Original Article

The Readability of Online Health Information on the Middle East Respiratory Syndrome Coronavirus Disease

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Abstract

The study aims at exploring the readability of health websites on Middle East respiratory syndrome coronavirus (MERS-CoV). The term "MERS" was searched in Google, Yahoo, and Bing search engines. The readability of the first 30 results for each search engine was evaluated by using the five readability scales, including Flesch-Kincaid Grade Level (FKGL), Flesch Reading Ease (FRE), Simple Measure of Gobbledygook (SMOG), Coleman-Liau Index (CLI), and Gunning Fog. Moreover, the official HONcode toolbar was used to identify websites that had been officially certified by the HON Foundation. Almost half of the retrieved websites were governmental (44.2%). All the surveyed websites were written above the recommended level and so, their readability is suitable for those with a high school or a college degree. The mean grade level for the MERS-related websites was in a similar range across the five readability scales. Furthermore, there was no association between the search rank, credibility, and readability. The readability level of MERS information available through search engine results exceeds the recommended 6th-grade level, and they do not currently adhere to the recommended readability guidelines. Even credible websites have provided content that is not readable enough for the public. Considering the lack of a specific policy about the providing of readable health information on the web, it is recommended for healthcare providers to advise their patients to use the online information after consulting with the physicians.

Keywords: the Middle East respiratory syndrome Coronavirus, MERS-CoV, Readability, e-Health, Health information, Self-care, Patient education, HONcode, Patient Portals

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Introduction

The Middle East respiratory syndrome (MERS) is a viral respiratory disease caused by a novel coronavirus (MERS-CoV) that was first identified in 2012 (1). Since 2012, MERS-CoV has been identified in 27 countries (1). In 35% of patients, the MERS infection has been led to death (2). There is currently no vaccine to prevent the disease. The most recent outbreak of MERS has raised questions about its symptoms as well as how to prevent it, and it is because good preventive health actions can help reduce the risk of infection in

people (3). For this purpose, it is useful to obtain information on preventive actions. In this regard, the internet is one of the main sources of health information. People use the Internet to find information about a disease, examine how to treat disease, and ask medical questions. This information can influence disease prevention, decision-making about how to choose a treatment as well as the decision to consult a physician (4). However, the ability of individuals to use health information appropriately depends on their ability to understand and interpret it (5). Whereas, to use health information accurately and effectively, this information must be consistent with the individual's health literacy.

Health literacy expresses cognitive and social skills and demonstrates individuals' motivation and ability to access, understand, and utilize information in a way that preserves and improves their health" (6). Health literacy is associated with better self-care (7), and the lack of health literacy is directly related to poorer health outcomes (8). Health literacy is a complex concept that encompasses the skills, knowledge, and expectations of health professionals of health information and health services. Personal skills are an important part of health literacy, but health literacy is not just related to the individual's abilities. In the United States, health literacy reflects the actions of health systems to provide understandable and practical health information and services.

Health professionals, the media, government agencies, and the private sector often provide health information in ways that make it difficult to understand and use the information. Publicly available health information may also be incomplete or inaccurate. As a result, the skills of health professionals, the media, government agencies and the private sector to deliver health information in a way that is appropriate to their audiences are as important as the individual skills (9). Many factors, including readability, can help alleviate problems arising from a lack of health literacy (10). Readability is how easy it is to read and understand the text. A readable text includes content that an individual can read fluently and easily understand its meaning (11).

Health information and health services are often unfamiliar, complex, and technical for everyone, even for those with a high level of education. People of any age, race, income, and level of education (not just people with the limited reading ability or people whose second language is English) may have limited health literacy. According to a survey by the US Department of Education, only 12 percent of English-speaking adults in the United States have information literacy skills, while a lack of health literacy affects low-income groups and minorities (12). On the other hand, some communities face numerous communication barriers, including concurrent lack of health literacy and limited English proficiency (LEP) (13). Furthermore, a study conducted to measure patients' reading ability in a public hospital showed that although the patients were high school graduates, their average reading ability was at a 7th-grade level (14).

