Using Google Trends to Evaluate the Public Interest to Ocular Diseases and Symptoms during the COVID-19 Pandemic

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ABSTRACT

Purpose: To investigate the worldwide public interest to the keywords related to ocular diseases and symptoms using Google Trends (GT) during the COVID-19 pandemic.

Methods: GT analyzes the relative search volume (RSV) of the searched term in a specific time period and geographic location. GT provides to compare the RSVs of the searched terms in similar periods in different time intervals in specific region. In this study, the RSVs of the selected keywords related to ocular diseases and symptoms between 1st March to 31th June 2020 and 1st March to 31th June 2019 were accessed on GT and data were compared.

Results: It was detected that there were no differences in the RSVs of the keywords related to ocular diseases including amblyopia, diabetic retinopathy, macular degeneration, and eye infection ($p>0.05$ for all). It was determined that the RSVs of blepharitis, cataract, conjunctivitis, dry eye, glaucoma, strabismus significantly decreased and the RSVs of retinal detachment, uveitis, eye allergy significantly increased during the COVID-19 pandemic ($p<0.05$ for all). Also, there were no differences in the RSVs of the keywords related to ocular symptoms including blurred vision, eye pain, itchy eyes, and lazy eye ($p>0.05$ for all). It was noted that the RSVs of double vision, eye twitching significantly decreased and the RSVs of red eye increased during the COVID-19 pandemic ($p<0.05$ for all).

Conclusions: This study has demonstrated that the changes of the users' internet search activity for ocular diseases and symptoms during the COVID-19 pandemic according to the previous year.

Keywords: COVID-19, Google Trends, ocular sign, internet search, infodemiology

INTRODUCTION

In December 2019, a novel coronavirus was identified in Wuhan City, China and it has caused an outbreak which was named as coronavirus disease 2019 (COVID-19).[1] The outbreak has spread all over the world since then. At 11 March 2020, the World Health Organization (WHO) declared this outbreak as a pandemic.[2] Currently, more than 25.6 million cases of COVID-19 and more than eight thousand deaths have been reported worldwide.[3]

'Social distancing' and 'stay-home' precautions have been recommended by the authorities due to coronavirus which has been reported to be transmitted by direct contact or inhalation.[4] Also, lockdown has imposed in many countries. As a result of these policies implemented during the COVID-19 pandemic, the number of people applying to the hospital has reduced, especially for non-emergency situations. It is likely that many people have used internet searches for their diseases, symptoms or complaints during this time.

Furthermore, Internet search activity provides a window

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into the overall intensity and seasonal fluctuation in public interest in health topics. For instance, it was reported that internet search activity predicts influenza outbreaks before conventional reporting systems do.[5] During the COVID-19 pandemic, it has become more important to evaluate the health concerns of the public by examining internet search activities. Moreover, Google is the most popular search engine and is used in 75% of the Internet searches.[6] Google Trends (GT) is a website by Google that analyzes the popularity of top search queries in Google Search. The search volumes of GT are generally increased for conditions with higher social impact or for periods with higher disease burden.[7]

In the present study, we aimed to determine the effect of the COVID-19 pandemic on public interest in the ocular diseases and symptoms using GT and compare the data during COVID-19 pandemic with the data of the same period of the previous year.

MATERIALS AND METHODS

This study was approved by the Ethical Committee of Necmettin Erbakan University and adhered to the tenets of the Declaration of Helsinki (No: 2020/2769). Data on the frequency of the keywords that users search on google search were obtained from GT.[8] GT data does not show the total number of searches for a keyword. Instead, GT organizes search data to represent the popularity of a search in a specific time period and geographic location among other searches and it provides related search volume (RSV). Then data points are scaled from 0 to 100, based on the ratio of a topic to all searches on all topics.[9] The 100 score represents the highest level of popularity a given search can get within a selected location and time frame. Also, GT excludes repeated calls from the same person in a short time to prevent selection bias.

