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Evaluation of Quality and Readability of Health Information of Diabetes Websites Using DISCERN Checklist and GUNNING Index

Mohammad Azami, Maryam Moazami*

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Abstract

Purpose: Most of the information accessible on the Internet is not only useless, but also may be false or misleading. This is of greater significance about medical information that seems alarming. Thus, the purpose of the study was to examine the quality, level of readability and coverage of health information of Persian-language websites concerning diabetes. Method: The study was applied in terms of its purpose and mixed method in terms of nature where content analysis method was used. In the study, the websites on diabetes were reviewed using the Discern checklist, Gunning Readability Index and the interviews were conducted with the patients admitted to the website for information about their illness. Results: The results showed that the readability of the websites on diabetes is not so desirable. The credibility of the information was largely undesirable. The quality of diabetes sites was not so desirable. Moreover, the overall ranking of publication sites regarding diabetes is moderate. Additionally, the results of the interviews showed that the quality of information about diabetes and the quality and structure of the website were evaluated from three aspects of drug information, information proportionality and overlapping of important information. Discussion and Conclusion: Given the low readability, undesirable quality and credibility of information on diabetes websites, providers and professionals should try to provide websites with simple, understandable, and relevant information for the entire society.

Keywords: Level of readability, quality of information, information credibility, diabetes websites, information coverage, health information

Introduction

Nowadays, millions of people use the Internet, and in most of the world's scientific and research centers, the use of the World Wide Web has reached its peak for educational and research purposes (Azami er al., 2019). The Internet is increasingly being used as a health information source and the search for health information on the Internet is the third most popular online activity (Sowter et al., 2016). Among the groups referring to these websites to meet their information needs are the diabetic patients. Diabetes is a chronic illness that a person suffers from when the pancreas does not produce insulin or the body cannot use the produced insulin effectively (Timareh et al., 2012). Diabetes reduces the life quality in almost all areas of life. This disease leaves a negative effect on the life quality and can endanger the patient's physical function (complications of the disease), mental status (depression) and social function (incompatibility). On the other hand, diabetes-related vascular side effects throughout the life expose the patients to increased heart stroke and stroke, renal failure, blindness, and amputation, imposing heavy burdens on them. These issues raise concerns and dissatisfaction with life and decrease the life quality (Timareh et al., 2012).

According to the World Health Organization (WHO), the number of people with diabetes has increased from 198 million to 422 million in 2014, meaning the number of people with diabetes will increase day-by-day (Miksch et al., 2009). In addition to an increase in the number of people with diabetes, information available on the web environment is another challenge that has raised concerns about the quality of information and the impact of this information on patients. Despite the wide variety of information available on websites and the combination of accurate and incorrect information, determining the quality and accuracy of information for patients is difficult (Pauer et al., 2016). The study in 2001 by RAND for the California Health Foundation showed that the information on the health website is often incomplete or outdated (Wang & Liu, 2007). Additionally, the lack of information control due to the lack of content management, arbitration, and editorial procedures for publishing content on websites has led the reliable and correct information to be alongside inaccurate information, which has rendered information evaluation in this environment a critical issue. Determining correct information from the incorrect is simply not possible to for most patients (Pauer et al., 2016).

Mohammad Azami
PhD, Assistant professor, Medical Informatics Research Center, Institute for Futures Studies in Health, Kerman University of Medical Sciences, Kerman, Iran.

Maryam Moazami*
MSc, Dept. of MedicaL Library and Information Sciences, Kerman University of Medical Sciences, Kerman, Iran.

***Email:** maryammoazami22@gmail.com

One of the methods helping solve this problem is evaluating and ranking web sites using and applying scientific methods. Regarding this, attention to evaluation of websites retrieved due to their direct effect on the health and well-being of individuals is important. Given the multiplicity of intervening criteria, evaluating information on web pages by users calls for the minimum level of expertise in related areas that ordinary health users do not have (Ghalavand et al., 2012). Among the evaluation indices of medical websites are the quality of information, the level of readability and the coverage of health information. The quality of information is closely related to information value. When evaluating the quality of information, factors such as proportionality, reliability, validity, semantics, completeness, accuracy, and timeliness will be decisive. At the level of readability of information, the proportionality of the text with the level of reading ability of the individual is important. Moreover, in the information coverage, the amount of subscription is among the subject coverage of the websites, evaluated by different dimensions, such as resources and type of information (Ghalavand et al., 2012; Callast Abbac. 2007)

