Queries combining toothache and COVID-19 were detected in Germany ("toothache corona"), Japan ("corona toothache"), the United Kingdom ("toothache during coronavirus", "toothache during lockdown"), the United States ("toothache coronavirus"), and worldwide ("toothache coronavirus").

Table 4 shows the distribution of main toothache-related queries according to distinct categories. In general, the terms were mostly

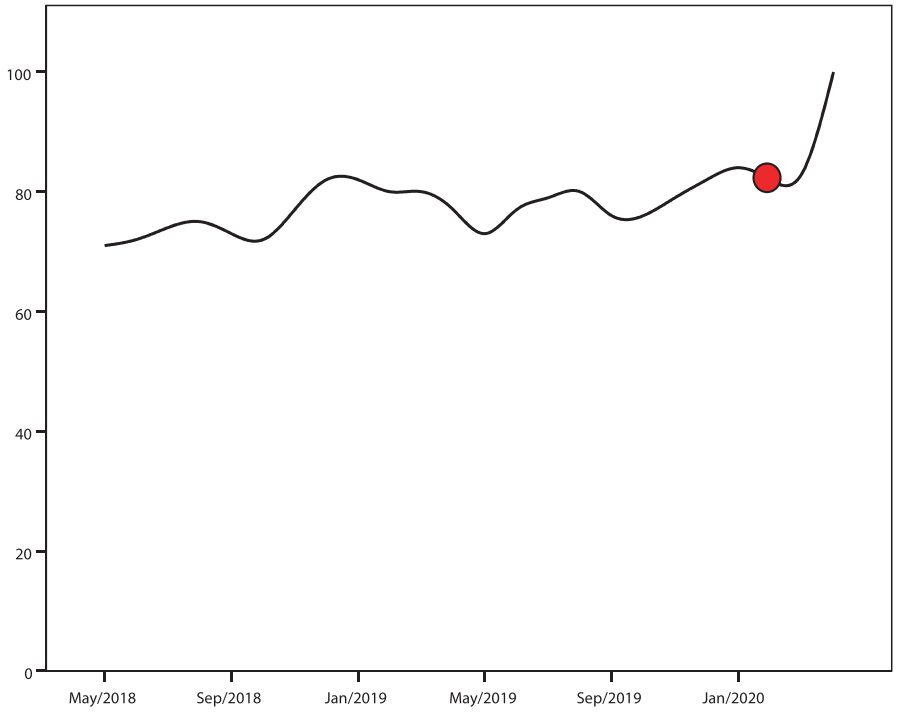

FIGURE 1 The variation of interest in toothache-related digital information worldwide from May 2018 to April 2020. The red point indicates January 20, 2020, when the social restriction started in China (SI>0)

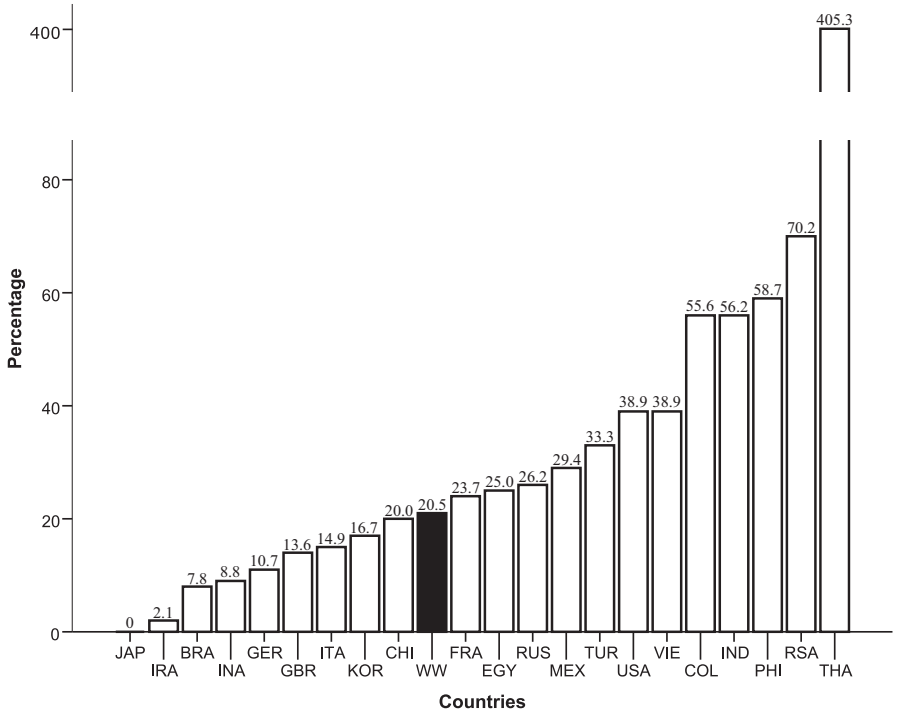

FIGURE 2 The percentage variation of toothache-related interest before and after the beginning of restrictive measures in each country

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 ≥ |0.6| between RSV and SI, and those with RSV variation ≤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