In addition, we have selected 20 keywords, considering the most common ocular diseases and symptoms (Table 1). Each keyword was entered in the main page of GT by using these filters: health (category), worldwide (location) and web search (search type). The resulting daily search interest datasets were downloaded. The RSVs of the keywords related to ocular diseases and symptoms between 1st March to 31th June 2020 (during COVID-19 pandemic) and 1st March to 31th June 2019 were obtained from GT. Both total and monthly (March, April, May, and June) RSVs of the keywords of two aforementioned periods were compared separately. Statistical analyses of the data were performed using the SPSS 20.0 software. Continuous variables with non-normal distribution were expressed as median (interquartile range). The Wilcoxon signed-rank test was used to compare the RSVs of the keywords between the periods of 2019 and 2020. A p value of less than 0.05 was considered statistically significant.

RESULTS

The RSVs of 20 selected keywords related to ocular diseases and symptoms are shown in Table 1. When the total RSVs of the keywords during COVID-19 pandemic compared with the previous year's data, it was determined that there were no significant differences in the total RSVs of the keywords related to ocular diseases including 'amblyopia', 'diabetic retinopathy', 'macular degeneration', and 'eye infection' between during COVID-19 pandemic and previous year (Table 1, p=0.395, p=0.254, p=0.455, and p=0.070, respectively). There were statistically significant increases in the total RSVs of the keywords of 'retinal detachment (RD)', 'uveitis', and 'eye allergy' during COVID-19 pandemic (Table 1, p<0.001 for all). In addition, statistically significant decreases were observed in the total RSVs of the keywords of 'blepharitis', 'cataract', 'conjunctivitis', 'dry eye', 'glaucoma', and 'strabismus' during COVID-19 pandemic (Table 1, p<0.001 for all).

When the monthly RSVs of the ocular diseases during COVID-19 pandemic compared with the previous year's data, it was observed that there were statistically significant increases in all months only in the keyword of 'uveitis' (Table 2, p<0.001 for all months). In addition, it was detected that there were statistically significant decreases in all months in the RSVs of the keywords of 'blepharitis' (p=0.004, p<0.001, p<0.001, p=0.006, respectively) and 'cataract' (p=0.001, p<0.001, p<0.001, p=0.002, respectively). Moreover, statistically significant decreases was noticed in the monthly RSVs of the keyword of 'conjunctivitis' after March during COVID-19 pandemic (Table 2, p<0.001, p<0.001, and p=0.001, respectively)

When the total RSVs of the keywords during COVID-19 pandemic compared with the previous year's data, it was determined that there were no significant differences in the

total RSVs of the keywords related to ocular symptoms including 'blurred vision', 'eye pain', 'itchy eyes', and 'lazy eye' (Table 1, p=0.650, p=0.133, p=0.187, and p= 0.096, respectively). In addition, during COVID-19 pandemic, statistically significant decreases were observed in the total RSVs of the keywords of 'double vision' and 'eye twitching' (p=0.001 and p<0.001). Also, statistically significant increase was noticed only in the total RSV of the keyword of 'red eye' compared to data of the previous year (Table 1, p<0.001).

When the monthly RSVs of the ocular symptoms during COVID-19 pandemic compared with the previous year's data, it was observed that there were statistically significant decreases in all months only in the keyword of 'eye twitching' (Table 2, p<0.05 for all months). Also, statistically significant increases was detected in the monthly RSVs of the keyword of 'red eye' after March during COVID-19 pandemic (Table 2, p<0.005, p<0.001, and p<0.001, respectively)

Table 1. *Total RSV values of the keywords related to ocular diseases and symptoms during the COVID-19 pandemic and in the same period of the previous year.*

Ocular Diseases Keywords	Mean (Interquartile Range)		p value	Ocular Symptoms Keywords	Mean (Interquartile Range)		p value
	2019	2020			2019	2020	
Amblyopia	41.5 (27)	44 (25.25)	0,395	**Blurred vision**	49.5 (15.25)	49 (17)	0,650
Blepharitis	64 (19)	47 (21)	**<0,001**	**Double vision**	59 (23.25)	52 (20)	**0,001**
Cataract	72 (17.25)	45 (24)	**<0,001**	**Eye pain**	74 (11)	74 (11)	0,133
Conjunctivitis	72 (18)	58.5 (16)	**<0,001**	**Eye twitching**	69 (13)	59.5 (14.25)	**<0,001**
Diabetic retinopathy	46 (26)	45 (19.25)	0,254	**Itchy eyes**	53 (20.25)	52 (22)	0,187
Dry eye	66 (12)	58 (13.25)	**<0,001**	**Lazy eye**	60 (18.25)	58.5 (19.25)	0,096
Glaucoma	64 (16.25)	51 (18)	**<0,001**	**Red eye**	64 (13.25)	71 (13)	**<0,001**
Macular degeneration	57 (21.25)	52 (16)	0,455				
Retinal detachment	46 (20)	54 (24.25)	**0,025**				
Strabismus	60 (20.5)	47 (17.25)	**<0,001**				
Uveitis	25 (11)	50 (16.25)	**<0,001**				
Eye allergy	44 (18.25)	61 (21)	**<0,001**				
Eye infection	60 (17)	64 (14)	0,070				