The level of written health information should be such that it is easy to understand the information by the general public, and complicated medical terms and jargon should not be used at the time of providing health information (15). In this regard, health organizations such as the American Medical Association (AMA) and the National Institutes of Health (NIH) recommend that the readability of patient education materials should not exceed the sixth-grade reading level (16) and the level of medical and health training materials should be usually understood by an 11-year-old person (17). Despite these recommendations, health information sources are often written at a higher level than most people's ability to read and in a highly technical, complex, and vague manner (18–23), The gap between the reading level of written health information and individuals' information literacy skills is well documented (9). Moreover, a significant proportion of the population worldwide has inadequate health literacy (24).

Regarding that, the anxiety and phobia due to a highly transmissible and viral infection such as MERS may impede the proper understanding of relevant information (25), and given the importance of the readability of health information, this study examines the readability of health websites related to MERS disease.

Methods

Search strategy: to do this research and to identify websites that are easily available to the general public,

the keyword " MERS " was searched in the three most popular search engines Yahoo, Google, and Bing (26,27). The search was performed on October 21, 2019, using the Google Chrome browser. The private mode of the browser was set, and all the search history and cookies were cleared before searching. Given that 90% of search engine users read only the first three pages of search results (28), the first three pages of search results of each search engine (the first 30 results reported by each search engine) were included in the study. All URLs were analyzed and redundant websites including irrelevant, non-English, duplicate, advertising, and inaccessible websites were excluded. After excluding the 47 redundant websites, 43 unique websites were eligible for evaluation (Figure1). The links of retrieved web pages were stored in the Excel file depending on how they initially appeared in each search engine result.

Readability Measurement Tool: To improve the validity of this study, five readability scales including Flesch-Kincaid Grade Level (FKGL), Flesch Reading Ease (FRE), Simple Measure of Gobbledygook (SMOG), Coleman-Liau Index (CLI), and Gunning Fog, were used to assess the readability of MERS related websites. These scales have been used in numerous studies (29–36). Furthermore, the FKGL, Gunning Fog, and SMOG scales are recommended by the National Institutes of Health for analyzing the readability of health information (37). Each of these scales checks the readability of a written text by a different technique.

The Flesch Reading Ease formula produces a score from 0 to 100. A higher score indicates higher readability. Generally, a text with a score between 90-100 can be understood by a person with 5th-grade reading skills. While a text with a reading score of 0-30 can be understood just by the people who possess a college degree.

The Flesch-Kincaid Grade Level formula produces a score that corresponds to the grade level of the written material. For instance, a score of 7.4 indicates that the text is readable by a seventh-grader.

The Gunning Fog formula is similar to the Flesch readability scale because it compares the syllables and length of the sentence. The scores of 5,10,15,20 indicate that the text is easily readable, hard

to read, difficult to read, and very difficult to understand, respectively.

The SMOG index estimates the years of education a person needs to understand a written text. For example, a score of 7.4 indicates that the text can be read and understood by a seventh-grade student. The Coleman-Liau index considers the number of characters instead of the syllables in each word and sentence. The result of this formula represents the grade of education that is needed to understand the written content. For example, 10.6 means that the text is appropriate and comprehensible for high school students in grades 10-11.

To use these scales, the free online automatic readability checker tool available at "www.readabilityformulas.com" was used (38). This web-based tool analyzes the readability of English texts using several scales such as the five ones used in this study. It has also been used in the readability evaluation of health-related written materials (29–36). The results were stored in SPSS version 17 based on the five scales mentioned above.

In this study, it was assumed that there is an association between the readability and credibility of websites. To do so, the HONcode toolbar was selected to identify websites that had been officially certified (39). This toolbar has been used in various studies to identify the HONcode officially verified websites (40–45). The Mann-Whitney test was used to test the difference between the readability and the officially verified and non-verified websites.

It was assumed that there is an association between the readability and websites' domain. Thus, the eligible websites were divided into three categories including Governmental, Commercial and organizational websites. The Kruskal-Wallis test was also used to find the correlation between the readability and websites' domain. The difference in the readability in terms of the websites' rank order during the initial search and the difference in the readability and the page number of the search results also was test by Kruskal-Wallis.

