ORIGINAL RESEARCH ORİJİNAL ARAŞTIRMA

DOI: 10.5336/dentalsci.2024-102330

Qualitative Analysis of Infoveillance and Readability of Online Texts About Early Childhood Caries

Erken Çocukluk Çürükleriyle İlgili Çevrim İçi Metinlerin Bilgilendirme ve Okunabilirliğinin Niteliksel Analizi

Büşra AKKAYA[a]

[a]Private Dentist, İstanbul, Türkiye

ABSTRACT Objective: The study aimed to assess the quality and readability of web-based information regarding the early childhood caries (ECC). **Material and Methods:** An internet search using ten different search terms was conducted using the Google search engine. The study was conducted in English on a total of 300 websites by a pediatric dentist. Only official and governmental websites were included in the study. The websites were evaluated for quality based on the Journal of the American Medical Association (JAMA) benchmark criteria, the DISCERN, and Ensuring quality information for patients (EQIP toolkits). The readability formulas Flesch-Kincaid reading ease, the Flesch-Kincaid grade level, Simple Measure of Gobbledygook reading grade level were used to analyze readability. The data obtained was analyzed with the SPSS 23 program, and $p<0.05$ was accepted as the statistically significant. **Results:** No website has reached an excellent DISCERN score. More than half of the websites did not meet any of the JAMA criteria. Only 3 of the websites met all JAMA criteria. When the total EQIP score was evaluated, it was determined that the websites showed a low-medium level of information quality. The mean reading level was 8th to 9th grade and considered standard to read. Only 7 websites were measured as difficult to read. **Conclusion:** The results of the conducted study showed that the information shared about ECC on websites were mostly poor in terms of quality, according to the readability formulas it was found to be significantly higher than the recommended 6th grade education level.

Keywords: Access to information; comprehension; dental caries; internet; qualitative research

ÖZET Amaç: Çalışma, erken çocukluk çağı çürüklerine [Early childhood caries (ECC)] ilişkin internet tabanlı bilgilerin kalitesinin ve okunabilirliğinin değerlendirmesini amaçlamaktadır. **Gereç ve Yöntemler:** Google arama motoru kullanılarak, on farklı arama terimi ile bir internet taraması yapıldı. Araştırma bir çocuk diş hekimi tarafından, İngilizce dilinde toplam 300 internet sitesiyle gerçekleştirildi. Araştırmaya yalnızca resmi ve hükümete ait internet siteleri dâhil edildi. İnternet siteleri, Amerikan Tıp Birliği Dergisi [Journal of the American Medical Association (JAMA)], DISCERN ve hastalara kaliteli bilgi sağlama [Ensuring quality information for patients (EQIP)] kıyaslama kriterleri temel alınarak kalite açısından değerlendirildi. Okunabilirliği analiz etmek için okunabilirlik formülleri Flesch-Kincaid okuma kolaylığı, Flesch-Kincaid sınıf seviyesi, Gobbledygook'un Basit Ölçüsü okuma notu seviyesi kullanıldı. Elde edilen veriler SPSS 23 programı ile analiz edildi ve $p<0,05$ istatistiksel olarak anlamlı kabul edildi. **Bulgular:** Hiçbir internet sitesi mükemmel bir DISCERN puanına ulaşamadı. İnternet sitelerinin yarısından fazlası JAMA kriterlerinin hiçbirini karşılamadı. İnternet sitelerinden yalnızca üçü tüm JAMA kriterlerini karşıladı. Toplam EQIP puanı değerlendirildiğinde web sitelerinin düşük-orta düzeyde bilgi kalitesi gösterdiği belirlendi. Ortalama okuma seviyesi 8. ila 9. sınıf arasındaydı ve okumanın standart olduğu kabul edildi. Yalnızca 7 internet sitesinin okunması zor olarak ölçüldü. **Sonuç:** Yapılan çalışmanın sonuçları, internet sitelerinde ECC hakkında paylaşılan bilgilerin çoğunlukla kalite ve içerik açısından zayıf olduğunu, okunabilirlik formüllerine göre önerilen 6. sınıf eğitim seviyesinin üzerinde olduğunu göstermiştir.

Anahtar Kelimeler: Bilgiye erişim; idrak; diş çürükleri; internet; niteleyici araştırma

Early childhood caries (ECC), although substantially preventable, is one of the most common chronic childhood diseases. Therefore, it can be said that ECC is a worldwide public health problem.[1] Nowadays; The American Academy of Pediatric Dentistry defines this type of caries as ECC and Se-

TO CITE THIS ARTICLE:
Akkaya B. Qualitative analysis of infoveillance and readability of online texts about early childhood caries. Turkiye Klinikleri J Dental Sci. 2024;30(3):422-9.

