Artículo original

Exploratory Google Trends study of user concerns about oral problems

Estudio exploratorio de Google Trends de las preocupaciones de los usuarios sobre los problemas orales

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ABSTRACT

Introduction: More and more people search for health information on the internet and oral health is no exception.

Objective: To analyze the changes in the relative volumes of internet searches regarding the most common oral diseases and / or injuries according to the World Health Organization.

Methods: Google Trends was used to provide data on the volume of searches on Google for the most common terms of comparison based on diseases and / or oral injuries according to WHO. The period of time chosen was from 2004 to 2019. Five search terms were compared in relation to dental caries, periodontopathies, dental trauma, oral cancer, oral manifestations of HIV, noma, cleft lip and palate, tooth loss, toothache.

Results: The search volume measured during the 2004-2019 period, indicated that the comparative terms of higher relative search volumes were: “tooth decay” was the most searched in Jamaica, “gingivitis” in Paraguay, “broken tooth” in the United States, “mouth cancer” in the United Kingdom, “HIV symptoms” in Zimbabwe, “cancrum oris” and “cleft palate” in Ghana, “no teeth” in the United

States, “toothache” in Trinidad and Tobago. In the comparison of the five terms of higher relative search volumes in the study, "gingivitis" was the term with the highest relative search volumes.

Conclusion: The results obtained confirm the interest in oral diseases and / or injuries through the internet, the search term with the highest frequency of search was "gingivitis", followed by "cleft palate", "tooth decay", "no teeth" and for "broken tooth".

Keywords: Dental Informatics; internet; oral health; social epidemiology.

RESUMEN

Introducción: Cada vez más personas buscan información sobre salud en internet y la salud oral no es una excepción.

Objetivo: Analizar los cambios en los volúmenes relativos de búsqueda en internet respecto a las enfermedades y/o lesiones orales más comunes según la Organización Mundial de la Salud.

Métodos: Se utilizó Google Trends para proporcionar datos sobre el volumen de búsquedas en Google de los términos de comparación basados en enfermedades y/o lesiones orales más comunes según la Organización Mundial de la Salud. El periodo de tiempo elegido fue de 2004-2019. Se compararon cinco términos de búsqueda en relación a *dental caries*, *periodontopathies*, *dental trauma*, *oral cancer*, *oral manifestations of HIV*, *noma*, *cleft lip and palate*, *tooth loss*, *toothache*.

Resultados: El volumen de búsqueda medido durante el periodo 2004-2019 señaló que los términos comparativos de mayores volúmenes relativos de búsqueda fueron: “tooth decay”, el más buscado en Jamaica; “gingivitis”, en Paraguay; “broken tooth” y “no teeth”, en Estados Unidos; “mouth cancer”, en Reino Unido; “HIV symptoms”, en Zimbabue; “cancrum Oris” y “cleft palate”, en Ghana; “toothache” en Trinidad y Tobago. En la comparación de los cinco términos de mayores volúmenes relativos de búsqueda en el estudio, “gingivitis” ocupó el primer puesto.

Conclusión: Los resultados obtenidos confirman el interés por las enfermedades y/o lesiones orales a través del internet, el término de búsqueda con mayor frecuencia de búsqueda fue “gingivitis”, seguido de “cleft palate”, “tooth decay”, “no teeth” y por “broken tooth”.

Palabras clave: informática odontológica; internet; salud bucal; epidemiología social.