The first source of information for patients is a specialist physician, but due to the limited time or weak communication skills of the physicians, it is essential to provide a patient education program, especially in the treatment of chronic diseases that requires self-care. One of these chronic diseases is diabetes, which has become a prevalent disease due to the prevailing style of life around the world, especially in developing countries. Diabetes is one of the common diseases in Iran and the world that is chronic and costly leading to many complications. It is always difficult for people with diabetes to accept to change their way of life based on disease. Developing mood disorders including depression will not be unexpected in these people, as these patients often have no knowledge of the short-term and long-term complications of the disease (Azami er al., 2019; Timareh et al., 2012). Moreover, the age of diabetes is reduced to adolescence. Thus, the prevention and control of this disease have been focused on and educational and information resources have been provided to these patients for the prevention and control of disease progression. For proper use of educational resources, these resources should be comprehensible to their audience and their readability should be consistent with the level of literacy of patients who use these resources. Nowadays, communication tools and e-information exchange between patients and healthcare centers and custodians are used in a different way, the most common and comprehensive of which is the website (Pauer et al., 2016; Mohammad Esmaeil & Ghaemi, 2009).

Web sites are a structured set of data shown as text, graphics, and videos. The most significant goal of any website is to provide information (Sowter et al., 2016). Whether a website meets the expectations of users and customers is an important issue that correlates with the quality of the website. The literature indicates no single and precise definition of the quality of website services as the variety of existing websites is very high and the dimensions of service quality vary by type of website. For example, dimensions such as reliability, ease of use and security for the websites that do e-commerce are of great importance. For the websites catering products or services, the search capabilities and reliability of digital information are of great importance. Each website may be connecte to several other websites (Mohammad Esmaeil & Ghaemi, 2009). On the other hand, to overcome this problem and to provide appropriate educational resources and information for patients, the level of health literacy and readability of educational and information resources such as websites should be evaluate simultaneously. This evaluation will indicate how well the training and information materials are available to patients getting this information. As electronic educational and information resources are the most important factors affecting the level of health literacy of diabetic patients in their health and self-care behaviors, and understanding these resources is closely related to their readability, examining the level of readability, quality and coverage of health information of Persian websites on diabetes seems necessary (Khosravi et al., 2013). The above points determine the importance of website quality and legibility regarding diabetes. Accordingly, the evaluation of these websites in terms of quality, level of readability and coverage of health information of Persian websites in regarding diabetes is necessary. Thus, this study is an attempt to enhance the quality, readability and coverage of health information of Iranian websites in the field of diabetes using three tools: gunning, discern, and interview. The results are likely to identify these reference resources through the scientific ranking of websites and direct diabetic patients towards them.

Methodology

The study method was combined (quantitative and qualitative). In this study, there are two populations. The first population was the patients admitted to Kerman Diabetes Centers who use medical websites to diagnose the disease, type of treatment. The second population was the Persian websites active in diabetes. In the first population, the diabetic patients, the sample size was chosen as purposive. Accordingly, it was mandatory to have two conditions for diabetic patients and users using websites to enter the study. After interviewing 16 people, the researcher realized that she had reached a theoretical saturation. The keyword “diabetes” and “blood glucose” were searched for in three search engines (Google, Yahoo, Bing) for selecting websites. Among the results of the recovery, the first three pages of each search engine used to be examined. Moreover, all the links in the retrieved websites were observed and if related to the domain of diabetes, were added to the web site listings. Non-specialized sites, such as blogs, news websites, and Wikipedia were deleted and 84 websites were retrieved with 70 websites eventually examined in the study. Selected websites were evaluated in terms of quality using Discern checklist, in terms of readability with the Gunning Index, and in terms of information coverage by interview. Discern criterion has been developed by the Public Health and Primary Health Care Department of Oxford University (Khosravi et al., 2016). The checklist has 16 questions in three distinct sections. In each question, score 5 is assigned to the highest option and score 1 for

