ORIGINAL ARTICLE

# Evaluation of websites reached using Google in the modern digital era related to approach to cholesterol

## Günümüz dijital döneminde Google üzerinden ulaşılan sitelerin kolesterol yaklaşımı açısından değerlendirilmesi

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## ABSTRACT

***Objective:*** The Google search engine is widely used as a source of medical information; however, legal and medical governance of the accuracy of the content retrieved is lacking. The aim of this study was to assess the most read Turkish-language texts related to cholesterol during a specific period according to the validity of the content.

***Methods:*** Google Trends was queried on January 5, 2019 for the search term "cholesterol" and the 9 other most popular search phrases used in Turkey that included the word cholesterol. In all, 100 links were obtained for each phrase, generating a total of 1000 links. Once duplicates were eliminated, a total of 604 links was used for the study. Since there is currently no validation scoring system for this purpose in the literature, the authors created a checklist according to well-accepted recent guidelines focused on cholesterol. The content of the texts acquired was classified as misleading, insufficient but favorable, or sufficient and favorable.

***Results:*** The source of the online texts studied was universities (n=8, 1.3%), hospitals (n=6, 0.9%), personal blogs (n=200, 33.1%), health websites (n=183, 30.2%), and medical journals (n=207, 34.2%). In all, 235 texts (38.9%) were classified as sufficient and favorable and 35 (5.7%) were categorized as misleading. A medical practitioner was named in 378 texts (62.5%). All of the results from universities and hospitals were ranked in the favorable group. A statistical difference in the word count was seen in a comparison of the misleading and favorable texts.

***Conclusion:*** Google can connect users to a significant quantity of material related to cholesterol that includes a wide range from misleading information to sufficient and favorable texts. The variation in the quality of the content on websites accessible via Google necessitates that cholesterol resource material should be selected with great care.

## ÖZET

***Amaç:*** Doğruluğu açısından herhangi bir yasal veya medikal uygulama ortaya koyulmamış olmasına rağmen, Google medikal konularda bilgi kaynağı olarak çok yaygın kullanılmaktadır. Çalışmamızın amacı içerik geçerliliklerine göre kolesterol konusunda çok okunan Türkçe yazıların değerlendirilmesiydi.

***Yöntemler:*** Google trends 5 Ocak 2019 tarihinde Türkiye'de 'kolesterol' ve kolesterol kelimesini içeren en popüler dokuz sözcük grubu açısından taratıldı. Her aratılan sözcük veya sözcük grubu açısından 100 adet bağlantı elde edildi ve sonuçta 1000 bağlantıya ulaşıldı. Bu ulaşılan bağlantılar oluşturduğumuz veri tabanında birden fazla yer alıyorsa silindi, tekrar sınıflandırıldı ve sonuç olarak 604 adet bağlantı çalışma grubunu oluşturdu. Bu amaçla literatürde herhangi bir skorlama sistemi yer almadığı için, yazarlar kolesterol konusuna odaklanan ve genel kabul gören son zamanlarda yayınlanmış rehberleri kullanarak kontrol listesi oluşturdu. Yazıların içerikleri yanlış yönlendiren, yetersiz ama uygun, yeterli ve uygun olarak sınıflandırıldı.

***Bulgular:*** Yazıların kaynakları şu şekildeydi: Üniversiteler n=8, %1.3, hastaneler n=6, %0.9, kişisel bloglar n=200, %33.1, sağlık internet siteleri n=183, %30.2, gazete kaynaklı yazılar n=207, %34.2. 235 yazı (%38.9) yeterli ve uygun olarak, 35 yazı (%5.7) yanlış yönlendiren olarak sınıflandırıldı. 378 yazıda (%62.5) tıbbi hekimlere yazının herhangi bir kısmında yer verildiği görüldü. Üniversite veya hastaneden yayınlanan yazılar uygun olan grupta sınıflandırıldı. Yanlış yönlendiren ve uygun olan yazılar arasında kelime sayısı bakımından istatistiksel olarak fark saptandı.