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Introduction

Oral pathologies are the most common no communicable diseases worldwide according to the World Health Organization (WHO), since they occur at any stage of the person's life, causing pain, discomfort, social stigmatization, disfigurement and even death.[1] WHO studied the global burden of oral diseases in 2016, reporting that it affects more than half of the world's population (3580 million people) and permanent tooth decay is the most prevalent disorder of all those considered.[2] It is estimated that, around 2400 million people worldwide suffer from permanent tooth decay, and 486 million children suffer from tooth decay. Periodontopathies occur around 15 to 20 % of adults (35-44 years) and approximately 30 % of people between 65 and 74 are edentulous.[3]

The analysis of the global oral health situation shows that, to improve indicators with a promotional and preventive approach, "bottom-up" policies should be prioritized, promoting equity approaches in access and oral health benefits, such as water fluoridation and school health programs. Other strategies include the implementation of food policies, restriction of the availability of sugary drinks.[4,5]

The inclusion of the internet in the field of massive communication has generated a worldwide impact, people perform many activities under this platform, which include obtaining basic information on aspects of health, because, more and more people care about their state of health, the internet provides them a lot of information about any disease or aspect of public health. To the point that, in the computer community, we already talk about the "Dr. Google" and the informed patient, someone who does not comply with the doctor's diagnosis and seeks information on their own. This process is not only limited to the patient, it also includes health workers because allows them to strengthen competencies, unify diagnostic and treatment criteria, search for information and promote medical research.[6,7]

Google Inc. developed in 2004 a tangible tool to quantify the trends in the search, conducted by different geographic populations worldwide called Goggle Trends (GT©), can be useful in disease prevention, surveillance, planning and limitation. GT© turns out to be a reliable platform to quantify medical information on demand,[8] while dental problems are changing diseases over time and may vary in trends according to media releases.[9]

Therefore, this type of information should be investigated. The present study was conducted with the objective of investigating internet search trends related to oral diseases according to the WHO classification.

Methods

Observational, descriptive and retrospective study. An exploratory analysis was conducted on the volume of Google searches through GT (https://trends.google.com/trends/), which covered a period of 16 years (2004-2019), the search was conducted on January 2, 2020, choosing "all categories", "web search" and "all countries in the world". The search and comparison terms were based on the most common oral diseases and / or injuries according to the WHO: dental caries, periodontopathies, dental trauma, oral cancer, oral manifestations of HIV, noma, cleft lip and palate, tooth loss, toothache (Table 1).[10]

Table 1 - Relative search volumes of oral diseases

1. Dental caries	Dental decay, Dental caries, Tooth cavity, Tooth decay, Teeth decay
2. Periodontopathies	Periodontal diseases, Gum disease, Bleeding gums, Gingivitis, Periodontitis
3. Dental trauma	Dental trauma, Fractured teeth, Fractured tooth, Broken teeth, Broken tooth
4. Oral cancer	Oral cancer, Mouth cancer, Cancer of mouth, Cancer oral, Symptoms of oral cancer
5. Oral manifestations of HIV	Oral HIV, HIV from oral, AIDS from oral, HIV symptoms, AIDS symptoms
6. Noma	Noma disease, Cancrum Oris, Gangrenous stomatitis
7. Cleft lip and palate	Cleft lip, Cleft palate, Harelip, Cleft lip palate, Orofacial cleft
8. Tooth loss	Missing tooth, Edentulous, Missing teeth, Tooth loss, No teeth
9. Toothache	Dental pain, Toothache, Tooth pain, Teeth pain, Jaw pain

Results

When performing the comparative analysis of GT of the most common oral problems and / or injuries according to WHO, during the period of 16 years from January 2004 to December 2019. Figure 1 shows the dental comparative relative search volumes (RSV) caries, periodontopathies, dental trauma, oral cancer, oral manifestations of HIV, noma, cleft lip and palate, tooth loss, toothache.

In relation to the comparative terms: "dental decay", "dental caries", "tooth cavity", "tooth decay" and "teeth decay". The term with the highest RSV was "tooth decay", followed by dental decay, tooth cavity, tooth decay and teeth decay.

The comparative RSV of the search terms: "periodontal disease", "gum disease", "bleeding gums", "gingivitis", "periodontitis", where the highest RSV was obtained by the term "gingivitis" followed by "gum disease", then "periodontitis", "bleeding gums" and "periodontal disease".

