Readability and quality levels of websites that contain written information about anterior cruciate ligament injury: A survey of Turkish websites

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ABSTRACT

Objective: This study aimed to evaluate the contents and readability levels of informative texts about anterior cruciate ligament (ACL) on Turkish websites.

Methods: In this cross-sectional study, online searches were performed using the Google, Yandex, and Yahoo search engines on 16, 17, and 18 November 2020, respectively. In these three search engines, ‘anterior cruciate ligament’, ‘anterior cruciate ligament surgery’, ‘ACL’, and ‘ACL surgery’ were entered in Turkish. The first 10 pages from each search on the websites were collected. The websites were divided into 3 groups according to their sources. Group 1 was classified as websites prepared by private hospitals or medical centers; group 2, as individual websites of orthopedics and traumatology physicians; and group 3, as non-profit websites providing general health information that does not fall into these two groups. The websites were analyzed based on both the website interface and a specific content scoring guide by two reviewers. The Flesch Kincaid (FK) grade level and the Flesch reading ease (FRE) score were used to determine the readability of information on the websites.

Results: Eighty-five unique websites were evaluated. The mean quality score of all the websites was 10.4 ± 4.5 with a maximum score of 25 (range = 3–21). No significant difference in quality score was found between the groups. The mean FK grade score of all the websites was 11.2 ± 1.7 (range = 7.9–15.3). The mean FRE score of all the websites was 46.8 ± 7.7 (range = 24.1–63.7). No statistically significant differences in FK grade and FRE score were found between the groups. Although 59 websites (69%) had a third-party seal indicating the certification of one of the organizations established to provide a standard of health information on the Internet, only 21 websites (25%) were updated in the year before the search.

Conclusion: The readability level of the informative texts about the ACL on the Turkish websites was above the educational level in Turkey. In addition, the quality score of the Turkish websites related to ACL was low. The content of the informative texts should be organized while taking into account the patients’ literacy level.

Introduction

In the world, the widespread use of smartphones has provided faster access to information by using the internet. While the global internet access rate was 25% in 2009, this rate was reported to have increased to 63.2% in 2020.¹ According to the Turkey Statistical Institute (TÜİK) data, the Internet use rate was 79.0% among individuals in the 16-74 years age group in 2020, which increased from 75.3% in the previous year. When the Internet use rate was examined by sex, the rate was 84.7% for men and 73.3% for women.² In a questionnaire study conducted by Bilgin et al. in Turkey, 67% of the participants stated that they used the internet primarily to obtain information about diseases.³

As the internet has become easily accessible via mobile devices today, it is one of the first tools to search for diseases and treatment options. The main reasons for using the internet are to evaluate and compare alternative treatment methods, to verify the information given by physicians, and to obtain answers to questions about diseases.⁴⁵ Unfortunately, health-related information from internet sources may contain misleading information for commercial interests. The main concerns about healthcare information obtained from the internet are the possibility of medically inaccurate information and the probability that the readability of the texts may be higher than the reading level of patients.⁶ The difficulty in understanding the orthopedic disease information provided by online resources can make it difficult to establish a relationship of trust between the treating physician and the patient. Therefore, the readability of easily accessible online resources should be planned according to the socio-cultural level of each country.

The readability of a text provides information on whether the written text is difficult or easy to understand by taking into account the characteristic features of syllables, words, and sentences.⁶ Readability formulas were developed by using criteria such as average word length, numbers of syllables of words, average sentence length, and the number of synonyms to evaluate readability.¹ This information is an objective indicator of the reading skills required to understand a written text.
Anterior cruciate ligament (ACL) injury is a common and costly orthopedic problem, especially among adolescents and athletes. In the United States, 200,000 ACL reconstructions are performed at a cost of approximately $1.7 billion per year. Information shared on websites about this costly but common orthopedic treatment is important for patients. The fact that patients are especially in the young age group and internet use is more common among younger ages increases the importance of online resources. Therefore, it is important that the information texts shared on the websites about ACL diseases and surgery can be read accurately and clearly by patients. We could not find previous research about the readability of Turkish websites related to ACL in our literature review.

We hypothesize that the readability levels of Turkish websites containing written information about ACL injury are higher than the education level of our country. Our second hypothesis is that the readability, accessibility, and readability of Turkish online resources regarding ACL injuries.