the last option. Scores of 2-4 are assigned to the answers between the two. Overall, 80 points was given to the websites meting all the criteria, and 16 to the ones not meeting any criteria. The checklist has three parts: publishing credibility, information quality, and general ranking of publications. The first part consists of questions 1-8 to evaluate the validity of the publication information, the second part was the questions 9-15, which evaluates the quality of information, and the third part was question 16, ranking the publication as a whole (Cho et al., 2008). The content of the websites was specified by the researcher and degree of readability for each web site based on the Gunning Readability Index. The Gunning readability index is a readability formula specifying the complexity of the language with the degree of readability of the texts. This formula evaluates the readability by analysis of the text. This analysis is done on the vocabulary, phrases and sentences of a single entry and by counting them (words and sentences) and using a specific formula and relationship, the value and level of difficulty or the degree of proportionality of the text with the age and level of reading ability is determined (Shekari & Najarian, 2017). In this method, the two factors are the length of the word and the length of the sentence and in that difficult vocabulary contains those words composed of four or more syllables. The interviews were semi-structured. Diabetic patients first answered some general questions and then answered a number of questions. Each interview took 45 to 60 minutes. The interviews were recorded by a tape recorder, and then written as text. Content analysis was used to analyze the converted into text. In the interview method, ONE NOTE software 2010 was used to analyze and categorize the quotations. In each text, the main words were highlighted and underlined. Repetitive sentences, tag questions, and diversions and so on were ignored and then a series of categories was obtained by reviewing the basic statements. By examining and analyzing the interviews, similar categories were associated with related topics and repetitious categories were deleted. The remaining categories were entitled as the main themes. Finally, a report of data analysis was obtained.

Results

Question 1: What is the status of the Persian websites regarding diabetes, in terms of credibility?
Using DISCERN Evaluation Index (8 items about the 70 websites), one sample t-test was used to answer the above question. The results are as follows:

Table 1. The mean of each data validation question for diabetes websites

Questions	q1	q2	q3	q4	q5	q6	q7	q8
Mean	3.34	2.9	3	2.73	2.79	2.83	2	2.31
Sum mean	2.74							

The mean of data validation for diabetes websites has been obtained from a value of 1 to 5, amounting to 2.74.

Table 2. T-test results of one sample t-test for information validity

Variable	t	Df	Sig	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Information validity	-2.281	69	0.026	-0.26250	-0.4920	-0.0330

The results of one smaple t-test showed that the value of T -2.28, degree of freedom 69 and the mean difference was -0.26. Finally, the significance level was 0.026, so the significant level was less than 0.05.

One can state that the average validity of information of the websites on diabetes is slightly different and, given the confidence interval and the mean of less than the hypothetical average, it can be seen that the validity of the information is largely undesirable, i.e. the validity of most sites is not confirmed.

Question 2: How is the information quality on Persian websites regarding diabetes?
DISCERN evaluation Index was used to answer the above question. In this regard, using 8 items of credentials, 70 websites were evaluated and the results were as follows:

Table 3. The mean of each quality information for websites regarding diabetes

Questions	q9	q10	q11	q12	q13	q14	q15
Mean	2.949	2.519	2.09	1.89	2.73	2.879	2.69
Sum mean	2.53						

The mean of information quality of the websites regarding diabetes was obtained as 2.53 using 7 items.

Table 4. The results of one sample t-test for information quality

Variable	T	df	Sig	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Information quality	-4.524	69	0.000	-046939	-0.6764	-0.2624

The results of one sample t-test - regarding the quality of information - show that the t value is -4.52, the degree of freedom 69, and the significance level 0.000. Thus, one could state that the quality of websites on diabetes is inappropriate and lacks the desirable quality.

Question 3: How are Persian websites on diabetes regarding general ranking?
Discern evaluation index was used to answer the above question. Regarding this, using a general ranking item of 70 websites publications was evaluated and the results were obtained as follows:

Table 5. Mean of overall publications ranking of website on diabetes

Question	q16
Mean	2.77
Sum mean	2.77

The mean overall publications ranking of website on diabetes is 2.772.

Table 6. One sample t-test results for the general ranking of publication

Variable	t	df	Sig	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Ranking of publication	-1.730	69	0.088	-0.22857	-0.4922	0.351

The results of one sample t-test show that the overall ranking of publication of websites on diabetes with t-value of -1.730, degree of freedom of 69, the significance level of 0.088, and a mean difference of -0.23, is insignificant as the significance level obtained is more than 0.05. Thus, one can conclude that the overall ranking of the publications of websites on diabetes is at a favorable and moderate level.