***Sonuç:*** Google kolesterol konusunda yanlış yönlendirenden uygun olana kayda değer sayıda yazıya bağlantı sağlamaktadır. Google ile ulaşılan sitelerdeki kolesterol ile ilişkili yazılarda kalite düşüklüğü okunacak yazıların çok ciddi özenle seçilmesi gerektiğini göstermektedir.

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Cholesterol management is a significant element of both primary and secondary prevention of vascular disease. When a reduction is achieved, particularly in total cholesterol and low-density lipoprotein (LDL) cholesterol levels, there is also a consistent and graded reduction in cardiovascular disease risk.[1,2] If improvement of the plasma lipid profile of a patient is a goal, lifestyle modification should be the first approach in order to reach target values. Lifestyle modification includes recommendations regarding dietary habits, physical activity, alcohol consumption, and smoking cessation.[3–5] Lipid-lowering drugs are an additional tool to reach the target, particularly if the improvement of the lipid profile is the sole purpose of the prescription. In Europe, it was recently documented that a majority of the population did not achieve their LDL targets.[6] Lipid profile awareness and management strategies should also be addressed seriously in Turkey in order to maintain the declining coronary heart disease mortality rates observed during the last decade.[7]

Analysis of Internet search data can provide valuable insights into population behavior. Low-cost accessibility has made the Internet a largely easily available source for healthcare information.[8] Google (Google LLC, Mountain View, CA, USA), one of the most popular search engines, is used for various health-related purposes, including expanding awareness of medical conditions and the prediction of infectious diseases, including influenza and dengue fever.[9–11] However, there is extremely limited regulation of the accuracy or appropriateness of the material available online. Therefore, informative texts, especially about common chronic diseases, such as hypertension, diabetes mellitus, and dyslipidemia, should be prepared very carefully since inaccurate website content could easily change public perception of an illness. The aim of this pilot study was to assess the quality of popular informative texts related to cholesterol on Turkish websites reached via Google.

## METHODS

On January 5, 2019, Google Trends was queried for the following search inputs: cholesterol, how to reduce cholesterol, signs of cholesterol, sign of cholesterol, what is cholesterol, what is good for cholesterol, what reduces cholesterol, reduce cholesterol, hypercholesterolemia, and what should cholesterol be. Phrases including the word cholesterol were determined to be the most popular related searches (compared with the term statin or phrases derived from statin, triglycerides or phrases derived from triglycerides, or lipid or phrases derived from lipid) and the most accessed texts by Google Trends in the 1 year period examined (January 5, 2018-January 5, 2019). The 10 most-searched phrases related to cholesterol and the monthly search volume were confirmed using the website https://app.neilpatel.com/en/ubersuggest. For this study, the 100 most frequently visited websites for each search phrase were accessed using Google, leading to a total group of 1000 websites for analysis (10 phrases x 100 websites) The following types of texts were excluded: non-Turkish language, non-educational in nature, and a topic not related to cholesterol. Websites that were duplicated in part or in full were treated as a single file for the analysis, yielding 604 websites in the final study group. In order to score the websites appropriately, texts of fewer than 200 words were also excluded. On the assumption that no user would search beyond the first 100 websites retrieved for a search term, only these pages were evaluated.