**Materials and Methods**

This descriptive research was conducted cross-sectionally at the Ordu Training and Research Hospital. Online searches using the Google (Mountain View, Calif, USA), Yandex (Moscow, Russia), and Yahoo (Sunnyvale, Calif, USA) search engines were performed on November 16, 17, and 18, 2020, respectively. The Google, Yandex, and Yahoo search engines are the first 3 search engines used in Turkey, with use rates of 74.41%, 21.03%, and 2.23%, respectively.[19] We used the following Turkish keywords in our search: “ön çapraz bağ” (anterior cruciate ligament); “ön çapraz bağ ameliyatı” (anterior cruciate ligament surgery); “ÖÇB” (ACL); “ÖÇB ameliyatı” (ACL surgery). The first 10 result pages in the search on the websites for each search keyword were examined. Each search engine was set to show only Turkish websites, and all searches were performed in Ordu, Turkey. Cookies were cleared before searching for each keyword. Medical article websites that targeted health professionals, websites containing ≤10 sentences of information, commercial sales websites, forums, and chat websites were not included in the evaluation. Websites containing only tables, pictures, videos, and paid websites were excluded. Patient information texts on these websites were copied and transferred to Microsoft Word (Microsoft Corporation, NM, USA, 2019). After the copyright notices, author information, image titles, training titles, website URL, addresses, and links to the information texts were removed to avoid affecting the results of the evaluation. The data were transferred to Microsoft Excel (Microsoft Corporation, NM, USA, 2019). The websites were divided into 3 groups according to their sources as follows: group 1 (n = 29), websites prepared by private hospitals or medical centers; group 2 (n = 44), individual websites of orthopedics and traumatology physicians; and group 3 (n = 12), non-profit websites providing general health information and websites not included in the other groups. The websites were evaluated by 2 orthopedic and traumatology surgeons with at least 5 years of experience. The study was conducted by the principles of the Declaration of Helsinki and with the approval of the Ordu University Training and Research Hospital Ethics Committee (decision no. 2020/270).

**Readability analysis**

All the texts obtained from the websites were automatically analyzed using the "online calculator." Calculations were also made with formulas to check the accuracy of the results. The Flesch Kincaid (FK) formula is calculated by measuring the word and sentence lengths. The average sentence length is inversely proportional to the readability and understandability of the sentence.

The Flesch reading ease (FRE) score indicates the approximate educational level of a person that is needed to read a text easily. The intelligibility of a document is indicated by a number between 0 and 100 in the FRE score. While 100 points indicate that the document is extremely easy to read, 0 points indicate that the document is highly complex and difficult to understand. The FRE score was calculated as 206.835 – 1.015 × (total words/total sentences) – 84.6 × (total syllables/total words). The FK grade level indicates the educational level required for a person to understand a text. The FK grade level was calculated as 0.39 × (total words/total sentences) + 11.8 × (total syllables/total words) – 15.59. Conversion tables can be used to convert scores to educational levels (Table 1).[15-17] We used the following scoring system developed by Bruce-Brand et al.[14] were general features, treatment options, and complications. Each subtitle was

**Table 1. Analysis of the Flesch Reading Ease (FRE) Score System[14-17]**

| FRE Score | School-Level | Explanation |
|-----------|--------------|-------------|
| 100.0-90.0| 5th grade    | Very easy to read. Easily understood by an average 11-year-old student |
| 90.0-80.0 | 6th grade    | Easy to read |
| 80.0-70.0 | 7th grade    | Fairly easy to read |
| 70.0-60.0 | 8th and 9th grade | Easily understood by 13- to 15-year-old students |
| 60.0-50.0 | 10th and 12th grade | Fairly difficult to read |
| 50.0-30.0 | College      | Difficult to read |
| 30.0-0.0 | College graduate | Very difficult to read. Best understood by university graduates |

**Table 2. ACL Reconstruction Specific Content Score[14]**

| General Aspects | Management | Complications |
|-----------------|------------|---------------|
| Age             | Observation| Infection     |
| Sex             | Physical therapy | Graft failure |
| Mechanism       | Bracing    | Knee pain     |
| Functional disability | Reconstruction with hamstring | Degenerative knee |
| Functional requirements | Reconstruction with patellar tendon | |
| Meniscal injury | Reconstruction with allograft | |
| Timing of surgery | Single bundle | |
| Anesthesia      | Double bundle | |
| Rehabilitation  | Anatomic reconstruction | |
| Return to sports/work | Meniscal repair | |
| Revision reconstruction | | |

ACL, anterior cruciate ligament.
assigned 1 point. The scores ranged from 0 to 25 points, with 25 points indicating the website with the maximum quality (Table 2).

