

Quality and Readability Assessment of Web-based Arabic Health Information on Early Childhood Caries

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Abstract

Background: Patients are increasingly using the internet for searching health-related information. However, the quality and readability of the information available on the internet need to be assessed. To date, no study has assessed the quality and readability of web-based Arabic health information on early childhood caries. **Objectives:** To evaluate the quality and readability of patient-oriented online Arabic health information regarding early childhood caries.

Materials and Methods: For this infodemiological study, the Google and Yahoo search engines were searched using specific Arabic terms for early childhood caries, and the top 100 searches from both search engines were considered. Eligible websites were categorized in terms of affiliation as commercial, health portal, dental practice, professional, and journalism. The quality of the websites was assessed using the Quality Evaluation Scoring Tool (QUEST), and readability using the Gunning Fog index (GFI).

Results: A total of 140 websites were included after applying the exclusion criteria, of which 50.7% websites were of journalism. The majority of the websites (70%) had an overall low-quality level, with a QUEST score <10. The quality of websites retrieved from Google searches was of significantly higher quality than those from Yahoo ($P < 0.0001$). More than half (51.4%) of the websites had good readability, with a GFI score ≤ 8 . Journalism websites had a significantly higher proportion of websites with poor readability level (62%) compared with other affiliations ($P = 0.0072$).

Conclusion: The web-based Arabic information regarding early childhood caries is currently of low quality and moderate readability level, thereby indicating a need for improving such patient-facing content.

Keywords: Arabic, caries, early childhood caries, health, health information, health education, internet, quality, web-based

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INTRODUCTION

Early childhood caries (ECC) is a significant worldwide health problem with a prevalence of up to 70%, indicating

that preventive measures are in need.^[1] A very high prevalence of ECC has also been reported from the Middle East regions, ranges from 26.5% to 99%.^[2] One of the

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effective components of health promotion and prevention is health-related education. Nowadays, the internet is one of the most commonly used resources for education and obtaining health information.^[3] More than 50% of people commonly use the internet to gain health information.^[3] However, there are some concerns about the publication of inaccurate, incomplete, or outdated information.^[4] Furthermore, to the majority of patients, most of the medical terminologies in health-related articles require a high level of reading comprehension. As a result, patients with insufficient health literacy can be easily misguided by low-quality information and with a compromised health decision.^[5]

Different previous studies have assessed the quality and readability of web-based dental health information regarding different topics. The majority of them indicated that the dental online information was not very reliable, and the quality of the information is in great need of improvement.^[6-12] For pediatric dentistry, to date, only one study has assessed the quality of websites for information on childhood dental caries in the Portuguese language, and the reported quality of the available online information was found to be a cause for concern.^[13]

Available literature in dentistry for the assessment of online dental health information, especially in the Arabic language, is relatively scarce. To the best of our knowledge, to date, no study has assessed web-based Arabic health information on ECC. Therefore, this study aimed to assess the readability and quality of patient-oriented online Arabic information regarding ECC using the QQuality Evaluation Scoring Tool (QUEST) and Gunning Fog Index (GFI).

MATERIALS AND METHODS

This is an infodemiological study wherein selected search engines were searched for specific Arabic terms of ECC, and then, the quality and readability of the selected websites was assessed.

Sample size calculation

Sample size was calculated by Epitools sample size calculator software (<https://epitools.ausvet.com.au/oneproportion>) with a 5% desired precision, 95% confidence interval (CI), and 10% estimated true population. The calculated required minimum sample size was 139 websites.

Selection of websites

An online search was done using two search engines: Google and Yahoo. Both engines were accessed on November 17, 2021. The translated Arabic keywords

“etiology of early childhood caries,” “prevention of early childhood caries” and “management of early childhood caries” were used with each search engine. Any website with the following criteria was excluded: (1) non-Arabic language websites; (2) Duplicated websites; (3) Websites presenting only brief information, audio, or video; (4) Scientific articles or textbooks; (5) Websites requiring ID and password for access; and (6) Non-operating websites. The remaining included websites were grouped based on affiliation into professional, commercial, health portal, dental practice, and journalism. Professional websites were those created by an organization or a person with professional knowledge such as governmental, institutional, and universities’ websites. Commercial websites were those including advertisements, products, or services for sale. Health portal websites were those displaying health information for a variety of health topics. Dental practice websites were those created by dentists or dental clinics. Journalism websites were news-oriented websites with non-medical articles.

