Research Article

Quality of Patient Internet Information on Dentures

R. Constance Wiener#, Matthew Harper, Christopher Waters, Alcinda K. Trickett Shockey, Ruchi Bhandari

West Virginia University, West Virginia, USA

#**Corresponding author:** Constance Wiener, Department of Dental Public Health and Professional Practice, West Virginia University School of Dentistry, 64 Medical Center Drive, P.O. Box 9600, Morgantown, West Virginia 26506-9600, USA

Abstract

Background: Internet misinformation impacts public health, especially for older adults. This was evident in the US with COVID-19 internet misinformation. This research is to assess internet sites for patient oral health information concerning dentures, a topic which would be searched primarily by older adults who have the most severe of dental sequale.

Methods: Three commonly used web browsers (Google Chrome®, Mozilla Firefox®, and Microsoft Internet Explorer®) were searched with the key word "Denture." The top 50 returned results were examined. Duplicate, irrelevant, non-English, and advertisements were excluded (n=128 excluded). Four tools for quality were used: (a) SMOG readability, (b) Journal of the American Medical Association (JAMA) criteria, (c) DISCERN, and (d) a modified Ensuring Quality Information for Patients tool (MEQIP).

Results: Authorship was reported in 3 (13.6%) articles; 18 (81.8%) included dates of development/revision. The mean SMOG was 8.35 (SD, 2.1). The mean JAMA score was 1.6 points (SD, 0.7) of 4 potential points. The mean MEQIP score was 17.0 (SD, 5.1) of 30 criteria. The mean DISCERN was 58.3 (SD, 10.8) of 16 criteria scored from 1 (no) to 5 (yes). The quality of information was not significantly related to ranking, indicating poor quality and good quality were as likely to appear early in searches. Information quality varied widely from misinformation to fair reporting. The 120 excluded advertisements appeared early in the searches. Public health officials need to be aware of the scope of the challenge for people to find quality health information on the internet.

Keywords: Health literature; Removable prosthesis; Web browsers; Website

Introduction

Home computers, the internet, and the flow of data have changed lives. When people have a question, they find answers on the internet using cell phones, tablets, laptop and/or desktop computers. The internet is an easy, inexpensive, and fast way of accessing information [1]. The data are presented in multiple formats making it accessible to people of all ages, literacy levels, and ability levels. Access is broad and reaches people living in remote areas. People have information available at any time or place through the internet, and many turn to it in making their decisions, including decisions about healthcare. Approximately 60% of patients referred to the internet for health-related information before or after a medical visit with a specialist [2]. Globally, the frequency of usage of internet for health-related information increased with the outbreak of COVID-19.

Given the significance that internet information has on people's lives, there are concerns about the quality (content and readability) of health-related information. Information quality on the most frequently used web browsers varies widely and is often substandard for specific health-related issues [2-5]. The quality ranges from questionable home remedies to sound evidenced-based advice [2-5]. Health-related internet information quality can be further specious when it is presented by commercial entities. Researchers reported that internet information concerning head and neck cancer was commercial in nature in 42% of their results [6]. Researchers of a systematic review reported 70% of the 79 studies evaluating the quality of information presented on the internet had quality-related problems (technical issues, design flaws, readability, accuracy in data representation, and completeness) [7].

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Some specific examples of online misinformation and harm that has occurred as a result of following the misinformation include claims from social media influencers that e-cigarettes are harmless and only contain water vapor when it is known that many of the e-liquids contain nicotine with its established negative health consequences[8]; the misinformation due to social media indicating a medication for lupus and malaria (hydroxychloroquine) was a preventative for COVID-19 leading to a worldwide shortage for people with these diseases (although the National Institutes of Health halted controlled trials as it was ineffective); and conspiracy misinformation delaying or causing people to not seek COVID-19 vaccinations [9]. Other vaccines are also presented as suspect online, leading to harm such as an increased global measles epidemic risk [10]. Not all health-related misinformation causes health-related harm. For example, goldenrod honey being touted through online misinformation as a superfood has led to environmental harm [11]. Goldenrod has been introduced into countries where it is not native and has become an invasive species [11].