Data were expressed as median (interquartile range).
p: Statistical significance in the Wilcoxon signed-rank test (bold data were statistically significant results)

Table 2. *The monthly RSV values of the keywords related to ocular diseases and symptoms during the COVID-19 pandemic and in the same period of the previous year.*

Keywords	Mean (Interquartile Range)										
	March		p value	April		p value	May		p value	June		p value
	2019	2020		2019	2020		2019	2020		2019	2020	
Amblyopia	37 (39)	48 (36)	0,471	49 (19.5)	39 (21.75)	0,144	37 (27)	43 (21)	0,480	40.5 (25.75)	45.5 (27.75)	0,104
Blepharitis	66 (21)	43 (31)	**0,004**	65.5 (19.25)	45 .5 (21.75)	**<0,001**	67 (22)	47 (13)	**<0,001**	57 (14.5)	49 (17.75)	**0,006**
Cataract	75 (18)	54 (37)	**0,001**	73 (15.5)	33 (6.25)	**<0,001**	70 (18)	42 (12)	**<0,001**	68.5 (18.25)	61 (12.25)	**0,002**
Conjunctivitis	73 (13)	70 (12)	0,268	76.5 (20)	53.5 (14.5)	**<0,001**	68 (18)	55 (13)	**<0,001**	72 (20.75)	57.5 (8)	**0,001**
Diabetic retinopathy	42 (20)	44 (19)	0,965	54.5 (24.75)	40.5 (17)	**0,022**	50 (30)	46 (25)	0,217	39.5 (24.75)	52 (18.25)	0,153
Dry eye	70 (14)	54 (18)	**<0,001**	65 (12.5)	55 (13)	**<0,001**	67 (9)	60 (11)	**0,001**	64 (15)	60,5 (7.5)	0,387
Glaucoma	69 (23)	56 (40)	0,090	61.5 (13.5)	46 (8.25)	**<0,001**	64 (16)	51 (13)	**0,001**	61 (15)	63 (9.25)	0,918
Macular degeneration	61 (22)	49 (15)	**0,028**	60 (27.75)	43 (15.75)	**0,004**	57 (19)	52 (10)	0,243	53.5 (20.75)	58.5 (24.5)	0,102
Retinal detachment	46 (23)	52 (38)	0,294	48 (18.75)	49.5 (28)	0,629	44 (13)	52 (15)	**0,001**	47.5 (21.5)	66 (25.25)	**<0,001**
Strabismus	59 (25)	46 (17)	**0,003**	63 (30.25)	46.5 (15)	**<0,001**	60 (20)	47 (16)	**0,006**	56.5 (17)	57 (18.25)	0,323
Uveitis	25 (12)	47 (19)	**<0,001**	25.5 (10.25)	47.5 (8.5)	**<0,001**	27 (12)	54(15)	**<0,001**	24.5 (11.75)	56 (19.5)	**<0,001**
Eye allergy	37 (15)	51 (14)	**<0,001**	57 (16.75)	66.5 (22.25)	0,056	48 (13)	71 (21)	**<0,001**	40 (9.5)	57 (15.75)	**<0,001**
Eye infection	60 (18)	68 (9)	**0,002**	57 (15)	59.5 (12.25)	0,065	61 (23)	64 (15)	0,372	64.5 (15)	58 (14.75)	0,104
Blurred vision	55 (17)	52 (14)	0,455	49 (17.5)	45.5 (10.75)	**0,048**	50 (14)	50 (17)	0,378	45.5 (17.25)	51.5 (25)	0,425
Double vision	56 (26)	46 (20)	0,056	57.5 (23.25)	47 (19.5)	**0,006**	59 (19)	52 (19)	0,072	64 (25.25)	60 (13.25)	0,805
Eye pain	78 (12)	73 (14)	**0,041**	74 (10)	75 (8.5)	0,087	73 (15)	76 (12)	**0,039**	72 (10.5)	73 (13.5)	0,254
Eye twitching	72 (19)	66 (13)	**0,011**	69 (13.5)	55 (9.25)	**<0,001**	69 (13)	61 (15)	**0,005**	68 (12.75)	57 (15)	**0,001**
Itchy eyes	52 (23)	73 (36)	**<0,001**	55.5 (14.75)	60 (22)	0,446	45 (25)	51 (11)	0,170	58.5 (38.5)	43.5 (12.25)	**0,004**
Lazy eye	59 (20)	51 (20)	**0,012**	61.5 (17.25)	52 (13.25)	**0,038**	59 (19)	64 (22)	0,638	60.5 (21.75)	62 (26.5)	0,496
Red eye	67 (10)	71 (11)	0,100	66.5 (14.5)	69 (12)	**0,005**	61 (11)	72 (10)	**<0,001**	62 (16.25)	72 (12.25)	**<0,001**