**Abbreviations:**

| | |
|---|---|
| *CI* | *Confidence interval* |
| *ICC* | *Intra-class correlation* |
| *LDL* | *Low-density lipoprotein* |

Two expert cardiologists (certified with Turkish board accreditation in cardiology) assessed each item separately and scored the material. Any discrepancies were resolved through consensus, and if consensus could not be reached a third expert cardiologist had the tie-breaking vote. All of the texts were read in full to confirm that they were related to cholesterol. It was noted if the name of any medical practitioner was mentioned or cited in the text. The websites were divided into 5 groups according to the source of the content: universities, hospitals, personal blogs, health websites and medical journals. The word count of each text was also calculated. As there is no validated scoring system designed to evaluate websites linked to cholesterol knowledge and insight that could be used for this purpose, the authors created a checklist and scoring system to assess the academic value of the content (Table 1). The authenticity of the information in the texts was verified using the latest European Society of Cardiology dyslipidemia guideline as the reference.[12] Each criterion on the checklist was scored 0: absent, 1: lacking but correct, 2: completely correct. The content of the texts was then classified as sufficient and favorable, insufficient but favorable, or misleading. Misleading

was defined inaccurate information in at least 1 criterion. Sufficient and favorable texts scored ≥8 points and those with <8 points were classified as insufficient but favorable. The mean of the total points was the score for the website text. The monthly search volume of the United States, United Kingdom, and Turkey for the most popular term in this study, the word cholesterol, is also presented for a comparison of search frequency. The density of search volume was calculated as searches per month/estimated population. The estimated population figure used was data on the website http://www.wikiwand.com/.

### Statistical analysis

The data were analyzed with IBM SPSS Statistics for Windows, Version 20.0 software (IBM Corp., Armonk, NY, USA). The normality of distribution was assessed using the Kolmogorov-Smirnov test. Continuous variables were defined as mean±SD or the median (interquartile range) for continuous variables that were not normally distributed. Categorical variables were presented as number and percentages. The mean differences between groups were compared using Student's t-test. The Mann-Whitney U test was applied for comparisons of data that were not normally distributed. Continuous variables were also compared using one-way analysis of variance models with the Tukey test for post hoc analyses. Categorical variables were compared using a chi-square test or Fisher's exact test, as appropriate. Statistical significance was defined as a p value of <0.05.

### Reproducibility

Intraobserver and interobserver variability were assessed by analyzing the intra-class correlation (ICC). An ICC value of ≥0.80 was considered excellent agreement. Intraobserver consistency was evaluated with a second analysis of the texts after 1 week. Two expert cardiologists assessed and scored each text separately in order to examine the interobserver variability. The intraobserver and interobserver reliability results for the checklist evaluation of the content were high: An ICC of 0.96 (95% confidence interval [CI]: 0.93–0.98) and 0.85 (95% CI: 0.80–0.91), respectively, was determined.

## RESULTS

This study examined and scored 604 texts that were found on widely read websites. The investigated material was generally classified as misleading or acceptable (Table 2). In the group of texts analyzed, 5.7% were categorized as misleading due to inaccurate information presented in least 1 evaluation criterion. The frequency of the mention of a medical practitioner in the text was statistically higher in the misleading texts when compared with the favorable texts (p=0.018). The source uploader subtypes and the word count of the texts were similar. The number of points awarded for valid information regarding treatment targets, body weight and physical activity, dietary recommendations related to lipid profile, and drugs for treatment of hypercholesterolemia was significantly higher in the favorable texts. (p=0.003, p=0.026, p=0.016, and p=0.011 respectively) After scoring, the website texts were divided into 3 groups: misleading, insufficient but favorable, sufficient and favorable (Table 3). There were 334 (55.2%) insufficient and favorable and 235 (38.9%) sufficient and favorable texts in the study group. The frequency of citing a medical practitioner was higher in misleading texts (p=0.059). The frequency of universities and hospitals as the source of the text was notably higher in the sufficient and favorable group (p=0.002 and p=0.009, respectively). The points granted for providing a definition of cholesterol and information related to laboratory lipid parameters, treatment targets, body weight and physical activity, dietary recommendations to improve the lipid profile, an alcohol cessation recommendation, a smoking cessation recommendation, and drugs used in treatment of hypercholesterolemia were all higher in the sufficient and favorable texts (p<0.001 for all). The features of the texts grouped according to the uploader/creator are presented in Table 4. The frequency of the inclusion of a named medical practitioner in the texts was higher in material sourced by universities and hospitals (p<0.001). The word count was significantly higher in the texts shared by universities (p=0.003). The total number of points obtained from the checklist was statistically higher in the texts uploaded by universities (p<0.001). Figure 1 illustrates a monthly search volume for the term cholesterol recorded in Turkey, the United Kingdom, and the United States. Calculation of the density of the search volumes revealed that the term cholesterol was searched more frequently in United Kingdom than in the United Stated and Turkey (Search density: 623, 414, and 277 respectively).