Correspondence: Büşra AKKAYA
Private Dentist, İstanbul, Türkiye
E-mail: dtbusrabostancii@gmail.com

Peer review under responsibility of Turkiye Klinikleri Journal of Dental Sciences.

Received: 21 Feb 2024 ***Received in revised form:*** 15 May 2024 ***Accepted:*** 15 May 2024 ***Available online:*** 20 May 2024

vere ECC (S-ECC) to better express its multifactorial etiology. ECC, which can also be called baby bottle caries, is defined as the presence of one or more decayed, missing, or filled tooth surfaces in primary teeth in children under the age of six. S-ECC is described as the presence of more than 4 decayed, missing, or filled tooth surfaces at the age of 3, more than 5 at the age of 4, or more than 6 at the age of 5.[2] ECC, affects not only oral health but also general health. The development of children with ECC may be slow and inadequate due to malnutrition, the infection observed in their teeth may cause focal infection, and problems such as pain, insomnia, and restlessness may cause psychological problems.[1,3]

As a result of widespread access to the internet, it has become an important source of information about various diseases and treatment processes. The vast resources of health information available on the internet have great potential to improve public health. Today, almost all patients browse different websites to clarify health-related issues before consulting doctors. The information obtained quickly and easily from the internet is very effective in the decisions individuals make regarding their health. If the information they obtain is not prepared in line with evidence-based data, it may lead patients to be misled or delay their treatment. However, there is no legal legislation or mechanism regulating the sources of health-related information on the internet, and the accuracy of the content and information provided is not checked.[4,5] Individuals may unintentionally get harmed while searching for health information on the internet too. The fact that individuals have access to contradictory, unclear, and inaccurate health information on the internet can increase their level of concern and anxiety about health. On the other hand, increasing the quality of individuals' health literacy can contribute to healthy lifestyle behaviors and quality of life.[6,7] Therefore, the quality, reliability, and validity of the information on the internet are very important. As a result of the increasing access of individuals to internet-based health-related information, some validated tools have been developed that evaluate the content of websites from different perspectives. The information about ECC on websites must have accurate and reliable content. The readability of the text is as important as the content of the information for patients to understand the information given and take appropriate actions. The first thing that comes to our mind is to do an internet search for everything we wonder about during the day, whether necessary or unnecessary. Undoubtedly, every child is the first priority of his/her parent/caregiver. A parent/caregiver who notices that their child has tooth decay will try to alleviate their concerns by researching this situation on the internet before consulting a doctor. In this context, if the information on the internet is not reliable and understandable, there will be a possibility of making wrong decisions about the child's health. For these reasons, this study aims to evaluate the content quality, reliability, and readability of information about ECC presented on official and government websites. With this study, which aims to examine the websites that provide information about ECC, which is very common in children all over the world, the current situation will be analyzed and an important step will be taken to make the necessary improvements.

MATERIAL AND METHODS

Ethics committee approval was not obtained because publicly available digital data was used in this descriptive study, in which websites providing information about ECC were analyzed in terms of quality, usability, content, and readability.

Google (Google LLC, Mountain View, California, USA), the most popularly used search engine worldwide, holding 92.21% of the global search engine market share, was used to access written texts related to ECC. Before starting the study, Google Trends was used to identify phrases that parents/caregivers are thought to frequently search on the internet to satisfy their curiosity about tooth decay in their children. The 10 most frequently preferred phrases in Google searches in the last year were determined. Keywords selected were all phrases and listed as follows: "ECC", "early childhood decay", "infant tooth caries", "infant tooth decay", "baby tooth decay", "deciduous tooth decay", "milk tooth decay", "nursing decay", "bottle caries", "baby bottle tooth decay".

An independent online search was conducted after deleting cookies and browser history to avoid

affecting the research results and disabling the location on the computer. GPS is disabled to prevent the search engine from only displaying websites close to the researcher's location.

Only official and governmental websites were included in the study. The duplicate websites, articles for academic purposes, book contents, advertisements, discussion groups, sites that require subscription or payment, social media, websites for the education of dental professionals, videos, and images were excluded from the evaluation. In addition, graphics, images, videos, tables, figures, and list formats, addresses, and telephone numbers within the text were not included in the evaluation to prevent erroneous results.