Data were expressed as median (interquartile range).
p: Statistical significance in the Wilcoxon signed-rank test (bold data were statistically significant results)

DISCUSSION

Admission to the outpatient clinics of hospitals have decreased due to the stay-at-home policy implemented during the COVID-19 pandemic.[10] In addition, it was recommended to the ophthalmologists not to perform patient examinations and surgical interventions except in emergencies due to social distance could not be maintained during the patient examinations.[11] In a survey study conducted with ophthalmologists, it has been reported that the rate of completely stopped all clinical work during lockdown was 72.5% and the rate of the operations of ocular emergency cases was 81.8%. In that study, ophthalmologists stated that they felt the risk of encountering COVID-19 was higher during patient examination compared to other specialties.[12] Hence, many ophthalmology clinics have significantly reduced the number of patients during the COVID-19 pandemic.[13,14]

Web sites which are sources of information that the public can access online have become more important in lockdown. During the COVID-19 pandemic, social media and mass media brought up COVID-19 and its associated symptoms and diseases. Due to unprecedented circumstances, internet users have resulted in massive data collection on Web sites and consequently, infodemiologic studies have escalated in this period. Infodemiology is a new field of scientific research focusing on accessing data on the Internet for public health-related data.[15] Eysenbach first described it and it was aimed to improve public health by analyzing search queries on the Web sites.[15]

In recent studies which were used GT, it was reported that the RSVs of keywords related to COVID-19 such as 'anosmia', 'pneumonia', 'diarrhea' have increased during the COVID-19 pandemic but the RSVs of keywords not related to COVID-19 such as 'constipation', 'abdominal pain', and 'lung cancer' have decreased.[16-18] Beside this, it was observed that patients' interest in internet searches about their illnesses increased after the diagnosis.[19] In the present study, a significant decrease was observed in the keywords of 'blepharitis', 'cataract', 'dry eye' and 'strabismus' at almost all months. Due to none of blepharitis, cataract, dry eye and strabismus diseases are an ocular emergency, the examination of the patients and the diagnosis of these diseases may have decreased during the COVID-19 pandemic. The RSVs of the keyword of 'glaucoma' significantly decreased in April, May, and at the 4-month single period. Although it may be an ocular emergency situation, the decrease in the RSVs of the keyword of 'glaucoma' may be due to it is an ocular disease that progresses insidiously. Thus, the diagnosis of glaucoma couldn't be done and the interest of glaucoma may be decreased.