**Table 1. Checklist used to evaluate website content**

| Content evaluation checklist | Points | Expected content |
|---|---|---|
| Definition of cholesterol | 2:Completely correct<br>1:Lacking but correct<br>0:Absent | 2:Structural definition and reference to the cardio vascular risk of cholesterol<br>1:Only one of the above items<br>0:Absent |
| Definition of laboratory lipid parameters | 2:Completely correct<br>1:Lacking but correct<br>0:Absent | 2:Definition of lipid and lipoprotein analyses (TC, LDL-C, HDL-C) and their potential effect on CVS<br>1:Only one of the above items<br>0:Absent |
| Treatment targets (primary and secondary prevention) | 2:Completely correct<br>1:Lacking but correct<br>0:Absent | 2:Defintion of target LDL-C for cardiovascular disease primary and/or secondary prevention<br>1:Includes primary or secondary prevention<br>0:Absent |
| Body weight and physical activity | 2:Completely correct<br>1:Lacking but correct<br>0:Absent | 2:Definiton and effect of body weight and physical activity on lipid profile<br>1: Includes only body weight or physical activity<br>0:Absent |
| Dietary recommendations for lipid profile | 2:Completely correct<br>1:Lacking but correct<br>0:Absent | 2:Definiton and effect of dietary recommendations (items to be preferred/to be limited) on lipid profile<br>1: Includes only preferences or limitations<br>0:Absent |
| Alcohol recommendations | 2:Completely correct<br>1:Lacking but correct<br>0:Absent | 2:Potential effect of alcohol on lipid profile and recommendations about alcohol consumption<br>1: Includes only effect or recommendations about alcohol<br>0:Absent |
| Smoking cessation recommendations | 2:Completely correct<br>1:Lacking but correct<br>0:Absent | 2:Potential effect of smoking on lipid profile and recommendations about smoking<br>1:Includes only effect or recommendations about smoking<br>0:Absent |
| Drugs for treatment of hypercholesterolemia | 3: Completely correct for statins and other drugs<br>2: Completely correct for statins<br>1:Lacking but correct for statins<br>0:Absent for statins | 3:Definition of statins and at least one other lipid-lowering drug and their effect on lipid profile<br>2:The definition of statins and their effect on lipid profile<br>1:Includes the definition of statins or their effect of lipid profile<br>0:Absent |
| Total points available: 17 | Sufficient and favorable:<br>≥8 points<br>Insufficient but favorable:<br><8 points<br>Any incorrect recommendation<br>in the text ⇒ misleading | |

CVS: Cardiovascular system; HDL-C: High-density lipoprotein cholesterol; LDL-C: Llow-density lipoprotein cholesterol; TC: Total cholesterol.