Each website was evaluated and scored separately by 2 independent reviewers. The content score was calculated by averaging the scores of 2 independent reviewers.

**Website interface criteria**
The setup, accessibility, and validity of the information on each website were evaluated. The criteria specified in Table 3 were used in this evaluation. These criteria were determined using an evaluation score applied in a previous study.15

**Statistical analyses**
Statistical analysis was performed using the Statistical Package for the Social Sciences version 15.0 software for Windows (SPSS Inc., Chicago, IL, USA). The Kolmogorov–Smirnov test was used to verify the normal distribution and homogeneity of the variances of the data. The analysis of variance (for the normally distributed data) and Kruskal–Wallis test (for non-normally distributed data) were used to determine any differences in quality, accuracy, and readability based on the FK grade and website providers. The significance level was set as $P < .05$. In addition, the intraclass correlation coefficient (ICC) was used as a statistical analysis to determine interobserver reliability.

**Results**
The initial search obtained 1200 websites. After removing duplicates ($n = 852$), websites that met the exclusion criteria ($n = 257$) and websites with irrelevant content ($n = 6$), 85 websites containing information on the ACL were evaluated. Of the 85 websites included in the study, 29 (34%) were prepared by private hospitals or medical centers, 44 (52%) were from individual websites of orthopedics and traumatology physicians, and 12 (14%) were non-profit websites providing general health information not included in either group. The flowchart diagram is depicted in Figure 1.

**Website interface Evaluation**
Sixty-five (76%) of 85 websites provided the date of creating the most recent update. Of the 65 websites, only 21 were updated within the year before the search. Eight websites (9%) had advertisements, and 3 websites (4%) had evidence of sponsorship, while 15 (18%) had evidence of commercial intent. Fifty-nine websites (69%) had a third-party seal to signify the certification by one of the organizations established to uphold the standard of health information on the Internet (Figure 2).

**Readability analysis**
The mean FK grade of all the websites was $11.2 \pm 1.7$ (range, 7.9-15.3). Only 1 website (1.2%) had an FK grade lower than the eighth-grade level. On the other hand, 33 websites (38.8%) had an FK grade that was within the 10th to the 12th grade (high school) level. No

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**Table 3. Website interface criteria**

| Date of last update present | Presence of sponsorship |
|-----------------------------|-------------------------|
| Copyright notice            | Privacy statement       |
| Statement of purpose        | Subscription/log in     |
| Disclosure of authorship    | Contact information     |
| Author credentials          | Commercial interest     |
| Financial disclosure        | Links to commercial interest |
| Presence of advertisements  | Third-party seal (i.e. HTTPS, SSL/TLS, etc.) |

HTTPS, Hypertext Transfer Protocol Secure; SSL, Secure Sockets Layer; TLS, Transport Layer Security.

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4 search terms (ACL, ACL surgery, Anterior cruciate ligament, Anterior cruciate ligament surgery) x Google/Yandex/Yahoo = 12 total search

First 100 websites x 12 search = 1200 initial website

- Duplicated websites excluded ($n = 852$)
  - Inappropriate websites ($n = 257$) (broken links, videos, paid websites, peer reviewed literature, etc)
  - Websites with irrelevant content ($n = 6$)

Websites analyzed ($n = 85$)

Figure 1. Flowchart of the study. (ACL, anterior cruciate ligament)
statistically significant difference in FK grade was found between the groups ($P = .89$).

The mean FRE score of all the websites was $46.8 \pm 7.7$ (range, 24.1-63.7). No statistically significant difference in FRE score was found between the groups ($P = .44$; Table 4).