When performing the comparative RSV of the search terms: “dental trauma”, “fractured teeth”, “fractured tooth”, “broken teeth”, “broken tooth”. The term with the highest RSV was broken tooth, followed by broken teeth, dental trauma, fractured tooth and finally fractured teeth.

The comparative RSV of the search terms: “oral cancer”, “mouth cancer”, “cancer of mouth”, “oral cancer” and “symptoms of oral cancer”, where the highest RSV was presented by “mouth cancer” followed by “oral cancer” and then “oral cancer”, followed by “cancer of mouth” and the lowest of all was “symptoms of oral cancer”.

Regarding the comparative RSV of the search terms: “oral hiv”, “hiv from oral”, “aids from oral”, “hiv symptoms”, “aids symptoms”, of which the search term most frequently was hiv symptoms, followed by aids symptoms, oral hiv, hiv from oral and by aids from oral.

When comparing the RSV of the search terms: “noma disease”, “cancrum oris”, “gangrenous stomatitis”, the term with the highest RSV was cancrum oris, followed by noma disease and gangrenous stomatitis.

In relation to the comparative RSV of the search terms: “cleft lip”, “cleft palate”, “harelip”, “cleft lip palate”, “orofacial cleft”, the one with the highest search was cleft palate, followed by cleft lip, cleft lip palate, harelip, orofacial cleft

Regarding the comparative RSV of the search terms: “missing tooth”, “edentulous”, “missing teeth”, “tooth loss”, “no teeth”, the one that obtained the largest search was no teeth, followed by missing teeth, tooth loss, missing tooth and by edentulous.

The comparative RSV of the search terms: “dental pain”, “toothache”, “tooth pain”, “teeth pain”, “jaw pain”, and the one with the highest search was toothache, followed by tooth pain, jaw pain, teeth pain and dental pain.