The search was performed by one pediatric dentist. The search was planned in English language on a total of 300 websites. Any duplicates were removed after sorting the database website URLs alphabetically. As a result of the Google search conducted between 13/09/2023 and 10/10/2023 using 10 relevant search terms, the addresses of the first 30 websites that met the inclusion criteria were copied and saved in an Excel file. Since it has been determined in previous similar studies that users can examine the data of the first 30 sites at most depending on the distribution of attention and interest in internet searches, within the scope of our study, the first 30 sites for each term are examined.[8]

The quality of websites included in the study was evaluated using the Journal of American Medical Association (JAMA) benchmark criteria', Quality Criteria for Consumer Health Information (DISCERN) questionnaire, and Ensuring of quality information for the patient (EQIP) criteria.

The readability level of informational texts on websites was calculated with the Flesch-Kincaid reading ease (FKRE), the Flesch-Kincaid grade level (FKGL), Simple Measure of Gobbledygook (SMOG) reading grade level which are common measurements used for English texts.

DISCERN criteria, which is a tool used to demonstrate the quality of health-related internet-based information, consists of 16 questions scored between 1-5. The first eight questions include general website information; "Are the objectives clear?" or "Were quotes used?" like. The second eight questions assess knowledge on treatment, "Is it clear that there is more than one treatment option?" like. The author independently examined the websites using the DISCERN criteria and a final DISCERN score was obtained for each website. The final DISCERN score ranges from 16 to 80. According to the score results, scores between 63 and 80 were considered "excellent", between 51 and 62 as "good", between 39 and 50 as "fair", between 28 and 38 as "poor" and between 16 and 27 as "very poor".[9]

JAMA Benchmark criteria analyze internet-based information under 4 criteria; authorship, attributions, annotation, and validity (JAMA score 0-4, Authorship (1 point): Authors and contributors, their affiliations, and relevant credentials should be provided; Attribution (1 point): References and sources should be listed for all content; Description (1 point): Conflicts of interest, funding, sponsorship, advertising, support and video ownership must be fully disclosed; Validity (1 point): Dates the content was published and updated must be stated. The rater assigns 1 point for each criterion in the text, and the final score ranges from 0 to 4. Four points represent the highest reliability and quality. According to JAMA results, videos with 0-1 points contain insufficient information (low reliability), videos with 2-3 points contain medium sufficient information (medium reliability) and videos with 4 points are completely. They are determined to contain sufficient (reliable) information.[10]

EQIP is used to evaluate the quality and design of websites containing written health information. With this method, it is evaluated that written information is conveyed to individuals, the information is evidence-based, and individuals or patients are included in the diagnosis and treatment processes. The original EQIP tool consists of 20 questions answered with yes/no. The modified EQIP tool has been altered to include a 36-item criterion based on guidance from the British Medical Association and the International Patient Decision Aids Standards on providing patients with the most relevant information. The modified EQIP tool removes the "partial yes" option found

in the original, which was thought to reduce reliability. Websites that scored above the 75th percentile are considered high-scoring websites while the others are low-scoring websites.[11]

There are many formulas used in assessing the readability of written texts. In this study, FKRE, FKGL, and SMOG formulas, which are among the most used readability formulas, were used. FKRE was published by Flesch in 1948. The score is determined according to the following formula:

Flesch Reading Ease formula=206,835-1,015x (number of words/number of sentences)+84.6x(number of syllables/number of words)

The resulting Flesch score can be converted to reading difficulty level and approximate education level by using the classification below (Table 1).

FKGL test, unlike the Flesch Reading Ease test, indicates which age group the prepared content appeals to in parallel with the education level. Here's how to calculate The FKGL score.

Flesch-Kincaid Formula=0.39x(Total words total sentences) 11.8x(Total syllables total words) 15.59

The SMOG readability formula was developed by McLaughlin. This formula consists of a readability equation based on the variables "average sentence length" and "proportion of words with 3 or more syllables". The SMOG readability conversion table is given in Table 2.

Those metrics were collected from the online tool Readable. io (Readable.io, Bolney, England) through the Uniform Resource Locator (URL) of the website or the direct input of the texts in the platform.

TABLE 1: Reading ease conversion table.

Score	Approximate education level	Reading difficulty
90-100	5th grade	Very easy
80-90	6th grade	Easy
70-80	7th grade	Almost easy
60-70	8th-9th class	Standard
50-60	10th-12th class	Almost hard
30-50	13th-16th class	Hard
0-30	University	Very difficult

TABLE 2: Simple Measure of Gobbledygook readability conversion chart.