In addition, many people do not have adequate knowledge/skill to access and use available and reliable information. In one study, the researchers indicated that none of the participants used a medical portal to search for health-related information; few of the participants used Boolean operators and filters; and, one participant thought the research results on the first page were the only results [12].

When focusing on internet misinformation related specifically to dentistry, there are additional factors to consider. There are limited studies in which researchers examined the quality of internet information and dentistry. Olkun and Demirkaya indicated that online dental information about an orthodontic procedure was poor and that the internet has not necessarily helped patients to be more informed [1]. Researchers of a systematic search of YouTube videos concerning dental implants reported limited quality (as 91% of sites lacked references, and 60% were biased/unbalanced) as well as limited quantity.

The authors of this study were interested in the quality of internet information about dentures. Although, there has been a decline in complete tooth loss (edentulism) in older adults, and therefore the need for complete dentures, 13.4% of the U.S. population, aged ≥ 65 years, is edentulous.[14]Hawaii has the lowest level of edentulism (6.2%) and West Virginia has the highest level (26.3%) [14]. As the quality of online information concerning other health-related procedures has been brought into question, there is also a critical need to assess the quality of information about dentures, particularly considering the use of such data by older adults with compromised oral health. Providers need to be aware of online information to educate their patients and discredit misinformation. Therefore, the purpose of this research is to assess the quality of the data found on websites after internet searches for information about dentures.

Methods

Data Source

The internet searches were completed in June 2021. Three common web browsers were used: Google Chrome[®], Mozilla Firefox[®], and Microsoft Internet Explorer[®]. The key word for the searches was "Denture." As in the protocols of previous studies, the first 50 results from each of the web browsers were included for a total of 200 examined websites [2,15,16]. Inclusion criteria were that the website articles were written in English, were unique, and were returned with the search term, "Denture." Advertisements, duplicates, non-English websites, irrelevant, and websites identified as potentially malicious websites by NortonLifeLock[TM] (Symantec Corporation, Tempe, AZ) [17] antivirus were excluded. (Figure 1) has the flow chart of included/excluded studies and (Table 1) has the ranked results of the searches where rank 1 indicates "First" returned, rank 2 indicates "Second" returned, etc.
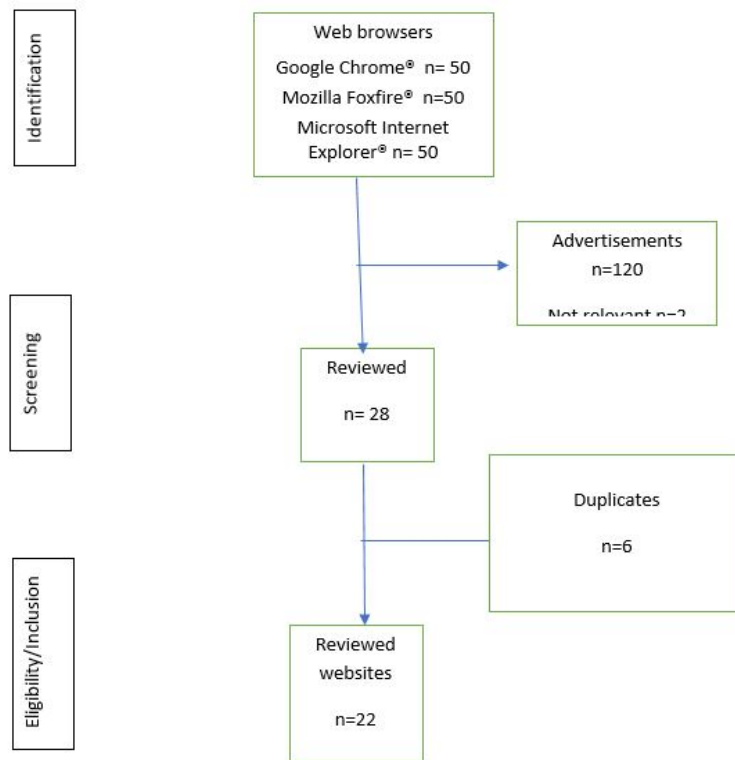
Figure 1: PRISMA flow diagram indicating search criteria.