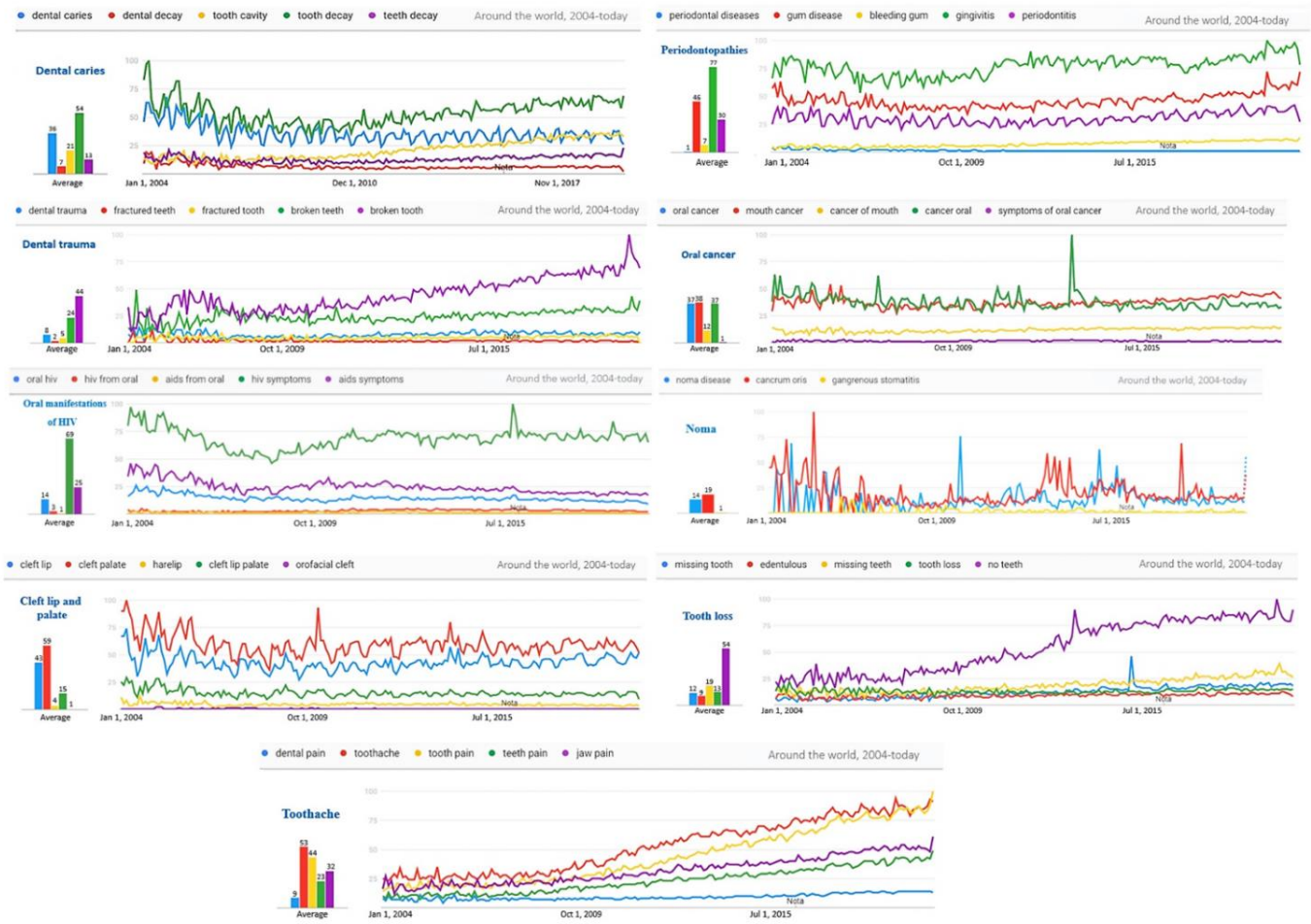

Fig. 1 - Comparative analysis of GT© of the most common oral problems and/or injuries according to the WHO.

Figure 2 illustrates the comparative graphs with respect to the five terms of highest RSV in the study. It should be noted that "Gingivitis" has the highest RSV followed by "cleft palate", then "tooth decay", followed by "no teeth" and broken tooth.

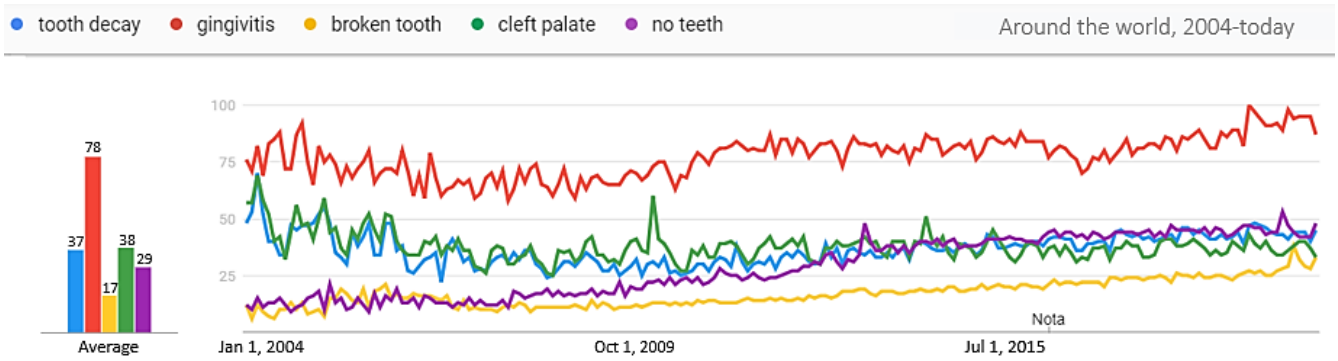

Fig. 2 - Search terms with higher RSV in relation to oral problems and/or injuries.