This research has been approved by the ethics committee of Shahid Beheshti University of Medical Sciences (ethics code: IR.SBMU.RETECH.REC.1399.848).

Results

A total of 43 MERS disease-related websites retrieved from three search engines were evaluated. Most of the related websites were retrieved by the Google search engine (N = 26).

Most of the websites relevant to the MERS belonged to the first pages of search results (N = 17) (Table 1). Among the different search results pages, the first page results contained more credible web pages compared to the second and third pages (35%); however, even on the first page, most websites were not HON verified.

Almost most of the retrieved websites (44.2%) were governmental (Table 2). Merely, 10 of the 43 assessed websites were officially verified by HONcode. None of the government websites were officially approved (Table 2).

The mean and standard deviation of the readability scores of the surveyed websites by the search engines are presented in Table 3. According to the Kruskal-Wallis test, there was no statistically significant difference between the mean readability scores of the websites in different search engine results (P value> 0.05).

The mean and standard deviation of the readability scores of the surveyed websites by the domain of websites are reported in Table 4. According to the Kruskal-Wallis test, there was no significant difference between the mean readability scores of the websites across different domains (Table 4).

The mean and standard deviation of the readability scores of the surveyed websites by the page
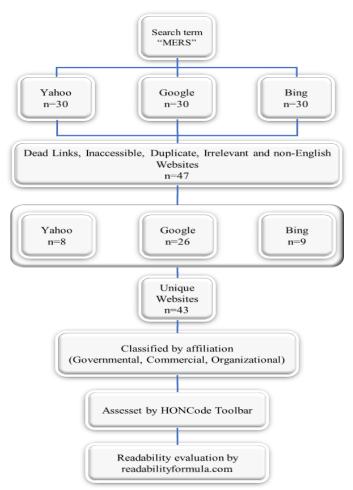

Figure 1. The flow diagram of search on the Internet.

Table 1: The frequency of HON Verified websites in each search engine results.

Search engine		Frequency	HON Verified	Total (Percent)
Google	Pages 1	9	3(33%)	
	Pages 2	9	1(11%)	26 (60.5%)
	Pages 3	8	0(0%)	
Yahoo	Pages 1	3	2(67%)	
	Pages 2	2	1(50%)	8 (18.6%)
	Pages 3	3	1(33%)	
Bing	Pages 1	5	1(20%)	
	Pages 2	2	1(50%)	9 (20.9%)
	Pages 3	2	0(0%)	
Total	Pages 1	17	6(35%)	
	Pages 2	13	3(23%)	43 (100%)
	Pages 3	13	1(8%)	

Table 2: The number of HON Verified websites in each domain.

Domain	HON Verified Yes	HON Verified No	Total
Commercial	3	9	12 (27.9%)
Governmental	0	19	19 (44.2%)
Organization	7	5	12 (27.9%)
Total	10	33	43 (100%)

Table 3: The mean and standard deviation of the readability scores of the surveyed websites by search engines.

Readability formula	Mean (SD)				P-value
	Google	Bing	Yahoo	Total	
FRE	42.52(14.14) (Difficult to read)*	46.19(9.11) (Difficult to read)	46.53(13.51) (Difficult to read)	44.03(12.99) (Difficult to read)	0.578
Gunning Fog	13.59(2.75) (Hard to read)	13.28(2.18) (Hard to read)	13.80 (2.98) (Hard to read)	13.56 (2.63) (Hard to read)	0.900
FKGL	12.34(3.27) (12th grade)	11.37(1.92) (11th grade)	11.46(3.02) (11th grade)	11.97(2.96) (12th grade)	0.510
Coleman-Liau	11.69(1.74) (11th grade)	11.22(1.92) (11th grade)	11.25(1.91) (11th grade)	11.51(1.78) (11th grade)	0.683
SMOG	10.91(2.32) (11th grade)	10.31(1.54) (10th grade)	10.55(2.25) (10th grade)	10.72(2.13) (11th grade)	0.609

* Items in parentheses are general assessments, age levels, or US-equivalent grade levels.

number of search engine results are reported in Table 5. The results show that although the readability of the websites retrieved on the first page of search engines is better, according to the Kruskal-Wallis test, the mean readability scores of the websites among the different pages of search engine results were not significantly different (P-value> 0.05).