Returned searches' ranks	Mozilla Firefox®	Microsoft IE®	Google Chrome®
1	Ad	Ad	Ad
2	Ad	Ad	Ad
3	Ad	Ad	Ad
4	Ad	Ad	Ad
5	Ad	Ad	Ad
6	Applicable	Ad	Ad
7	Ad	Ad	Ad
8	Ad	Ad	Ad
9	Applicable	Duplicate of FF[1] 6	Ad
10	Ad	Ad	Applicable
11	Ad	Duplicate of FF[1] 22	Duplicate of FF[1] 6
12	Ad	Applicable	Duplicate of FF[1] 9
13	Ad	Ad	Ad
14	Ad	Ad	Ad
15	Ad	Ad	Ad
16	Ad	Ad	Duplicate of FF[1] 34
17	Ad	Ad	Duplicate of FF[1] 29
18	Ad	Ad	Ad
19	Ad	Ad	Ad
20	Ad	Ad	Ad
21	Ad	Ad	Ad
22	Applicable	Ad	Ad
23	Ad	Ad	Ad
24	Ad	Duplicate FF[1]27	Ad
25	Ad	Duplicate FF[1] 9	Ad
26	Ad	Applicable	Ad

27	Applicable	Ad	Ad
28	Applicable	Ad	Ad
29	Applicable	Ad	Duplicate FF[1] 27
30	Applicable	Ad	Ad
31	Ad	Ad	Duplicate FF[1] 9
32	Ad	Ad	Applicable
33	Applicable	Duplicate FF[1] 34	Ad
34	Applicable	Applicable	Ad
35	Ad	Ad	Ad
36	Ad	Ad	Ad
37	Ad	Ad	Ad
38	Ad	Ad	Ad
39	Ad	Applicable	Ad
40	Ad	Ad	Ad
41	Ad	Ad	Ad
42	Ad	Ad	Ad
43	Applicable	Ad	Duplicate FF[1] 22
44	Ad	Applicable	Ad
45	Applicable	Ad	Ad
46	Ad	Ad	Ad
47	Ad	Ad	Ad
48	Applicable	Ad	Ad
49	Dictionary	Ad	Applicable
50	Applicable	Ad	Applicable
[1]Abbreviation, FF= Firefox			

Table 1: Ranked Results of the Searches for the Key Word, "Denture".

Measures

To assess the quality of health-related information concerning dentures, validation tools were used to evaluate its various domains. The Simple Measure of Gobbledygook (SMOG) was used to assess readability [18]. Other domains were assessed with the Journal of the American Medical Association (JAMA) benchmark criteria tool for information in website articles, the DISCERN tool, and a modified version of the Ensuring Quality Information for Patients tool, MEQIP [1,19,20]. Readability analysis of the websites was conducted by placing a sample of content into the SMOG readability automated system [14]. For long passages, the number of ≥3 syllable words in 10 sentences from the beginning, middle, and end of the passages were counted; their square root determined and 3 added to the result for the grade level. For shorter passages, a conversion formula was used based on the polysyllabic word counts and lines of text. Details are available at TextCompare.org.