Evaluation of websites

For website evaluations, QUEST was used for quality assessment and GFI for readability assessment. Selected websites were analyzed and graded by two reviewers. Prior to grading, 10 websites were randomly selected and assessed by the reviewers to enhance mutual calibration. The intra-examiner and inter-examiner assessment of QUEST had an average measure of 0.823 and 0.843, respectively, ($P < 0.001$), which is considered as good reliability.^[14]

Quality assessment and classification

QUEST is a validated tool designed for application to a variety of health topics including information on both treatment and prevention, as well as general health information.^[15] QUEST quantitatively measures the following six aspects of the quality of online health information: authorship, attribution, conflict of interest, currency, complementarity, and tone. Based on the website assessment, each aspect is given a score that is to be multiplied by a specific value for each aspect. The individual section’s score is then weighted and summed to generate an overall score of up to 28. The description of the QUEST evaluation criteria is presented in Figure 1. The website’s quality was classified as low quality if the overall score was ≤ 9 , moderate quality if the overall score was 10–18, and high quality if the overall score was >18 .^[15]

Readability assessment and classification

GFI was used for the readability assessment. It provides the reader with the number of years of education that is

theoretically needed to understand a particular written text. It is designed primarily to assess English texts but can also be used for other languages.^[16] To assess the readability, an online program was used (<http://gunning-fog-index.com/>). The content of each website was copied and pasted into this program. Then, the language of the website to be evaluated was selected, of which Arabic language was chosen. After that, the program automatically calculated the index score for each selected website. The GFI scores are categorized according to the reading level by grade [Figure 2]. The readability of the websites was then classified into good and poor readability levels based on the GFI score. A good readability level (i.e., text that is easy to be read) is considered when a GFI score is ≤ 8 , which is equal to a reading level by grade that is less than high school. A poor readability level (i.e., text that is difficult to

read) is considered when the GFI score is ≥ 9 , which is equal to a reading level by grade that is high school and above.

Statistical analysis

All of the statistical analyses were performed using SAS version 9.4. Data were presented as frequencies and percentages, as appropriate. Qualitative variables were tested using Fisher's exact test, as appropriate. A P value < 0.05 was considered significant.

RESULTS

Distribution of websites

Of the first 100 websites retrieved from the Google and Yahoo search engines using the chosen keywords, a total of 60 were excluded based on the selection criteria, and thus 140 websites were included in the study. Websites were categorized in terms of affiliation as follows: journalism (50.7%), health portal (27.2%), dental practices (15%), commercial (5%), and professional (2.1%).

Overall quality and readability assessment

Table 1 presents the results of the overall quality and readability of the study's websites using QUEST and GFI. The majority of the websites (70%) had an overall QUEST score < 10 , indicating an overall low-quality level; only one website that was under the journalism category scored high quality. On the other hand, a good readability level was found for 51.4% of the websites (i.e., GFI score: ≤ 8).

Quality assessment

In terms of search engines, 54.3% ($n = 38$) and 1.4% ($n = 1$) of websites retrieved using the Google search engine were of moderate- to high-quality level, respectively, compared with only 4% of websites retrieved from Yahoo being of moderate-quality level (and none of high-quality level) ($P < 0.0001$). There was no significant difference between websites based on website affiliation. Regardless of the website affiliation, most of the websites (70%) were of low quality [Table 2]. Table 3 presents the results of different aspects of the QUEST index for the

Figure 1: Description of the QQuality Evaluation Scoring Tool evaluation criteria.^[15] Individual sections score is weighted and summed to generate an overall score of up to 28

Authorship (score x1)	
0	No indication of authorship or username
1	All other indications of authorship
2	Author's name and qualification clearly stated
Attribution (score x3)	
0	No sources
1	Mention of expert source, research findings (though with insufficient information to identify the specific studies), links to various sites, advocacy body, or other
2	Reference to at least one identifiable scientific study, regardless of format (e.g., information in text or reference list)
3	Reference to mainly identifiable scientific studies, regardless of format (in $> 50\%$ of claims)
For all articles scoring 2 or 3 on attribution: type of study (score x 1):	
0	in vitro, animal models, or editorials;
1	all observational work;
2	meta-analyses, randomized controlled trials, clinical studies
Conflict of interest (score x3)	
0	Endorsement or promotion of intervention designed to prevent or treat condition (e.g., supplements, brain training games, or foods) within the article
1	Endorsement or promotion of educational products and services (e.g., books or care home services)
2	Unbiased information
Currency (score x1)	
0	No date present
1	Article is dated but 5 years or older
2	Article is dated within the last 5 years
Complementarity (score x1)	
0	No support of the patient-physician relationship
1	Support of the patient-physician relationship
Tone (includes title; score x3)	
0	Fully supported (authors fully and unequivocally support the claims, strong vocabulary; e.g., "cure," "guarantee," and "easy"; mostly use of nonconditional verb tenses ["can," "will"], no discussion of limitations)
1	Mainly supported (authors mainly support their claims but with more cautious vocabulary; e.g., "can reduce your risk" or "may help prevent"; no discussion of limitations)
2	Balanced/cautious support (authors' claims are balanced by caution, includes statements limitations or contrasting findings)

Figure 2: Gunning Fog Index scores categorized according to the reading level score by grade

Fog Index	Reading Level by Grade
20+	Post-graduate plus
17-20	Post-graduate
16	College senior
15,14,13	College junior, sophomore, freshman
11-12	High school senior, junior
10	High school sophomore
9	High school freshman
8	8 th grade
7	7 th grade
6	6 th grade

study's assessed websites. Although most of the analyzed websites were found to be up to date (61.42%), the authorship (52.14%) and references (80%) were not clear.