Question 4. How is the coverage of information on Persian websites on diabetes?
In this section, the data from the interview is examined. The data were described based on units, categories, and variables, or encoded in multi-dimensional designs. First, the main codes were identified, followed by sub-codes. Finally, the similar extracted data were placed next to each other and brought under one main theme. Data categorization should be comprehensive and inclusive i.e. no data should be omitted as it does not fit into a particular class, nor should any data be between two classes or more than one class. The data collected from the interview were then analyzed:

Organizing interview information

First, all the concepts discussed were extracted in the interview.

Table 7. The initial extracted concepts from the interviews

Questions	**Frequency**	**Concepts**					
Expectation form the website	20	Valid and effective website, methods of preventing diabetes, the introduction and history of diabetes, how to treat, to diagnose drugs and their effects, offering medical education videos for treatment, comprehensive and complete information, scientific information, the availability of information, the citation of information appropriate nutrition for diabetic patients, specialized information on diabetes, introduction of symptoms of diabetes, increased coverage of the community in terms of education level, complications of diabetes, system availability, satisfaction, beautiful appearance, reliability, storage capacity, information accuracy, agent quality with users, website processing speed					
Patients and	7		Very unfavorable	Unfavorable	Average	Favorable	Very

treatment information							favorable
		Person	1	2	6	4	2
		Normal and usual, with no scientific confirmation, information on treatment of disease, low specialty, disease invention, learning and learning aspects, uncertainty					
Referee information	7		Very unfavorable	Unfavorable	Average	Favorable	Very favorable
		Person	1	1	3	7	3
		Failure to provide complications, only beneficial effects of the drug, general and general, non-specialized, drug interactions, allergy and medication					
Information proportionality	6		Very unfavorable	Unfavorable	Average	Favorable	Very favorable
		Person	1	2	3	7	2
		Related to the information needs of the users, general and public information, information proportionality, problem solver and guide, and information completion					
Information overlap	13		Very low overlap	Low overlap	Average overlap	High overlap	Very high overlap
		Person	3	5	4	2	1
		Copy, repetitive, notifier, complete information, update and high overlapping in information retrieval, covering general information, suggesting solutions, planning for notification, wide and in a variety of domains, without overlapping, 60% overlapping, comprehensive information,					
Total	53						

As is seen in the table, 53 concepts were extracted from the interview in the preliminary study. The mean of information favorability about disease and treatment is 3.13, which was slightly higher than average. The mean of drug information of the websites on diabetes was 3.66, which is between the moderate and desirable. Ultimately, as 15 persons examined the information proportionality and an average was 3.16, one can state that according to the interviewees, the proportionality of information was between moderate to favorable.

Removal of unrelated indices and integrating indices with conceptual overlap

At this step, 53 concepts were mentioned and carefully evaluated, and finally the indices with conceptual overlap are merged. Firstly, according to the interviewees, the expectations from the website are divided into two parts - information on diabetes and the quality and structure of the website - each of which mentions some issues as shown in the diagram below.