**Table 2. Comparison of favorable and misleading texts according to baseline characteristics and points**

| | Misleading texts (n=35) | All favorable texts (n=569) | *p*-value |
|---|---|---|---|
| Medical practitioner mentioned | 20 (57.1) | 358 (37.1) | 0.018 |
| Uploader/creator | | | |
| Universities | 0 (0.0) | 8 (1.4) | NS |
| Hospitals | 0 (0.0) | 6 (1.1) | NS |
| Personal blogs | 12 (34.3) | 188 (33.0) | NS |
| Health websites | 12 (34.3) | 157 (27.6) | NS |
| Medical journals | 11 (31.4) | 194 (34.1) | NS |
| Word count | 568.0 (312.0–794.0) | 486.0 (344.0–722.0) | NS |
| Definition of cholesterol points | 2.00 (1.00–2.00) | 2.00 (1.00–2.00) | NS |
| Laboratory lipid parameters points | 1.00 (1.00–2.00) | 1.00 (1.00–2.00) | NS |
| Treatment target (primary and secondary prevention) points | 0.00 (0.00–1.00) | 1.00 (0.00–1.00) | 0.003 |
| Body weight and physical activity points | 1.00 (0.00–2.00) | 1.00 (0.00–2.00) | 0.026 |
| Dietary recommendations for lipid profile points | 1.00 (1.00–2.00) | 2.00 (1.00–2.00) | 0.016 |
| Alcohol cessation recommendations points | 0.00 (0.00–1.00) | 0.00 (0.00–1.00) | NS |
| Smoking cessation recommendations points | 0.00 (0.00–1.00) | 0.00 (0.00–1.00) | NS |
| Drugs for treatment of hypercholesterolemia points | 0.00 (0.00–0.00) | 0.00 (0.00–1.00) | 0.011 |
| Total points | 5.00 (4.00–8.00) | 7.00 (4.00–11.00) | 0.028 |

## DISCUSSION

Our study is the first research of its kind to evaluate the appropriateness and accuracy of information provided on Turkish websites reached via Google as a source of public information related to cholesterol. Our results revealed that the informative texts were rather heterogeneous, and 5.7% of the texts were classified as misleading. The total checklist score of the misleading texts was statistically lower than that of the favorable texts, which was primarily a result of points related to treatment targets, body weight and physical activity, dietary recommendations, and drugs for the treatment. University and hospital-based websites were the high scorers when compared with other website sources, which constituted the majority of the group.

Google's great potential comes from its design to facilitate and power research of any topic. Patients have been using search engines as a service hotline to learn more about disease for years. Wicks et al.[13] reported that data related to lithium use reported by amyotrophic lateral sclerosis patients led to the same conclusion regarding the medication's efficacy as later clinical trials. Google is a frequently used reference tool to expand knowledge about chronic diseases such as hypercholesterolemia, hypertension, and diabetes mellitus. Unfortunately, there is no fair benchmark in use to judge the accuracy of website texts on cholesterol. The quality of the content depends only on the uploaders' initiative. No adjudicatory enforcement has been performed to correct misleading texts and they continue to be read, despite presenting a danger to public health. A frustrating result of our research was the significantly higher frequency of a mention of a medical practitioner in misleading texts. Most of the misleading texts included inaccurate information about lipid-lowering drugs. Several studies have already reported that long-term use of statins in actual clinical practice settings is far from optimal.[14,15] The majority of patients who discontinue the use of statins have been reported to be aged <60 years.[16,17] Since patients aged <60 years are the primary age group to use the Internet more actively as a source of medical information, targeting improvement of the plasma lipid profile becomes even more difficult when misinformation must be countered, especially if the material is supported by professional colleagues, as seen in our results.[18]

**Table 3. Comparison of the insufficient but favorable, sufficient and favorable, and misleading texts according to baseline characteristics and points scored**