Readability assessment

Table 4 presents the readability scores of the analyzed websites in terms of search engines and website affiliation. There was no significant difference in the readability level of websites retrieved from both search engines. In terms of website affiliations, journalism websites had significantly higher proportion of websites with poor readability level (62%) compared with other affiliations ($P = 0.007$).

DISCUSSION

This study found that the quality of web-based Arabic health information on ECC is mostly of low quality. This highlights the need to continually evaluate sources for the quality and readability of the content available online, as patients often seek online health content regardless of its quality. Patients should also be educated regarding obtaining health information only from reliable websites such as government health agencies, reputable medical institutions, or professional dental organizations.

For the data collection, Google and Yahoo search engines were used, as they are the most common search engines used by the majority of internet users.^[17] Most of these search engines cooperate with sponsors' links, that is, companies pay to appear at the top of the list for a particular search keyword, which could lead to a bias, and thus, negatively impact the quality of the provided data. To overcome this limitation, the first 100 websites from each search engine were chosen.^[18] In addition, as most internet users tend to search for health-related information using their local language, the search was conducted in Arabic

language, which is one of the main languages in the world with almost 448 million speakers.^[18] Website assessments were done using QUEST and GFI, both of which are validated tools for the quality and readability evaluation of online health information.

For the quality assessment, the majority of the reviewed websites in the study had an overall low-quality level. This is in agreement with a recent infodemiological study on a total of 102 Arabic websites to assess the quality and readability of information related to dental caries using different tools and indexes, which concluded that the web-based Arabic information is readable but of low quality.^[19] In a study by Ayala Aguirre *et al.*, wherein an assessment was done regarding the quality of ECC web-based information in different languages (English, Spanish, and Brazilian Portuguese) and countries, it was found that the content on ECC is of poor quality in general, independent of country or language. Further, the study also found that authorship did not impact the quality of content, as low-quality information was found even in websites authored by healthcare professionals.^[20] Nonetheless, it should be noted that websites should mention authorship, provide citations, and state the date of the published information, as it could highly influence the quality and reliability of the website's content. Although most of the assessed websites in the current study were up to date, the authorship and sources of the published information were not clear. Similarly, results of previous studies for the assessment of web-based Arabic information about oral cancer and periodontal diseases showed that most of the websites did not mention authorship or cite references.^[11,12]

Websites not only need to have accurate and reliable content, but also have content that is understandable and readable by the targeted audience. In the present study, half of the assessed websites were found to be difficult to read, as it required a readability level of high school and above. On the other hand, the available web-based content for other Arabic dental topics such as periodontal diseases and denture hygiene have been found to be simple and easy to read.^[12,21]

Table 1: Overall readability and quality of the websites

Variable	Category	n (%)
Overall quality	Low (QUEST score ≤ 9)	98 (70)
	Moderate (QUEST score 10–18)	41 (29.29)
Overall readability	Less than high school (fog index ≤ 8)	68 (48.57)
	High school and above (fog index ≥ 9)	72 (51.43)

QUEST – QQuality Evaluation Scoring Tool

Table 2: Quality scores of the analyzed websites in terms of search engines and websites affiliation

Variable	Category	Low (QUEST score ≤ 9), n (%)	Moderate (QUEST score 10–18), n (%)	High (QUEST score > 18), n (%)	P
Search engine	Google	31 (44.29)	38 (54.29)	1 (1.42)	<0.0001
	Yahoo	67 (95.71)	3 (4.29)	0	
Website affiliation	Professional	2 (66.67)	1 (33.33)	0	0.9372
	Commercial	6 (85.71)	1 (14.29)	0	
	Health portal	28 (73.68)	10 (26.32)	0	
	Dental practice	15 (71.43)	6 (28.57)	0	
	Journalism	47 (66.20)	23 (32.39)	1 (1.41)	

QUEST – QQuality Evaluation Scoring Tool

The majority of websites retrieved using Google were found to have a moderate to high-quality level, whereas a very small proportion of websites from Yahoo were of medium quality and none were of high quality. This indicates that Google has optimized the quality of content that is retrieved as compared with Yahoo. This finding is consistent with those of studies done to assess the quality of web-based content for periodontal diseases and oral cancer.^[11,12]

Moreover, for different website affiliations in the study, journalism websites were the most frequently retrieved. This is most probably due to such websites commonly

targeting the general population. However, although health portals, dental practice, and professional organization websites play an important role in oral health education and promotion, they were less frequently found among the top-searched websites in the study. On the other hand, according to Leite and Correia, scientific papers were the major retrievable websites providing information for ECC in the Portuguese language.^[13] This highlights the need for both better search engine optimization of Arabic content from reliable sources and for more scientific publications on ECC in the Arabic language.