**Content analysis**

In the evaluation of quality scores of the websites, the mean score difference between the 2 observers was 0.1 points. The quality score of all the websites showed almost perfect interobserver agreement and ICC was 0.974 (Table 5). The mean quality score of all the websites was $10.4 \pm 4.54$ with a maximum score of 25 (range, 3-21). The mean quality score between the groups was $10.03 \pm 4.96$ in group 1, $10.75 \pm 4.52$ in group 2, and $10.0 \pm 3.78$ in group 3. No significant differences in the mean quality scores of the websites were found between the groups ($P = .73$), but the quality score of orthopedics and traumatology physicians’ websites was higher than other websites.

### Table 4. Comparison of informative texts according to the source of the websites

| Parameter       | Group 1 (n = 29) | Group 2 (n = 44) | Group 3 (n = 12) | $P$     |
|-----------------|-----------------|-----------------|-----------------|--------|
| FK grade level  | Mean ± SD       | Median (min-max)| Mean ± SD       | Median (min-max) |
|                 | $11.20 \pm 2.01$| $10.80 (7.90-15.30)$| $11.25 \pm 1.47$ | $11.15 (8.60-14.60)$ |
| Content analysis| Mean ± SD       | Median (min-max)| Mean ± SD       | Median (min-max) |
|                 | $10.03 \pm 4.96$| $9.00 (3.00-19.00)$| $10.75 \pm 4.52$| $10.00 (4.00-21.00)$ |
| FRE score       | Mean ± SD       | Median (min-max)| Mean ± SD       | Median (min-max) |
|                 | $48.09 \pm 9.84$| $51.90 (24.10-63.70)$| $46.84 \pm 5.84$| $47.35 (35.80-57.60)$ |

*Kruskal–Wallis test; **ANOVA test.
FK, Flesch–Kincaid; FRE, Flesch reading ease; SD, standard deviation.

### Table 5. ICC of interobserver reliability

| Intraclass Correlation (95% CI) | Intraclass Correlation (95% CI) |
|---------------------------------|---------------------------------|
| Single measures                 | Average measures                |
| 0.974 (0.960-0.983)             | 0.987 (0.980-0.991)             |

ICC, intraclass correlation coefficient.

### Discussion

The internet is an increasing source of reference for health-related information in our country and the world. Our study is the first in Turkey to analyze both the readability and quality of internet websites containing informative texts on ACL. The most important finding of this study is that the information regarding ACL provided by Turkish online resources has low quality and is difficult to read.

In the treatment of patients, especially in making serious decisions such as surgery, the patient–doctor relationship is important. A study has shown that internet resources strengthen the physician–patient relationship. For patients to benefit from health information in online resources, texts should be written in an understandable and sufficient quality. In our study, we found that Turkish websites containing information about ACL had high readability levels and low intelligibility. Besides, the websites prepared by private hospitals or medical centers had a higher intelligibility rate than others.

Recently, because the internet is easily accessible from anywhere with the help of smartphones, patients use the most common online resources as a source of medical information. Hence, it is important that the information about health in the internet environment is prepared correctly at a readability level suitable for the general...
community. Many formulas have been defined to evaluate the readability of written materials but the FK formula is most commonly used to assess the readability of written healthcare information materials. Among the commonly used readability formulas in health care literature, only the FK formula was developed with the cloze procedure for validation. The advantage of the cloze procedure is the ability to measure the comprehension of passages without introducing elements that influence passages or question difficulty. Since comprehension is an important aspect to understand the written findings, the Flesch–Kincaid Reading Grade Level (FKRGL) has also been validated against the cloze comprehension tests. Since FKRGL is validated against the cloze comprehension tests and they directly give a grade level, FKRGL is more commonly used in daily practice.\(^{17-20}\) Catal et al\(^{21}\) evaluated Turkish websites containing information about platelet-rich plasma (PRP) injections with the FK formula. They reported that only 31.4% of all websites had readability lower than the eighth grade, and the mean quality score of the websites was 7.1 ± 4.3 of 25 points. In our study, 38.8% of the Turkish websites that provide information about the ACL were in the 10th-12th grade, while only 1 website had readability lower than the 8th grade. The mean quality score of these websites was 10.4 ± 4.5 of 25 points. Accordingly, Turkish online resources containing ACL information have been shown to have higher quality scores and more difficult readability in comparison with PRP injection. According to the TUIK data, the mean education period of individuals in our country in 2015 has been reported to be 6.5 years.\(^{22}\) According to this data, the readability level of both PRP and ACL-related websites is higher than the country average.