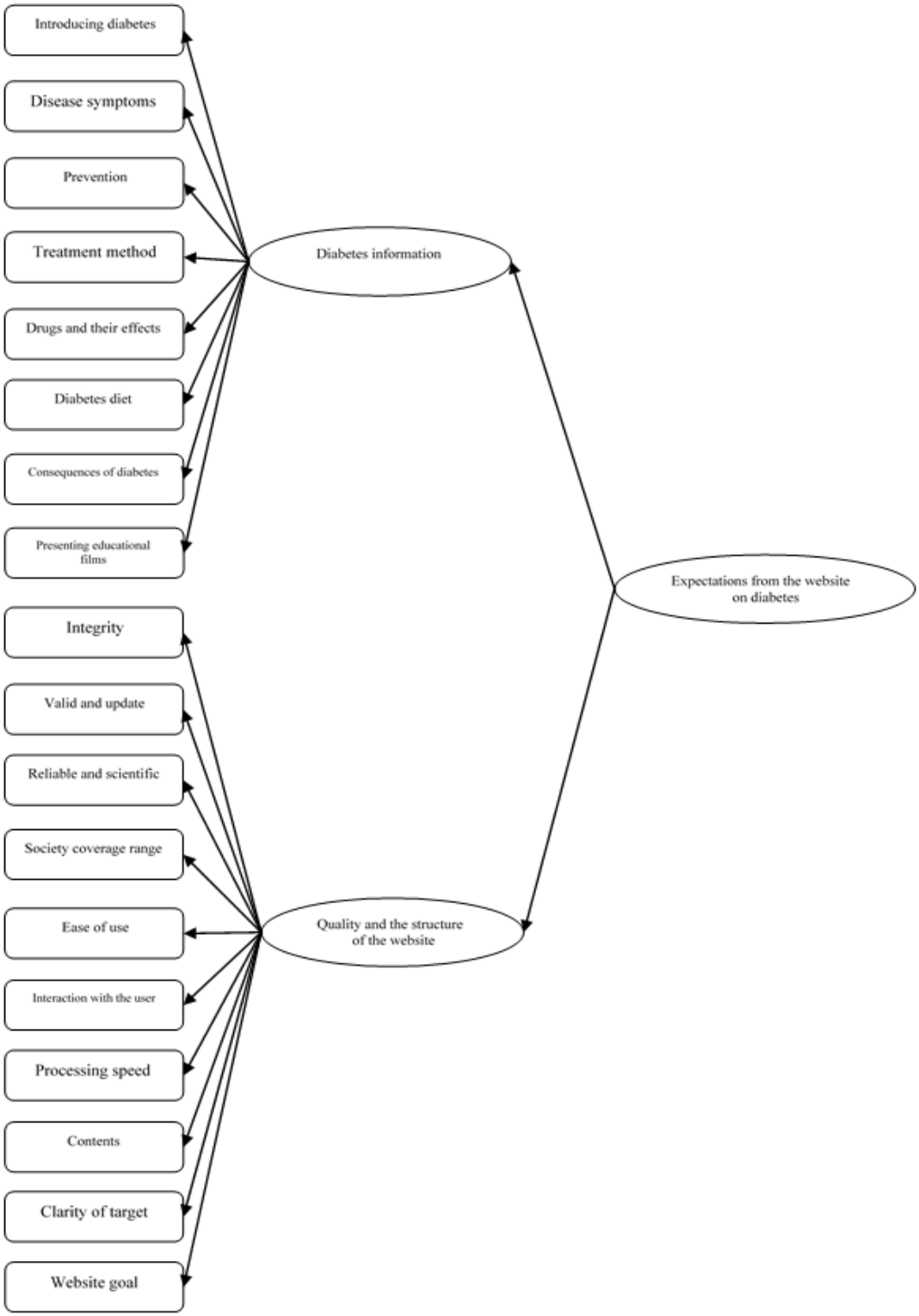

Figure 1. Indices of the expectation from the website on diabetes

Then, the quality of the information presented on the website was evaluated based on three aspects of drug information, proportionality of information and information overlap and their indices were determined.