The readability level in the study was found to be more difficult in the journalism websites compared with the other affiliation websites. On the other hand, Al-Ak'hali *et al.* reported that there was no significant difference in readability based on affiliation for the web-based Arabic content for periodontal diseases, all of which were reported to have simple and readable content.^[11] Notably, in the current study, the majority of websites were of low quality, regardless of the affiliation, mostly due to lack of key information such as stating the authorship, date of publication, and providing citations for the provided facts. Again, this contrasts with the findings of Al-Ak'hali *et al.*, wherein professional and health portal websites were found to be of a good quality level.^[11]

Table 3: Different aspects of the QQuality Evaluation Scoring Tool index for the websites

QUEST aspect	Total, n (%)
Authorship	
No indication of authorship or username	73 (52)
All other indications of authorship	51 (36)
Author's name and qualification clearly stated	16 (11)
Attribution	
No sources	112 (80)
Mention of expert source, research findings	21 (15)
Reference to at least one identifiable scientific study, regardless of format	5 (4)
Reference to mainly identifiable scientific studies, regardless of format	2 (1)
Type of study for articles scoring 2 or 3 in attribution	
<i>In vitro</i> , animal models, or editorials	10 (100)
All observational work	0
Meta-analyses, randomized controlled trials, clinical studies	0
Conflict of interest	
Endorsement or promotion of intervention designed to prevent or treat condition within the article	85 (61)
Endorsement or promotion of educational products and services	13 (9)
Unbiased information	42 (30)
Currency	
No date present	27 (19.3)
Article is dated but 5 years or older	27 (19.3)
Article is dated within the last 5 years	86 (61.43)
Complementarity	
No support of the patient-physician relationship	27 (19)
Support of the patient-physician relationship	113 (81)
Tone	
Fully supported	88 (63)
Mainly supported	29 (21)
Balanced/cautious support	23 (16)

QUEST – QQuality Evaluation Scoring Tool

Recommendations and limitations

The findings of this study highlight the immense need to improve the quality and readability of web-based Arabic information regarding ECC. Such websites need to be easy to retrieve, access and read, and quality-based measures should be considered while developing content for such websites. Furthermore, it is recommended that websites providing information to the public regarding children's oral health and ECC should be reviewed by relevant departments at Ministry of Health or a professional health organization. Such websites could also include questions led by algorithms that help parents to know problems and when to seek dentist's attention.

A limitation of this study was that only two search engines were used, which limits the generalizability of the results; nonetheless, given that Google is the most commonly

Table 4: Readability scores of the analyzed websites in terms of search engines and website's affiliation

Variable	Category	Less than high school (fog index ≤ 8), n (%)	High school and above (fog index ≥ 9), n (%)	P
Search engine	Google	33 (47.14)	37 (52.86)	0.8658
	Yahoo	35 (50)	35 (50)	
Website affiliation	Professional	2 (66.67)	1 (33.33)	0.0072
	Commercial	7 (100)	0	
	Health portal	19 (50)	19 (50)	
	Dental practice	13 (61.90)	8 (38.10)	
	Journalism	27 (38.03)	44 (61.97)	

QUEST – QQuality Evaluation Scoring Tool

used search engine, there is a certain degree of merit in the findings. Furthermore, as the content of websites is dynamically changing, the content in the websites evaluated may have altered over time.

CONCLUSION

This study found that most of the Arabic web-based content on ECC is of low quality and only about half the websites have a good readability level. Improving the quality and ease of readability of web-based ECC Arabic content is extremely important, as it would enhance patient education, which in turn could potentially improve patient compliance, clinical outcomes, effective communication, and shared decision-making, and enhance the patient–physician relationship.

Ethical consideration

The research only evaluated publicly available written texts on the internet, and thus ethical approval was not required.

Peer review

This article was peer-reviewed by two independent and anonymous reviewers.

Data availability statement

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Author contributions

Conceptualization: F.A., R.A., and Y.B.A.; Methodology: F.A., R.A., Y.B.A., and B.A.; Data analysis: B.A.; Writing–original draft preparation: S.S.A., F.A., R.A., and Y.B.A.; Writing – review and editing: S.S.A., F.A., and R.A.; Supervision: S.S.A. and Y.B.A.

All authors have read and agreed to the published version of the manuscript.

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Conflicts of interest

There are no conflicts of interest.

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