The JAMA benchmark quality criteria tool for information in website articles is a 4-point evaluation for: 1) authorship; 2) attribution; 3) disclosures; and 4) date of development/revision [21]. Websites were searched for having an author (yes, no); having attributed statements/facts with citations as needed (yes, no); having disclosed any conflicts of interest (yes, no); and providing year of creation/update (yes, no). The DISCERN tool consists of 16 questions with options of 1 (no) to 5 (yes) for each question. The DISCERN tool has potential scores from 16 to 80. It is used to determine the quality of the article's content, and details about treatment choices [20]. According to the tool, quality publications have explicit aims and meet those aims; have meaningful and explicit explanations; are balanced and provide citations/references; are current; describe benefits/risks/methods/ alternatives/consequences of no treatment; and address support options, quality of life and decision-making [16]. A Modified Ensuring Quality Information for Patients tool (MEQIP) was created to meet the specific needs of this study on denture information. Thirty items were evaluated (yes, item present =1; no, not present =0) for the MEQIP score (0-30) (Table 2) [19].

Definition, description, or purpose of dentures
Describes different types (immediate/conventional/partial/implant loaded)
Description of benefits
Description of risks (acclimation, allergies, etc.)
Description of alternatives
Description of sequence of denture construction (procedures)
Description of post-operative visits
Addresses impact on quality of life
Addresses eating
Addresses speech
Addresses appearance
Addresses singing
Addresses the appropriate use of adhesives
Addresses how to clean dentures
Addresses if dentures should be worn 24 hours/day
Describes the need for periodic oral evaluations (cancer screenings)
Describes the lifespan of a denture
Describes the need for denture relines or remakes
Provides date when the website was developed or revised
Provides information about the organization providing the information
Provides name of author that produced the website (reviewer)
Everyday language is used and complex words explained
Average sentence length is <15 words
Respectful tone
Clear information without ambiguities or contraindications
Balanced risks and benefits
Logical order
Satisfactory word layout
Clear figures and graphs
Provides lists of other resources

Table 2: Criteria for the Modified Ensuring Quality (denture) Information for Patients.

Statistical Analysis

Descriptive analyses (frequencies) of the results of the SMOG scores, JAMA benchmark criteria, DISCERN, and MEQIP were conducted. Kendall's tau (τ) nonparametric correlation analyses of website rankings for each of the web browsers and the scores were also conducted. The software package used for the analyses was IBM SPSS® version 26 (Armonk, NY).

Results

Using the search criteria listed above, the three web browsers retuned the following number of search results: Google Chrome®, n=14,000,000; Mozilla Firefox®, n= 14,400,000; and, Microsoft Internet Explorer®, n= 27,600,000. On each of the web browsers, the first 50 website articles were from electronic pages 1 through 4. A total of 150 website articles were examined. There were 120 (80%) advertisements, which were excluded. Two website articles were excluded as they did not correspond with the topic being examined (one was a dictionary definition, and one was an article limited to dental implants). There were 6 duplicate results among the web browsers. The final sample consisted of 22 unique websites (14.7%).

In terms of the JAMA criteria, the mean score was 1.6 (SD, 0.7). Three of the 22 website (13.6%) articles provided an author's name, and one provided a reviewer's name. Three articles attributed the American Dental Association (ADA) as a source, one cited the National Institutes of Health; and two cited the American College of Prosthodontics. One webs

ite article had attributions to 45 sources, including the ADA; however, there was a request for additional citations for verification. Eight had no attributions. Three had the Health on the Net (HON) symbol. HON is a not-for-profit organization with a mission to promote transparent, reliable online health-related information. Eighteen (81.8%) website articles had dates of development or revision. The dates ranged from 2007 to 2021. The mean year of development or revision was 2019.

Each web browser's first returns were advertisements. The first applicable article was the sixth returned website in Mozilla Foxfire®, the ninth returned website by Microsoft Internet Explorer®, and the tenth returned website by Google Chrome®.

The mean SMOG readability score was 8.35 (SD, 2.1). Scores were from 3.9 to 12.5. The mean score represented fairly easy or conversational English (eighth grade level).