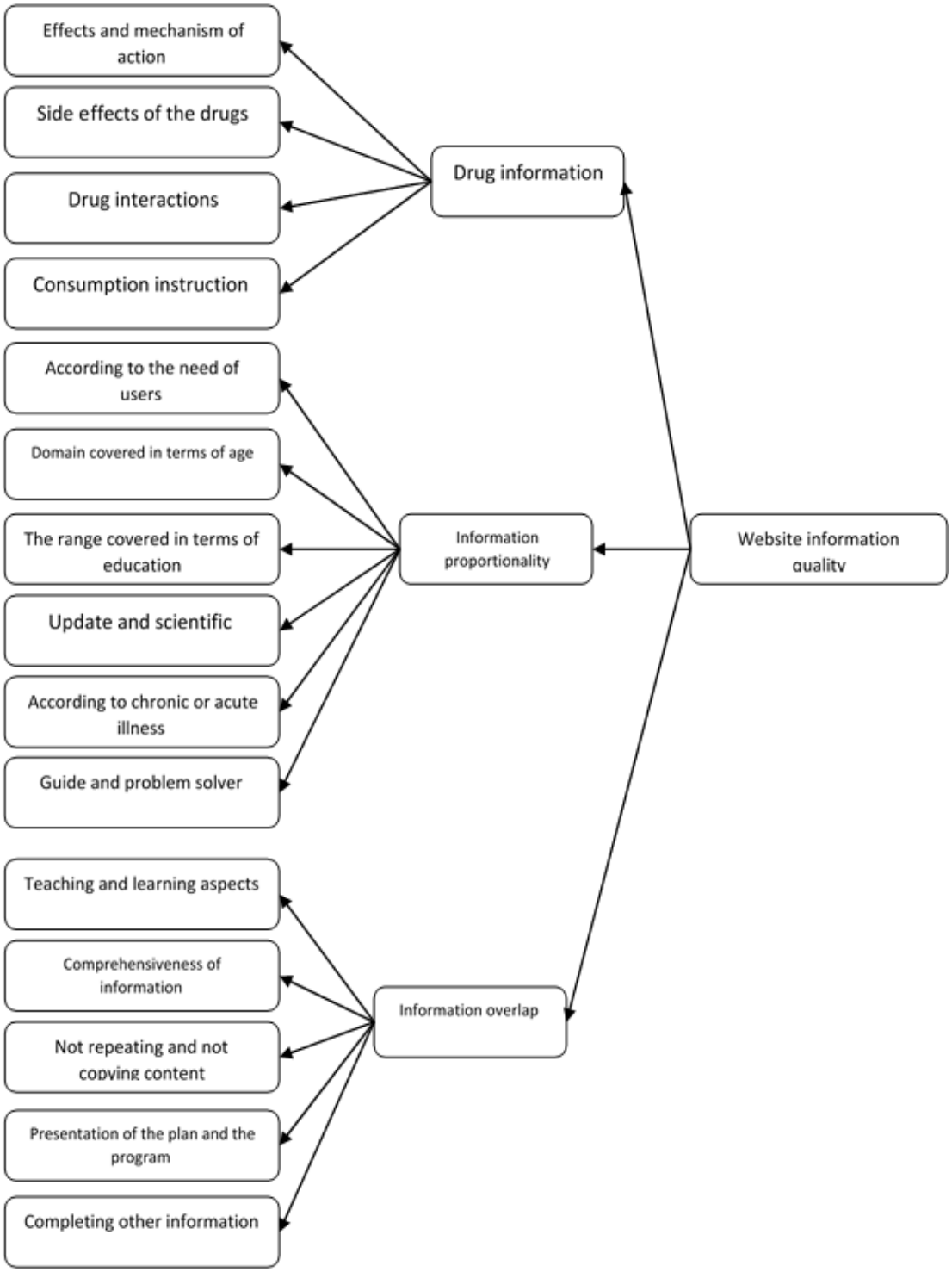

Figure 2. Indices of website information quality

Question 5: What are the readability levels indices of the content of Persian language in the area of diabetes?
Gunning Readability Index was used to answer this question. In doing so, 70 selected sites were examined. From each website, three 100-sentence texts were selected, their number of sentences, the length of the sentences, the number of words, and, finally, the coefficient of readability were determined.

Table 8. Gunning readability level of the sample websites for diabetes

Readability coefficient	Total hard sentences and average sentence length	The number of hard sentences	Average sentence length	Average number of sentence	The number of words
7.53	18.82	2.79	16.04	6.47	100.6

As already stated, the average number of sentences analyzed in 210 texts of 100 words (three one hundred words for each website) is 6.47.

Moreover, the average length of sentences used is 16 words and the number of difficult words is approximately 3 (2.79). Finally, as the number of difficult words should be combined with the average sentence length and divided into 0.4, the results showed that the readability level of diabetes websites is 7.5% that is not very desirable as the users should have 8 years of literacy as the designed websites should include both community members and even less literate people. With the result, one can state that website designers on diabetes did not care about the information needs of people below the primary level and their base is people with higher education levels.

Discussion and Conclusion

The results of one sample t-test for quality of data showed that the t value is -4.52, degree of freedom 69, and the significance level 0.000. Thus, one can state that the quality of diabetes websites is unsuitable and lacks desirable quality. In line with this, the results of Janatian et al. indicated that Persian websites in the area of depression in the indices of information, resource validity, availability, links, user support, and confidentiality of information were not in desirable condition and their score was less than the average (Gantian et al., 2014). Shahrzadi et al. (2015) showed that the quality of information in Persian websites on diabetes clarifies that the quality of diabetes websites is not appropriate. In line with the results of this study, Stiano et al. (2015) showed a significant difference in quality between commercial and non-commercial websites with the commercial websites receiving lower scores.

Examining the status of Persian websites on the diabetes in terms of information validity showed that the average validity of information in diabetes websites was slightly significant, and given the confidence interval and mean less than the hypothetical mean, one can conclude that the information validity is largely undesirable. In other words, the validity of most sites is not verified. The results are in line with the results of Gantian et al. (2014) and Shahrzadi et al. (2015). Furthermore, Parviz rad and Mirzai (2004) conducted a study on the quality of Iran's health-related health information databases in 2005. Overall, the surveys showed the inappropriate status of the examined websites regarding quality indices. Among other important results was the diversity of content of the websites and the lack of basic standards for this category. In explaining this result, one can state that today the Internet is one of the most important sources of access to information, and due to lack of arbitrating and editing, many invalid information is being published on the Internet. Most of the information available on the Internet is not only inappropriate, but may even be false or misleading. This is especially critical in health information, and it seems alarming because many users may use the Internet as a source for their, family and friends' medical information.