Total number of multisyllabic words	Approximate education level
1-6	5
7-12	6
13-20	7
21-30	8
31-42	9
43-56	10
57-72	11
73-90	12
91-110	13
111-132	14
157-182	16
183-210	17
211-240	18

The data obtained as a result of the study was recorded with Microsoft Office Excel (Microsoft Office 365; Microsoft Inc., USA). The data were imported to IBM SPSS Statistics for Windows software, version 23 (SPSS Inc., Chicago, IL, USA). All variables were analyzed for normality using Kolmogorov-Smirnov test. Descriptive statistics of categorical data were shown using frequency and percentage values, and descriptive statistics of numerical data were shown using median values. In the study, Mann-Whitney U test was used between two independent groups for numerical data comparisons and Kruskall-Wallis non-parametric analysis of variance evaluation was used for multiple independent groups, and Chi-square test was used for categorical data comparisons. The relationship between evaluation methods was examined with the Spearman correlation coefficient. $p<0.05$ was considered statistically significant.

RESULTS

All of the 300 websites containing information on ECC examined for the study are official or governmental sites belonging to dental and health professionals.

The DISCERN score of the websites evaluated ranged from 16 to 62 and had an average score of 41.3±11.34. No website has reached an excellent DISCERN score. Almost half of the websites received poor or very poor scores. The most remark-

TABLE 3: Descriptive statistics of scores of DISCERN, JAMA benchmark, FKRE, FKGL and SMOG.

	Outcomes	DISCERN	JAMA	EQIP	FKRE	FKGL	SMOG
Overall	X̄±SD	41.38±11.34	0.82±1.03	49.8±14.6	63.84±11.97	7.67±2.11	7.40±5.18
	Median	40	1	47.2	65	7.4	7
	Minimum	16	0	22.2	5	2.9	4
	Maximum	62	4	88.8	96	16.9	93

SD: Standard deviation; JAMA: Journal of American Medical Association; EQIP: Ensuring of quality information for the patient; FKRE: Flesch-Kincaid reading ease; FKGL: Flesch-Kincaid grade level; SMOG: Simple Measure of Gobbledygook.

able deficiencies in the websites were that it was unclear when it was produced and the reference sources (Table 3).

More than half of the websites (53.7%) did not meet any of the JAMA criteria. Among the JAMA criteria, it was determined that the most complied was authorship, while the least was disclosure. Only 3 of the websites met all JAMA criteria. These 3 were the websites in fair category with the highest DISCERN total scores (Table 3).

The average EQIP score was 49.8 with a standard deviation of 14.65. The lowest score in the survey was 22.2, and the maximum score was 88.8. When the total EQIP score was evaluated, it was determined that the websites showed a low-medium level of information quality. Of the 300 websites evaluated, 281 were considered low-scoring websites -below the 75th percentile- while only 19 were evaluated as high-scoring websites (Table 3).

The mean FKRE value was 63.84±11.97 which was equivalent to a reading level of 8th to 9th grade and considered standard to read. The mean FKGL for all the websites was 7.67±2.11. SMOG analysis showed an average score of 7.4±5.18 for all the websites (Table 3). Only 7 websites were measured as difficult to read. The Spearman correlation coefficient of all readability formulas was found to be 0.000 ($p<0.05$).

DISCUSSION

ECC is a substantial worldwide community problem due to its impact on quality of life, especially for children.[12] Internet is the most frequently used source for obtaining health-related information. Although information on the internet is also available in video and audio format, it is mostly in text format.[13] Therefore, it is very important for parents and caregivers who are worried about their children to obtain proper and eligible information about ECC. However, all websites are not at the same level of accuracy, and previous studies have stated enormous variations in quality and accessing low-quality websites negatively affects patients' interactions with healthcare professionals.[14] As far as we know, this is the first study in English language that evaluates both the content quality with three different toolkits and readability of online information about ECC. Ten phrases were used to attain different types of websites, and the keywords were selected by estimating what the general population might use when seeking ECC treatment.[15]

Google is the most frequently used search engine in the world, and in our study, only one search engine "Google" was used, which provided more results compared to other search engines.[16] Studies have shown that patients have a low potential to search beyond 30 websites. For this reason, the search for the current study was limited to only 30 websites for each phrase.[17]

According to the study results, the average content and reliability scores of the examined websites were determined to be at the low-medium level. The fact that the websites are mostly prepared by dental professionals (63%) can be seen as the reason why these values are not very low contrary to previous studies.