The mean MEQIP score was 17.0 (SD, 5.1). The minimum MEQIP score was 5 and the maximum score was 29. The potential DISCERN scores were 16-80. The mean DISCERN score was 58.3 (SD, 10.8). The minimum DISCERN score was 20 and the maximum score was 80.

(Table 3) presents the Kendall's tau nonparametric correlation analysis of the search return rankings of the websites with the criteria to evaluate content quality. For the three web browsers examined, there were no significant relationships between their rankings and the criteria for evaluation.

	MEQIP	DISCERN	JAMA	SMOG
	r[1]p-value	rp-value	rp-value	rp-value
Mozilla Firefox®	-0.250.244	0.12 0.581	-0.130.585	-0.13 0.540
Microsoft Internet Explorer®	-0.400.121	-0.210.417	-0.130.623	-0.18 0.468
Google Chrome®	1.001.000	-0.391.000	-0.33 0.219	-0.23 0.369
[1]Kendall's tau-b correlations				

Table 3: Correlations of ranking and quality criteria.

Discussion

To the best of our knowledge, this is the first study to evaluate the quality of information about dentures available on the internet. The quality of information was not significantly related to the ranking of the article returned by Google Chrome®, Mozilla Firefox®, or Microsoft Internet Explorer® indicating poor quality articles and good quality articles about dentures were as likely to appear early in searches as further along in the searches. Information quality varied widely from misinformation to fair reporting. Of the 150 websites examined, there were only 22 (14.7%) unique websites that returned non-advertisement denture information from the three web browsers examined.

It should be noted, that 8 of the excluded advertisement websites offered do-it-yourself kits to fabricate dentures and/or purchase off-the-shelf dentures. This is particularly worrisome. As individuals searching online for educational resources are often inundated with advertisements, it becomes difficult to find needed, trustworthy health information. This trend appears to be growing. With the increasing globalized environment, internet web browsers have allowed firms access to larger markets to sell their products [21].As was the case with the results of this research, consumer-based websites are often mixed with, or ranked higher than, informational websites as firms can buy the positioning of their advertisements to expand their customer base, advance their products and increase their profits [21]. There is the potential for vulnerable/naive individuals to be influenced in the digital environment to make spurious decisions about their healthcare options without input from their healthcare provider.

Globally, the increase in the number of internet users has far outpaced the increase in the population. While the world population has increased by 1,570 million people between 2000 and 2019, the number of internet users has increased steeply by 4,626 million [22,23]. The increasing number of internet users everywhere can be attributed to the development and use of mobile technology, making possible a greater reach of the internet.

The increased number of internet users, combined with an incredibly low investment, offers opportunity for almost anybody that can read and write to have access and presence in the World Wide Web. Almost any business can reach a large market, directly, quickly, and economically, regardless of the size or location of the business. In 2019, worldwide retail e-commerce sales accounted for $3.53 billion (U.S.), with e-retail revenues projected to grow to 5.424 billion U.S. dollars in 2022 [24]. Although the initial intent was for businesses to benefit from internet access, given the low investment cost, it has created possibilities to present misleading information to boost sales.

It is not uncommon for product advertisements to have discrepancies in their content or to have incomplete information. Either of these has the possibility of nudging individuals to make choices that benefit the business and may not necessarily be helpful to the individual. Advertisements may lead to acceptance of inaccurate claims as facts about procedures or products. In a clinical setting, the patient may be so influenced by the advertisement that education provided by the clinician is discounted. Clinicians provide information about risks and benefits in a balanced manner so that patients can make autonomous informed decisions, a central tenet of healthcare ethics. Ambiguous or misleading claims on the internet can undermine the provider-patient relationship, or cause financial hardship to patients that may lead to civil litigation. A current example of a dental advertisement with a class action legal case (Kraus et al v. Snow Teeth Whitening et al. Case No. 20-cv-6085, E.D.N.Y) was filed for alleged fraudulent advertisement in a tooth whitening product [25].