Figure 3 shows the graphs of comparisons by region of the search terms selected according to their RSV. As for "tooth decay" there were more searches in the European region, North America and Oceania. In "gingivitis" there was a greater search in North America, South America, Oceania and part of Africa. In relation to "broken tooth" was North America, part of Europe and Oceania. By "oral cancer" was South America and part of Europe and North America. Regarding "hiv symptoms" there was a higher search in North America, Oceania and part of Europe and Africa. In relation to the term "noma disease" part of North America and Oceania. In "cleft palate" there was a great predominance in all regions except Africa where there were fewer searches. In relation to toothache there were higher searches in part of Europe and part of South and North America.

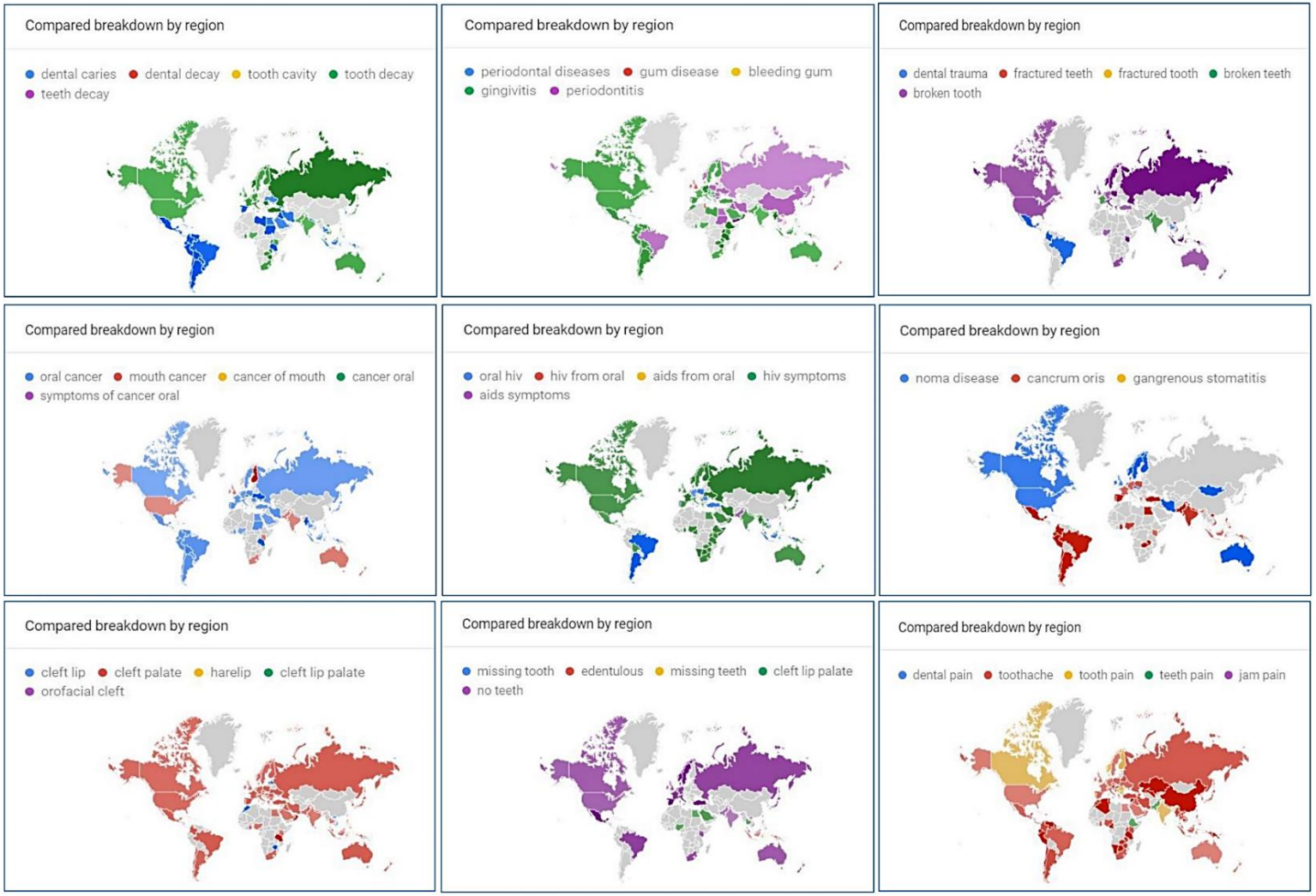

Fig. 3 - Comparisons between regions of the most common diseases and / or injuries according to WHO, through GT, 2004-2019.

Discussion

The present study is an exploratory analysis of the global search patterns on the most common diseases and/or injuries according to WHO. Oral diseases are the most common non communicable diseases, affecting more than half of the world's population.[10]

Dental caries is one of the dental pathologies with a global increase in its prevalence, which affects all age groups in general, independently of ethnicity, being more frequent at an early age, this may be associated with the food transition of humanity.[11] Our study showed that the search term "tooth decay" obtained the highest RSV, compared to the rest, differing from what was reported by *Aguirre et al*.[12] and *Patthi et al*.,[13] where the most frequent search term was "dental caries", it was also observed that the related terms were mainly the signs, symptoms and treatments of the disease, while the methods of promotion and prevention were not very welcome, this is because most people take interest about carious lesions when they are already suffering.[14] Something to note is reported by *Cruvinel et al*.,[15] they found a general tendency to decrease the search interests in GT© related to dental caries in most South American countries, except in Uruguay, Paraguay and Brazil where there was a progressive increase. In the present study, it was evidenced, that searches were higher in Singapore unlike *Strieder et al*.,[16] and *Harorli et al.*[17] where the search term "dental caries" was more frequent in Spain and the Philippines, respectively.