	Dichotomized groups					
	Correlation			RSV variation (%)		
Criteria	<0.6	≥0.6	*p*	≤20%	>20%	*p*
Relative search volume (RSV)	60.01 ± 2.22	72.33 ± 1.93		67.62 ± 23.69	60.86 ± 21.89	
	68.00 (34.50)	74.00 (34.75)	<0.001	75.00 (25.25)	62.00 (26.50)	0.022
Stay at home (SHR)	-[a]	-		-	-	
	0.50 (1.25)	1.00 (1.25)	0.705	0.00 (2.00)	1.50 (2.00)	0.808
Restrictions on internal movement (RIM)	-	-		-	-	
	1.00 (2.00)	1.25 (2.00)	0.918	1.00 (1.00)	0.75 (2.00)	0.754
Stringency index (SI)	45.88 ± 2.89	49.82 ± 3.12		47.96 ± 11.01	50.75 ± 11.60	
	48.69 (61.45)	56.50 (68.46)	0.705	44.84 (19.68)	49.01 (10.99)	0.496
Years lived with disabilities (YLDs)	30.42 ± 3.01	24.43 ± 2.69		27.09 ± 7.55	27.28 ± 11.42	
	29.90 (15.22)	21.54 (15.23)	0.251	25.22 (11.63)	25.45 (20.99)	0.934
Internet penetration	79.40 ± 4.20	69.50 ± 4.40		79.33 ± 13.67	68.44 ± 12.32	
	81.50 (24.50)	68.50 (17.25)	0.197	82.00 (25.50)	69.00 (20.00)	0.191
Google market share	78.54 ± 9.47	94.98 ± 1.55		80.96 ± 30.46	92.20 ± 14.12	
	92.47 (25.69)	97.17 (6.63)	0.115	92.95 (20.47)	96.99 (4.11)	0.422

[a]Means and standard deviations are not showed since SHR and RIM are represented by ordinal scales (non-parametric measures).

TABLE 3 Toothache-related queries that suddenly increased after the outbreak of coronavirus pandemic

Toothache (Topic)			
Region	**Queries**	**Region**	**Queries**
Worldwide	Toothache coronavirus	Philippines	Celecoxib
	Toothache spray medicine		Acupressure for toothache
			Natural remedy for toothache
Brazil	How to relieve toothache		
	Home remedy for inflamed tooth pain	Russia	How to remove toothache
			How to relieve toothache
France	How to calm a toothache		How to reduce toothache
	Toothache remedy		Toothache plot
			What to drink from toothache
Germany	Toothache corona		
	Toothache during pregnancy	Turkey	What is good for toothache
			Prayer for tooth pain
India	Home remedies for tooth ache		What is good for a toothache
	Home remedies for toothache		Toothache while fasting
	Dental clinic near me		Dicloflam
			What does toothache
Indonesia	Cooling 5		Prayers that are good for toothache
	Toothache spray		
	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
	Home Toothache		ICD code for tooth pain
			What to do if your tooth hurts
Italy	Zimox for toothache		How to ease a toothache
			Home remedies for teeth pain
Japan	Corona toothache		How to stop a toothache fast
Mexico	Causes of toothache		

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

TABLE 4 Distribution of the main toothache-related queries according to particular categories

	Searching information		Home remedies	
Countries	**Causes/Symptoms**	**Treatment/Self-resolution**	**No**	**Yes**
Brazil[a,A]	230 (3.0%)	7330 (97.0%)	6820 (93.0%)	510 (7.0%)
France[b,B]	0 (0%)	680 (100%)	0 (0%)	680 (100%)
Germany[c,C]	320 (28.1%)	820 (71.9%)	0 (0%)	820 (100.0%)
India[d,D]	210 (10.0%)	1900 (90.0%)	0 (0%)	1900 (100.0%)
Indonesia[e,E]	340 (17.1%)	1650 (82.9%)	0 (0%)	1650 (100.0%)
Iran[d,D]	210 (10.6%)	1780 (89.4%)	0 (0%)	1780 (100.0%)
Italy[c,C]	160 (25.4%)	470 (74.6%)	0 (0%)	470 (100.0%)
Japan[f,F]	180 (75.0%)	60 (25.0%)	60 (100%)	0 (0%)
Mexico[g,G]	50 (2.2%)	2250 (97.8%)	0 (0%)	2250 (100.0%)
Philippines[h,H]	0 (0%)	1850 (100%)	0 (0%)	1850 (100%)
Russia[f,I]	380 (73.1%)	140 (26.9%)	0 (0%)	140 (100.0%)
South Africa[i,J]	0 (0%)	160 (100%)	0 (0%)	160 (100.0%)
Thailand[d,D]	70 (10.9%)	570 (89.1%)	0 (0%)	570 (100.0%)
Turkey[d,D]	370 (10%)	3320 (90.0%)	0 (0%)	3320 (100.0%)
United Kingdom[a,K]	60 (3.6%)	1620 (96.4%)	0 (0%)	1620 (100.0%)
United States[a,K]	490 (3.4%)	13990 (96.6%)	0 (0%)	13990 (100.0%)
Vietnam[c,C]	130 (28.3%)	330 (71.7%)	0 (0%)	330 (100.0%)
Worldwide[j,L]	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.

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

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.

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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.

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