Furthermore, in terms of overall ranking of publications, given that the significance level is greater than 0.05, one can conclude that the overall ranking of publications of Persian websites on diabetes is at a desirable level and average. In the interpretation of these results, one can state that search engine engines use their own algorithms to rank websites that are confidential and only part of them are notified to compete between websites. For example, Google can use its various services to decide on website rankings. As another example, if users have logged into their user accounts and searched Google for diabetes and dissatisfied with the information provided on diabetes and return to Google again and choose another website, Google considers a negative rating for the first web site that was left, affecting website ranking on Google negatively. In addition, the length of time users or those who need information about diabetes need to stay on the website along with the number of exits after entering the website are effective in the ranking of results. Thus, a successful strategy for websites about diabetes creates valuable content that makes the content more engaging with users, increases the time users stay on the website, brings positive user participation, ends in better ranking of the results of the pages and definitely makes users more familiar with the website.

Additionally, the average of the desirable health information of the websites examined for the disease and treatment was 3.13, a bit higher than the average. The mean medical information for diabetes websites was 3.66, which is between moderate and desirable. Given the mean of 3.16, one can state that the interviewees considered the appropriateness of information between the average and the desired. In line with this finding, Stiano et al. (2015) conducted a study entitled “Examining the quality and content of health information websites about a herbal drug for menopausal symptoms” in 2015. The tests showed no significant differences in information coverage between governmental and non-governmental websites.

The results showed that the level of readability of diabetes websites was 7.5, and this is not a desirable factor as the websites designed should include both community members and even less literate individuals. Site designers in the area of diabetes should also be more aware of the information needs of people with lower literacy levels. Overall, the majority of Persian diabetes websites are difficult to read and have a low readability, and a huge group of people who are the main audience of these websites are not able to understand these resources. Those are able to understand these websites that have university education. Khosravi et al. (2016) study is consistent with the results of this study, indicating that most websites did not have a good quality regarding content and appearance criteria. Additionally, in the same vein, it is consistent with Stiano et al., (2015). Khosravi et al. conducted a study of the readability of Iranian nutrition and treatment diet websites in 2016. Additionally, Stiano et al. (2015) conducted a research entitled “Evaluation of quality and content of the websites on health information,” and found no significant differences between the views of government and non-governmental websites. Hence, health information providers in these resources should identify the audience, their specific needs, the level of education, and their understanding, and provide websites with the proper content and readability level (Parviz Rad & Mirzaei, 2004, Azami et al., 2019). If those websites are provided that their information is readable, the likelihood of understanding the information increases, and people are more willing to come refer to the information, and they will also be effective in terms of raising awareness. If the audiences are of different age groups, the adult learning problem should also be addressed and try to design websites that are well-suited for them.

Given the role and effect of information of the websites on diabetes in informing patients and community health, the evaluation of the websites of this domain - given their more use by Farsi speaking users - is very important. The results of this study can help diabetics and other people in the community to identify valid websites in this area, help managers and designers of diabetes websites and other medical areas in knowing the quality of existing websites and identifying the strengths and weaknesses that can lead to more appropriate design and upgrade their site's quality levels and ultimately provide the necessary information to authorities and the Ministry of Health, Medical Education, and health care decision makers to identify and introduce the valid websites on diabetes.

As diabetes websites have less been evaluated, it is suggested that web designers and administrators design more and more reliable websites on diabetes and collaborate with organizations that can evaluate the validity of these websites.

Furthermore, the results showed that the quality of diabetes websites is not so desirable, so it is suggested that website admins on health get the contents needed by diabetic patients from update and valid resources. As the readability indices of the information content of Persian websites on diabetes is not desirable, it is recommended that diabetes specialists create separate websites for age groups and different literacy level and provide readable information tailored to them so that they do not get into trouble on these websites. Furthermore, given the weaknesses of the websites examined in publishing rankings, it is recommended that designers of health websites act purposefully and fully scientifically, specialized, and consider international standards in designing Persian websites regarding diabetes.

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