With the same hypothesis, we may think that the examination and treatment of ocular diseases that are included in the scope of emergency are carried out urgently. Both of uveitis and RD are important emergency ocular disorders and the RSVs of the keywords of 'uveitis' and 'RD' also increased in all months in our study. For this reason, internet searches of patients with uveitis or RD may have come to the fore compared to other non-emergency ocular diseases. In a study conducted at Moorfields Eye Hospital, it was reported that uveitis was the most common reason for patients to present to the emergency department between March and April 2020.[20] Compared to the period January-February 2020 and March-April 2020, it was reported that there was a decrease in both the total number of patients and the number of patients presenting with uveitis but the frequency of uveitis rose from the 3rd to the 1st place. In the same study, it was stated that the number of patients who applied with RD decreased but no information was given about the increase or decrease of the frequency of RD.[20] It has also been reported that uveitis isassociated with higher levels of psychological stress.[21] The frequency of uveitis may have increased due to the increase in psychological stress during the COVID-19 pandemic period. In the study of Kutlu[22], the public interest in search terms related to dermatologic disorders was evaluated using GT analyzes during the COVID-19 pandemic. In this study, it was reported that the RSVs of the keywords of 'acne' and 'hair loss' increased during this period and has emphasized that acne and hair loss were stress-related conditions.[22]

In addition, the RSVs of the keyword 'eye allergy' have also increased in all months in our study. In the study of Denier et al.[23] which has conducted with GT analysis, it was observed that the RSVs of allergy-related keywords in 4 different languages have increased during the COVID-19 pandemic. The authors claimed that this could be the result of the similarity between COVID-19 symptoms and allergy symptoms or it could be indicative of an aggressive 2020

allergy season combined with excessive screen time as a result of working from home.[23]

Moreover, conjunctivitis is known to be one of the ocular signs of the COVID-19.[24] Even, it was declared that conjunctival epithelium is another possible route for the transmission of coronavirus.[25] We should state that it is interesting that the RSVs of the keyword of 'conjunctivitis' have decreased in all months, in our study. Danieret al.[23] explained this outcome as the effect of the decrease in the spread of non-COVID-19 conjunctivitis factors with compliance with social distance rules and the closure of schools. Our proposition is that the relationship between conjunctivitis and COVID-19 may not emphasized enough in mass media. For instance, in the study of Panugantiet al.[18], it was reported that there was a significant increase in the RSV of anosmia after the publication of an article in the New York Times that drew attention to the relationship between anosmia and COVID-19. Indeed, this entity shows how effective mass media is on public interest. In addition, the increase in the RSVs of the keywords of "red eye" and "eye infection" which can be used more frequently by the public in defining conjunctivitis should also be taken into account. In addition, it should be taken into consideration that "red eye" is a symptom of uveitis and the RSVs of the keyword of 'uveitis' increased significantly in all months. Therefore, the RSVs of the keyword of "red eye" may have increased.

After all, we used GT to analyze available data outside of a clinic environment to investigate whether the public interest in search terms related to ocular diseases and symptoms during the COVID-19 pandemic but the present study has some limitations. The keywords analyzed in the present study represent a subjective trend towards terms related to ocular diseases and symptoms that internet users are predicted to search for widely on the internet. GT determines the RSVs of keywords according to their search frequency not the number of searches. For this reason, it is more logical to evaluate the change in the frequency of patients with the change in GT data. Therefore, the outcomes observed in the present study cannot be measured to determine the actual number of searches.

The data determined by GT are derived from a population sample and therefore it may not accurately represent the entire population of the area under investigation. It should also be noted that GT data may not cover the entire population as it is generated by a population that is literate, technologically proficient, has internet access, and has chosen Google as their internet search engine.

Nevertheless, the present study has a novel topic in its area and the outcomes of our study showed that some of the keywords related to ocular diseases and symptoms increased and some of them decreased when the data of internet search activity during the COVID-19 pandemic compared with the data of the same period of the previous year. Therewithal, prospective studies including real clinical data may be useful in terms of showing whether the incidence of these diseases with higher RSVs increases or not during the COVID-19 pandemic.

CONCLUSION

The underlying reasons for conducting an internet search are diverse and may include learning about individuals' symptoms, being aware of events happening around the world, searching for information for academic interests, or many other reasons. But, it should be stated that the internet has big data for researchers to investigate the internet search activity of the public, especially during the outbreaks. On this basis, this data may predict infectious diseases activity before real clinical data.

Indeed, the application of more advanced software may make this data more efficient and obtain specific information related to infectious diseases and it may enable authorities to respond to emergency situations quickly in epidemic diseases. Ultimately, it should be noted that infodemiologic studies will be the top research topics in the new era.

CONFLICT OF INTEREST

No conflict of interest was declared by the authors.

FINANCIAL DISCLOSURE

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