The mean and standard deviation of the readability scores of the surveyed websites by their credibility are reported in Table 6. The results show

Table 4: The mean and standard deviation of the readability scores of the surveyed websites by domain.

Readability formula	Mean (SD)			P-value
	Commercial	**Governmental**	**Organization**	
FRE	44.75 (12.63) **(Difficult to read)**	44.16 (11.10) **(Difficult to read)**	43.11 (16.67) **(Difficult to read)**	0.968
Gunning Fog	13.35 (2.06) **(Hard to read)**	13.15 (2.14) **(Hard to read)**	14.43 (3.67) **(Hard to read)**	0.506
FKGL	11.79 (2.55) **(12th grade)**	11.88 (2.77) **(12th grade)**	12.30 (3.79) **(12th grade)**	0.997
Coleman-Liau	10.75 (1.54) **(11th grade)**	11.84 (1.17) **(12th grade)**	11.75 (2.56) **(12th grade)**	0.192
SMOG	10.66 (1.97) **(10th grade)**	10.41 (1.78) **(10th grade)**	11.27 (2.80) **(11th grade)**	0.577

Table 5: The mean and standard deviation of the readability scores of the surveyed websites by search engine pages.

Readability formula	Mean (SD)			P-value
	Page 1	**Page 2**	**Page 3**	
FRE	44.29 (9.09) **(Difficult to read)**	43.92 (17.20) **(Difficult to read)**	43.80 (13.59) **(Difficult to read)**	0.829
Gunning Fog	13.57 (2.48) **(Hard to read)**	13.56 (2.96) **(Hard to read)**	13.55 (2.69) **(Hard to read)**	0.920
FKGL	11.70 (2.22) **(12th grade)**	12.22 (3.90) **(12th grade)**	12.08 (2.96) **(12th grade)**	0.753
Coleman-Liau	11.24 (1.99) **(11th grade)**	11.54 (1.61) **(11th grade)**	11.85 (1.73) **(12th grade)**	0.601
SMOG	10.69 (1.63) **(10th grade)**	10.74 (2.71) **(11th grade)**	10.72 (2.25) **(11th grade)**	0.722

that although the readability of the HON verified websites was better than the other websites, but based on the Mann Whitney test, the mean readability scores of the websites were not significantly different between the verified and non-verified websites.

The search was performed using the most popular search engines, Yahoo, Google, and Bing, and searches on other search engines may have different results. Moreover, given the dynamic characteristics of websites, searching at different periods may yield different results.

Discussion

The use of plain language at the time of writing for the web allows users to find what they need, understand it, and then use it to meet their needs (46).

This study examines the readability of the websites that are relevant to MERS disease and are accessible to the general public.

Table 6: The mean and standard deviation of the readability scores in officially verified and not verified websites.

Readability formula	Mean (SD)		P-value
	Officially verified	**Not verified**	
FRE	45.40 (13.17) **(Difficult to read)**	43.62 (13.12) **(Difficult to read)**	0.508
Gunning Fog	14.35 (3.06) **(Hard to read)**	13.32 (2.49) **(Hard to read)**	0.372
FKGL	11.77 (3.18) **(12th grade)**	12.03 (2.95) **(12th grade)**	0.463
Coleman-Liau	11.10 (2.13) **(11th grade)**	11.64 (1.67) **(11th grade)**	0.334
SMOG	10.95 (2.29) **(11th grade)**	10.65 (2.12) **(10th grade)**	0.719

The mean level of the readability for the 43 assessed websites providing information on MERS had a similar range across all the readability scales used in this study. All of the surveyed websites were written above the recommended level and so, their readability is suitable for those with a high school or a college degree. However, it is recommended that health websites must be readable to an 11-year-old person or by people with a sixth-grade reading level (17). The findings are similar to the research on the readability evaluation of websites on COVID-19 disease (47) as well as several studies on various health topics (48–51).