Küçükdürmaz et al\(^{23}\) compared the quality of information on online Turkish and English websites about total knee arthroplasty. Although they did not find a significant difference in accessibility between the Turkish and English websites, they found that the usability and reliability of the Turkish websites were significantly low. In our study, the quality score of the Turkish websites related to ACL was low. In addition, the frequency rate of third-party seals, a reliability indicator in our study, was lower especially in group 2 (57%) than in the other groups. This situation is an indication that orthopedics and traumatology physicians do not attach enough importance to the reliability of their individual websites. Gosselin et al\(^{24}\) investigated websites containing information on ACL injuries in young women and showed that only 18 (51%) of the 35 websites indicated the last update date, while only 3 of these 18 websites were updated in the year before the search. In our study, 65 (76%) of 85 websites provided the date of creating the most recent update. Of the 65 websites, only 21 were updated within the year before the search. Thus, it has been determined that Turkish websites containing ACL information are more up-to-date.

Various studies have evaluated the quality of Turkish websites on orthopedics and traumatology. Küçükdürmaz et al\(^{25}\) evaluated the reliability of the information on Turkish websites that were prepared for patients with meniscus rupture and showed that the information quality of the websites was low. In our study, we evaluated the quality and readability of the information provided on websites. We found that Turkish websites containing information on the ACL had high readability but low quality. Küçükdürmaz et al\(^{26}\) evaluated the content of the Turkish-language websites that provided information about hip fractures and found that 9 of the 30 websites contained information for patients on the subject, and the mean quality score of these 9 websites was 7.0 ± 4.81 (range, 2-14). In our study, the mean quality score was 10.4 ± 4.54 (range, 3-21) of 25 points for the Turkish websites that contained information about the ACL. In addition, we found that the readability of these websites could be understood by individuals studying in the 10th grade and higher. Our study shows that Turkish websites that provide information about the ACL have insufficient content quality, and their readability levels are high. This can lead to users getting incomplete or wrong information and false prejudices about the subject.

One of the limitations of our study is that although patients may use different terms when searching on websites, we only used 4 search terms. We used these terms because they were the most well known. The second limitation is that because the internet is a dynamic environment, we could evaluate the quality and readability of websites at only one time point. The third limitation is that we used the FK formula, which is the most commonly used method in evaluating readability in the study. One of the reasons we chose this scoring system is that it was the most frequently used scoring system to evaluate the readability of written health care information materials.\(^{17}\) Furthermore, the FK formula was developed with the cloze procedure for validation. The advantage of the cloze procedure is the ability to measure the comprehension of passages without introducing elements that influence passage or question difficulty.\(^{18}\) On the other hand, Turkish adapted equivalents of this method were also described and readability values may differ when these methods are used.

In conclusion, to our knowledge, this study is the first to assess the quality and readability of information on Turkish websites regarding the ACL. Considering the educational level of our country, the information on Turkish websites about ACL injuries is too difficult for the average reader to understand, and the quality scores are low. Additionally, the quality of the information from Turkish websites about ACL injuries is not affected by the type of website. The new regulations can bring both the readability of the patient information texts on the internet websites to a level appropriate for the literacy of Turkish citizens and increase the information quality. In this way, we think that better communication can be achieved between the patient and the physician. Necessary studies should be conducted for the widespread use of internet instruments (accreditation systems) and to increase the reliability of the information, including that in Turkish websites.

**Ethics Committee Approval:** Ethical committee approval was received from the Ethics Committee of Ordu University, (Approval No: 2020/270).

**Informed Consent:** Written informed consent was obtained from all participants who participated in this study.

**Author Contribution:** Concept - A.A.Ş, M.B.; Design - A.A.Ş, M.B., T.K.; Supervision - A.A.Ş, M.B., T.K.; A.Ç.; Materials - A.A.Ş, M.B.; T.K.; Data Collection and/or Processing - A.A.Ş, M.B., T.K., A.Ç.; Analysis and/or Interpretation - A.Ü, A.A.Ş; Literature Review - A.A.Ş, M.B., T.K., A.Ü, A.Ç.; Writing - A.A.Ş, M.B., T.K., A.Ü, A.Ç; Critical Review - A.A.Ş.

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