| | Misleading texts (n=35) | Insufficient but favorable texts (n=334) | Sufficient and favorable texts (n=235) | *p*-value |
|---|---|---|---|---|
| Medical practitioner mentioned | 20 (57.1) | 125 (37.4) | 86 (36.6) | 0.059 |
| Uploader/creator | | | | |
| Universities | 0 (0.0) | 0 (0.0) | 8 (3.4) | 0.002 |
| Hospitals | 0 (0.0) | 0 (0.0) | 6 (2.6) | 0.009 |
| Personal blogs | 12 (34.3) | 106 (31.7) | 82 (34.9) | NS |
| Health websites | 12 (34.3) | 95 (28.4) | 62 (26.4) | NS |
| JMedical journals | 11 (31.4) | 117 (35.0) | 77 (32.8) | NS |
| Word count | 568 (312–794) | 486 (344–722) | 496 (342–755) | NS |
| Definition of cholesterol points | 1.00 (1.00–2.00) | 1.00 (1.00–2.00) | 2.00 (2.00–2.00) | <0.001 |
| Laboratory lipid parameters points | 1.00 (1.00–2.00) | 1.00 (1.00–1.00) | 2.00 (1.00–2.00) | <0.001 |
| Treatment target (primary and secondary prevention) points | 0.00 (0.00–1.00) | 0.00 (0.00–1.00) | 1.00 (1.00–2.00) | <0.001 |
| Body weight and physical activity points | 1.00 (0.00–2.00) | 0.00 (0.00–1.00) | 2.00 (2.00–2.00) | <0.001 |
| Dietary recommendations for lipid profile points | 1.00 (1.00–2.00) | 1.00 (1.00–2.00) | 2.00 (2.00–2.00) | <0.001 |
| Alcohol cessation recommendations points | 0.00 (0.00–1.00) | 0.00 (0.00–0.00) | 1.00 (1.00–2.00) | <0.001 |
| Smoking cessation recommendations points | 0.00 (0.00–1.00) | 0.00 (0.00–0.00) | 2.00 (1.00–2.00) | <0.001 |
| Drugs for treatment of hypercholesterolemia points | 0.00 (0.00–0.00) | 0.00 (0.00–0.00) | 1.00 (0.00–2.00) | <0.001 |
| Total points | 5.00 (4.00–8.00) | 5.00 (4.00–6.00) | 11.0 (9.00–14.00) | <0.001 |

**Table 4. Comparison of the texts according to uploader/creator**

| | Universities (n=8) | Hospitals (n=6) | Personal blogs (n=200) | Health websites (n=183) | Medical journal (n=207) | *p*-value |
|---|---|---|---|---|---|---|
| Medical practitioner mentioned | 8 (100) | 6 (100) | 68 (34) | 74 (43) | 72 (35) | <0.001 |
| Misleading texts | 0(0.0) | 0(0.0) | 12 (6.0) | 12 (6.6) | 11 (5.3) | 0.885 |
| Word count | 1388.6±731.5 | 502.6±193.4 | 561.3±363.3 | 611.0±498.7 | 556.0±263.6 | 0.003 |
| Total points | 13.0±1.07 | 11.8±0.98 | 7.64±4.12 | 7.10±3.85 | 7.35±3.93 | <0.001 |

As expected, medical university and hospital-based websites host the most informative texts about cholesterol. If we want to achieve a better national lipid profile, there should be a considerable increase in the number and quality of websites and texts related to cholesterol in order to raise awareness with accuracy. A proper effort to address hypercholesterolemia should include appropriate lifestyle modifications and lifelong use of lipid-lowering drugs as an adjunct to those modifications when necessary.[19–21] Additional high quality material shared by authoritative sources such as universities and hospitals could help to use the power of search engines, as can easily be understood from our study. Also, national digital health committees can take responsibility for increasing the accuracy of the information shared in websites reached via Google and other search engines.[22] Search density differs by country, which may be a result of several factors, such as educational status, individual custom and practice, and Internet literacy and access. Thus, there is a need to establish customized national digital health committees. More research about the effect of