In this study, some of the website articles provided references that were online links to other sites that did, in fact, further explain the topic. However, when the references were provided at the end of the website articles, they were often in small font and were difficult to locate. Even the HON symbol that was provided at the end of only three website articles in this study, was small and did not adequately identify its role in online health-related information. Further research into knowledge and recognition of the HON symbol is recommended.

Policy Implications and Future Research

Suggestions to disqualify misinformation have been met with scientific rigor and attempts to develop effective discourse to counteract the harm from misinformation [26]. Alarmist/negative approaches, satire, and accusation have had limited results [26]. Nevertheless, they are used in anti-drug ("This is your brain on drugs") and anti-smoking ("Real Stories: Tips from Smokers") campaigns. Sociologists and psychologists have conducted much research into developing a knowledge base and theories to counter rumors and are working toward application of that knowledge to online misinformation [27].These researchers indicate the need for an interdisciplinary approach [27]. One effective measure to reduce the spread of misinformation is the use of warnings such as "This tweet may have misinformation;" [28] however, it is beyond the scope of many platforms to monitor every tweet or posting for correct content. Another method that was successful occurred in research conducted with university students in which a "Fake news game" was helped them to recognize and critically evaluate information [30]. The game helped them to develop a "Cognitive Immunity" to some misinformation [30]. Misinformation is counteracted with education. As such, it is important for dental healthcare providers to be aware of the information that their patients may adopt and caution the patients about the ambiguity and potentially inaccurate online information. Providers need to help patients learn to assess online information critically. Patients should review the references cited in the online articles. Lastly, stricter regulations are required for businesses to upload only reliable, high quality online information. Additional interprofessional research is needed to develop successful interventions to protect the public from misinformation as a public health threat.

Strengths and Limitations

Our study has several strengths. There are very few research studies providing information on quality of website information, specifically on a dentures, useful for many older people. A strength of the study is that we used three most commonly used web browsers to retrieve information, viz., Google Chrome®, Mozilla Foxfire® and Microsoft Internet Explorer®. Another strength of the study is that it utilized three well-established validation tools to evaluate different domains of quality of health-related information, JAMA benchmarks; SMOG readability, and DISCERN. The modified EQIP, enabled a rigorous assessment of quality of the information. Similarly, the JAMA tool was used to measure the basic quality standards for internet information on healthcare [1]. Another strength is the use SMOG, since EQIP's evaluation of the comprehension of written information or readability is not adequate [19]. A strength of the correlational analysis used in this study is that it does not rely on an assumption of normality of the data.

Our study has limitations. The primary limitation of this paper also highlights the public impact of access to healthcare information. That impact is that strong information on healthcare is difficult to find and discern from misinformation, leading to a negative impact to public health and wellness.The final sample size was small, restricted to 22 websites after the duplications, advertisements, and other exclusion criteria were imposed. We were therefore constrained in doing further subgroup analyses with the data. We used four commonly available web browsers and there is a possibility that other browsers would have returned results with better quality.

Conclusion

Healthcare information is dynamic. Healthcare professionals have a licensing-imposed, limited number of continuing education requirements to meet to be updated with those dynamic changes. However, it is equally as important to hold oneself to a higher standard of life-long continuous education to be aware of new, evidence-based developments within one's profession and to be aware of the potential misrepresentations that would negatively affect one's patients. Providers and public health officials should help vulnerable populations discern quality websites that provide balanced and trustworthy information. Such information often is not the first returned results at various websites, as was evidenced in this research. Teaching the public to recognize website features (such as the HON symbol) and the source of information, as well as encouraging the use of medical portals would be beneficial. Much of the teaching of how to think critically is the responsibility of the education system; however, health information changes so rapidly, that healthcare providers and public health officials must have an integral role in providing reputable references and sources of information.

Declarations

Funding

Conflict of Interest

The authors do not report any conflicts of interest.

Ethical Approval

This research was determined to be non-human subject research by the West Virginia University Institutional Review board (protocol number, 2012193204).

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