Periodontal diseases are frequent inflammatory conditions of the oral cavity that could cause tooth loss and contribute to the development of some systemic diseases such as diabetes mellitus, bacterial endocarditis, and others.[18] According to our study, it was observed that the search term "Gingivitis" obtained the highest RSV compared to the others, coinciding with reported by *Patthi et al*.[13] and differing with *Harorli et al.*[17] where "Gum disease" was the most common search term, with relatively higher searches in countries such as the United Kingdom, Ireland and New Zealand with terms related to symptoms and treatment.

In the present study it was observed that the search term with the highest RSV was "broken tooth" in comparison to the other search terms, coinciding with reported by *Patthi et al*.,[13] however, there were differences in the countries with the highest search, since in their study, the countries of the United Kingdom were the ones that showed the greatest interest unlike our research where the countries of Colombia, Mexico and Brazil were the countries with major internet searches. The prevalence of dental

injuries in recent years remains high, and among the causes, the violent sports activities, the degree of emotional activity and violence are acquiring a preponderant role.[18]

Oral cancer is one of the deadliest worldwide pandemics, the search for information on the Internet can help to understand better this disease to those who suffer it. It is estimated that the incidence of oral cancer worldwide is four cases per 100 000 people. Oral carcinogenesis is influenced by hereditary and environmental genetic mutations, mainly associated with the consumption of tobacco and alcohol.[19] In the present study, "mouth cancer" was the search term for the highest RSV, coinciding with *Murray et al*. [20] when they evaluate the search activity in Ireland; and differs with a study conducted by *Harorli et al*,[17] where it was observed that the term "oral cancer" was the most consulted search term, mostly in Indian cities, where oral cancers are the most common and they are especially related to tobacco consumption.[21] Something to note is, the increase in internet searches in relation to oral cancer, these findings may have exciting clinical implications, because, an increase in public awareness about oral cancer could result in an earlier diagnosis and a better prognosis.