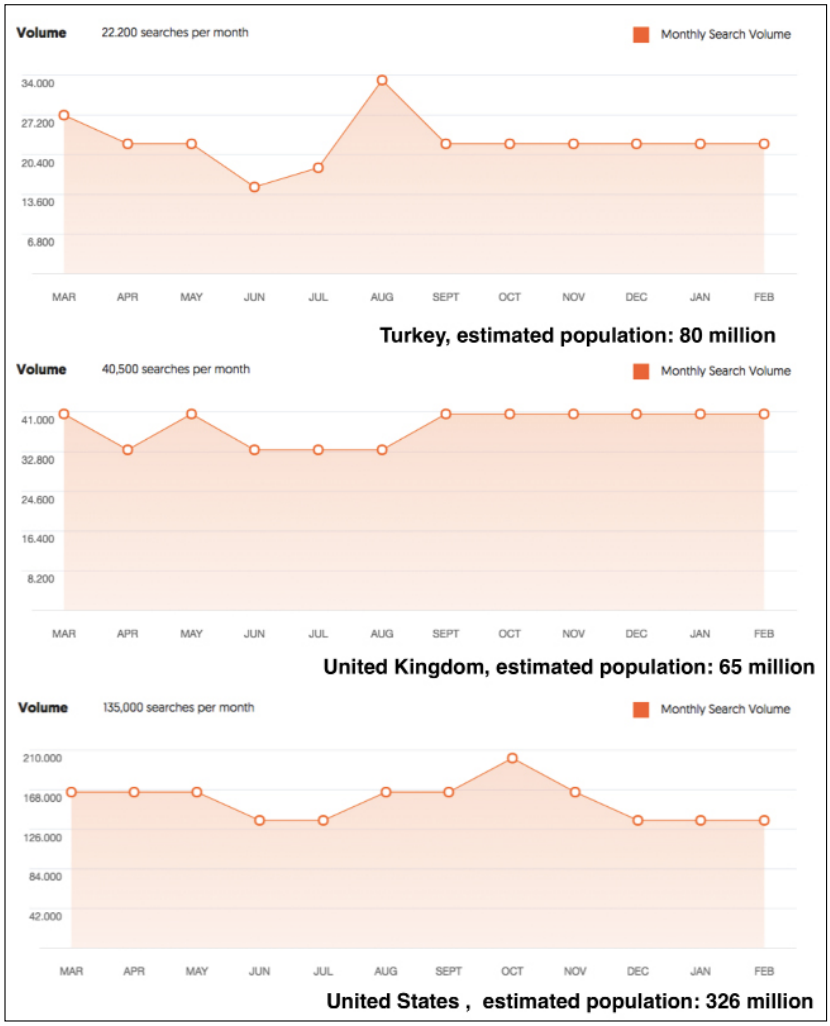


**Figure 1.** Monthly search volume data for "cholesterol" in Turkey, the United Kingdom, and the United States.

the use of search engines to explore chronic diseases such as hypercholesterolemia will provide clarification for a roadmap to address digital health policies and digital misinformation.

## Study limitations

Our study has several limitations. First, the scoring checklist was inevitably subjective. Assessment of favorability was based on a checklist developed by the authors and was not externally validated. Second, the assessment reflects a limited period of time and the content of the most popular Google search results can change at any time. Therefore, the results may vary at another point in time. Third, our study was limited to the Google search engine, and the results cannot be applied to other search engines. In addition, Turkish phrases were researched, which eliminated texts written by international lipid societies. Furthermore, since the investigation included only the most common cholesterol phrases, it may not reflect the overall cholesterol perception. Finally, our study was conducted before the publication of the latest guidelines on dyslipidemias, thus the generalizability of our study findings may be limited with regard to revised sections in the guidelines.

## Conclusion

Digitalization of medicine is here to stay. Search engines are a common face of the digital world and provide a generally easily accessible virtual gateway to information. The accuracy and favorability of publicly available information is very important in the struggle against prevalent diseases like hypercholesterolemia and to increasing patient compliance with

treatment. The use of the Internet and its search engines is well-accepted as a technological tool within the cardiology field and cardiologists should consider being willing to embrace it more broadly. Greater participation from universities and hospitals to increase the medical quality of the results generated by search engines would be valuable. Digital committees and other authorized teams can investigate and help to eliminate misleading information.

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