It has been reported that a website that does not meet at least three of the JAMA criteria may be considered suspicious. Only 1% (n:3) of the sites examined in this study met all JAMA criteria, while 92% did not meet at least three criteria. It was determined

that the biggest deficiency was not specifying the information sources and their current status.[10]

In this study, the quality of official and governmental websites providing information about ECC was evaluated. Because individuals generally trust well-known and current official institutions more than promotional and advertisement websites.[18] Patients often pay attention to whether the information is easily accessible, understandable, and useful when searching using the internet. However, the fact that information obtained on the internet is easily accessible and understandable does not indicate the accuracy of this information.[19] Because data is not edited, inaccurate information removed, or reviewed for accuracy before it is publicly accessible.

Many assessment tools attempt to evaluate various aspects of health information on the internet. These tools help individuals or patients to choose qualified and reliable websites. JAMA, DISCERN, and EQIP are the most well-known of these assessment tools.[9,10,20] For this reason, in our study, three different evaluation methods (JAMA, DISCERN, and EQIP), which have been used in various studies before, were used to obtain a more accurate result.

Although the questions included in the DISCERN and EQIP toolkits generally coincide with each other, the DISCERN toolkit evaluates the quality in terms of information, while the EQIP toolkit evaluates the quality in terms of both information and understanding of the information by the reader. For websites to achieve their purpose, their content must not only be accurate and reliable but also must be readable for the target audience.[21,22]

According to the DISCERN toolkit results in this study, the quality of the websites evaluated was generally found to be fair. None of the websites were evaluated as "excellent", and 67 websites were evaluated as "good". The data obtained from this study are similar to the data obtained from other studies conducted with DISCERN.[23-25]

There are many studies in the literature in which content analysis was conducted using different tools on various topics related to oral and dental health in pediatric patients. However, there are almost no studies evaluating website quality and readability regarding ECC. In a recent study, websites providing information about ECC in English, Spanish, and Portuguese were evaluated according to DISCERN and JAMA toolkits and language-based readability formulas. According to the results of the study, although the websites were generally easy to read, their content quality was found to be low.[24] Also, similar to our study, the quality of the websites was low regardless of whether they were prepared by health professionals.

In another study evaluating the content quality and reliability of websites providing information about restorative treatments in pediatric patients, the results were found to be moderate low, similar to the current study.[23]

Healthcare professional organizations have recommended that patient education materials be at a reading level of 6th grade and below to be easy to read and understand for individuals of all literacy levels.[26,27] It was determined that the average readability of most of the informational texts on the websites of health-related institutions and organizations included in this study was equivalent to the 8th and 9th grade reading level which means standard.

Hendrickson et al evaluated the readability of online pediatric oral health education materials using the FKGL, FKRE, and SMOG formulas, but unlike the current study, it was observed that the three formulas did not yield compatible results with each other.[28]

In a study evaluating the content and quality of online patient information texts regarding dental treatments with sedation in pediatric patients, it was reported that improvements were needed in both aspects.[29]

Similarly, in the current study, Kılınç and Ateşçi evaluated the quality and content of web-based information on the treatment of traumatic dental injuries using the DISCERN toolkit, and FKGL, FKRE, SMOG formulas and found it to be at a medium-low level.[30]

It is recommended to keep sentences short, use uniform and plain language throughout the text, avoid long lists as much as possible, and use bullet points and graphics carefully while preparing information texts for patients.[31,32]

A parent/caregiver who notices that their childs have tooth decay will immediately do an internet search. However, if the online information they access about ECC has low quality content or is difficult to read, it will be inevitable to make the wrong decision. This situation will pave the way for the child not to receive the necessary oral and dental healthcare services and for ECC to remain a common social problem all over the world. In particular, it is encouraging to reconsider the contents of websites that provide information on issues that continue to be a common problem all over the world, and the collaborative work of governments and professional organizations will contribute greatly to the creation of reliable and understandable online information sources.

CONCLUSION

The results of the conducted study showed that the information shared about ECC on websites varies. In addition to the fact that the websites included in the research were mostly poor in terms of quality, according to the readability formulas, the readability of the websites was found to be significantly higher than the recommended 6th grade education level. In order to access better quality online health information in the future, information should be constantly updated, inaccurate and incomplete information should be changed, and the quality and reliability of the information should be evaluated. Considering the negative consequences that online health information may create, a control mechanism is required to evaluate the quality and reliability of the information, to check whether the content consists of accurate information, and to ensure that the information is standardized in content related to any health issue. The present study has some limitations. The fact that the study was conducted by a single pediatric dentist may have enabled some objective evaluations. In the future, conducting new studies by increasing the number of samples and evaluators will make great contributions to the literature.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

This study is entirely author's own work and no other author contribution.

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