The oral cavity plays a key role in the HIV/AIDS epidemic, since it is often the first clinical sign of the disease. There are about 40 variable oral manifestations of the disease that have been reported since the beginning of the AIDS epidemic.[22] In the present study it was observed that "hiv symptoms" was the most frequent RSV, being similar reported by *Patthi et al*.[13] It was found that African countries such as Kenya, Nigeria, Cameroon, Rwanda and Namibia showed greater search interest, the use of the internet can provide information about new tools to control HIV / AIDS as reported by *Mahroum et al*.[23]

Noma (cancrum oris) is a mutilating necrotizing disease that mainly affects children with malnutrition, infectious diseases, HIV and extreme poverty, and the African continent is most affected.[24] In the current search, "cancrum oris" is the search term with the highest RSV, followed by "noma disease" and "gangrenous stomatitis", and the countries with the greatest interest within Africa (Ghana, Egypt, Nigeria and Kenya), this attracts attention since the countries with the highest incidence are sub-Saharan countries like Niger, Nigeria, Senegal or Burkina Faso, this whole area is known as the "noma belt",[25] this may be due to the socioeconomic characteristics of most African countries, which is a barrier to access to information through the internet.

Oral clefts such as cleft lip and cleft palate are heterogeneous disorders that affect the lips and oral cavity, and occur independently (70 %) or as part of a syndrome that affects more than one in 1000

newborns all over the world.[26] The search term "cleft palate" was the one with the highest RSV, while the countries with the highest searches were Puerto Rico, Oman and Brunei, differing with *Patthi et al*.[13] where the Philippines and other Southeast Asian countries were the countries with the highest search pattern.

Dental caries and periodontopathies are the main causes of tooth loss. In the present study, "No teeth" was the search term with the highest RSV, which is supported by a study conducted by *Patthi et al*.,[13] tooth loss results in digestive, aesthetic problems, among others, so greater emphasis and awareness should be placed on the diagnosis, prevention and retention of dentition, than the use of dentures.[27,28]

Dental pain is defined as an orofacial pain originating in the tooth or in adjacent structures as a result of dental caries, periodontal disease, dental trauma, among others.[29] This dental pathology affects negatively, the quality of life of people, in the present study "toothache" was the search term with the highest RSV, which is supported by the studies of *Lotto et al*.[30] and *Harorli et al.,*[17] where they found, there is a growing interest in dental pain information, independently of the country, so it is suggested to use the internet as a source of data to propose focused health strategies in the possible consequences of an untreated dental pain or professional training to prescribe good quality information for patients and avoid the ineffective self-control of odontalgia.

In addition, the present investigation provided an idea of the five main search terms in GT© related to common oral problems that affect the world, it was observed that the term "Gingivitis" had the higher RSV in the entire search period, this indicates the concern and popularity surrounding gingival disease, because of its great impact on the overall burden of oral diseases.

The results obtained confirm interest in oral diseases and/or injuries through the internet, the search term most frequently was "gingivitis", followed by "cleft palate", "tooth decay", "no teeth" and "broken tooth". GT© is a useful tool that generates data on geographic and temporal patterns according to the search terms, however, the results obtained through GT© should not replace the epidemiological data obtained through fieldwork.

Limits

1. It is possible that the study does not have the assessment of people who transmit their oral health practices in a spoken way and not through the use of the internet, especially among rural populations, and it could cause an alteration in the results.

2. Many countries in the world are in the process of development or underdeveloped, since only 40 % of the world's population has access to the use of the Internet. Therefore, internet search trends can ignore the group of people who do not have this service.

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Conflict of interests

There authors declare no conflicts of interest.

Authors contributions

Christian Renzo Aquino-Canchari: Participated in conception and design of study, data collection, analysis and interpretation of data, critical revision, drifting and reviewed to the final manuscript.

Brenda Sofia Caira-Chuquineyra: Participated in desing of study, data collection, drifting and reviewed to the final manuscript.