In this research, the readability of the websites was also evaluated based on the websites' domain. Government websites are expected to be more readable than other types of websites, as these types of websites are usually intended to educate the general public (52) . But the findings of the present study showed that the readability of MERS disease-related websites in all domains, including government websites, is inappropriate (Table 4). However, in some other studies, the findings have shown that government websites are more readable than the other websites (49). Therefore, people looking for information on or about the prevention, symptoms, treatment, and management of MERS disease on government websites will find content with a high readability level,

which may lead them to misunderstand the information. This misunderstanding of the information may lead to anxiety or incorrect health decision-making.

The findings of the present study showed that although the readability of the websites retrieved on the first page of the search engines results was better than that of the websites retrieved on the second and third pages, there was no statistically significant difference between the mean readability scores of the websites across different pages (Table 5). Indeed, there is no relationship between the ranking of search results and their readability. A study on pediatric emergency medicine-related complaints also found no relationship between the readability of websites and their ranking. However, at the time of searching for health information, most people study the first page of the search results (50,53). Thus, people looking for information about MERS will find websites with poor readability, which may lead them to misunderstand the information.

Therefore, different health organizations, in addition to trying to make their websites better ranked by the search engine, should also pay particular attention to the readability of their websites so that the content provided would be properly understood by individuals. This will lead people to benefit more from health information websites in preventive actions and

health decision making and to cope with communicable diseases such as MERS.

The findings showed that only a small amount of the MERS-related websites were HON verified and credible to use. Considering the lack of a specific policy about the publication of credible health information on the web, healthcare providers must advise their patients to use only trustworthy websites that contain high-quality information. Furthermore, it is necessary to teach them the criteria for assessing the trustworthiness of health websites

In this study, the relationship between the readability of websites and their credibility based on HONcode principles was also investigated. The findings showed that the readability of the surveyed websites is poor. Although the readability of the officially approved websites was better than other websites, no significant difference was found between the officially verified and non-verified websites (Table 6). Thus, people who seek out information on MERS even on credible websites will encounter readability problems that may lead to wrong understanding and non-appropriate health decisions. While in research on the readability of prostate health websites, the credible websites had better readability than the non-credible ones (54). It is therefore recommended that authoritative organizations providing health information about various infectious and hazardous diseases, including MERS, pay more attention to enhancing the readability of their websites, thereby helping people understand the content provided .This will lead to higher health literacy and better health decision-making since the relationship between health literacy, health outcomes, and the utilization of health information resources is currently well proven. Some documents highlight the importance of health literacy in the outcomes and consequences of infectious diseases. In this regard, the European Centre for Disease Prevention and Control (ECDC) has described the role that health literacy can play in infectious diseases (55). On the other hand, International organizations recommend that websites be readable for an 11-year-old person or people with a sixth-grade education level. Nevertheless, the findings of this study showed that all MERS-related websites that result from public search engines were written above the recommended level. Thus, the websites on MERS

disease which were assessed in this study are understandable only for those whose education level is at least at the high school level, and easy to read for those with a college degree. Thus, it seems that the information available on these websites will not be able to improve individuals' health literacy on MERS disease. Whereas, "Easy-to-read written health information may be important not only for making written health information comprehensible but also for increasing readers' self-efficacy for adopting health-related behaviors (56)".

Considering the lack of a specific policy about the providing of readable health information on the web, it is recommended for healthcare providers to advise their patients to use the online information after consulting with the physicians.

This study also had some limitations. The present research evaluated the readability of MERS disease-related websites. Regarding that the readability of health websites may vary by topic of the website, thus, further researches are needed to be done on other health topics.

Conclusion

The reading level of online information related to MERS exceeds the recommended grade level for patient education materials. Even the information provided on each of the websites of government agencies was not readable enough. While MERS is an infectious and hazardous disease and people may have great concerns about the prevention and prevalence of the disease. This effort is expected to raise awareness of web readability issues in health information websites. As people with different conditions may have particular information needs, thus, it is recommended to health organizations appraise the readability of their websites and provide information that is readable enough and understandable to everyone in the community. This will lead to more effective educations on disease prevention and an increase in the level of health literacy of people and a better awareness of infectious diseases such as MERS.

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Conflicts of Interest

The authors declare that there are no conflicts of interest.

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