Evaluating the readability, quality and reliability of online patient education materials on post-covid pain

Erkan Ozduran [Corresp., 1], **Sibel Büyükçoban** [Corresp. 2]

[1] Department of Physical Medicine and Rehabilitation, Algology, Dokuz Eylül University, Izmir, Turkey

[2] Department of Anesthesiology and Reanimation, Dokuz Eylül University, Izmir, Turkey

Corresponding Authors: Erkan Ozduran, Sibel Büyükçoban
Email address: erkanozduran@gmail.com, sbuyukcoban101@gmail.com

Background. The use of the Internet to access healthcare-related information is increasing day by day. However, there are concerns regarding the reliability and comprehensibility of this information. This study aimed to investigate the readability, reliability, and quality of Internet-based patient educational materials (PEM) related to "post-COVID pain." **Methods.** One-hundred websites that fit the purposes of the study were identified by searching for the terms "post-COVID pain" and "pain after COVID" using the Google search engine on February 24, 2022. The website readability was assessed using the Flesch Reading Ease Score (FRES), Flesch–Kincaid Grade Level (FKGL), Simple Measure of Gobbledygook (SMOG), and Gunning FOG (GFOG). The reliability, quality, and popularity of the websites were assessed using the JAMA score, DISCERN score/Health on the Net Foundation code of conduct, and Alexa, respectively. **Results.** Upon investigation of the textual contents, the mean FRES was 51.40 ± 10.65 (difficult), the mean FKGL and SMOG were 10.93 ± 2.17 and 9.83 ± 1.66 years, respectively, and the mean GFOG was 13.14 ± 2.16 (very difficult). Furthermore, 24.5% of the websites were highly reliable according to JAMA scores, 8% were of high quality according to GQS values, and 10% were HONcode-compliant. There was a statistically significant difference between the website types and reliability ($p = 0.003$) and quality scores ($p = 0.002$). **Conclusion.** The readability level of PEM on post-COVID pain was considerably higher than grade 6 educational level, as recommended by the National Institutes of Health, and had low reliability and poor quality. We suggest that Internet-based PEM should have a certain degree of readability that is in accordance with the educational level of the general public and feature reliable content.

Evaluating the readability, quality and reliability of online patient education materials on post-covid pain

Erkan Ozduran[1], Sibel Buyukcoban[2]

[1] Physical Medicine and Rehabilitation, Algology, Dokuz Eylul University, Izmir, Turkey

[2] Anesthesiology and Reanimation, Dokuz Eylul University, Izmir, Turkey

Corresponding Author:

Erkan Ozduran[1]

Inciraltı mahallesi Mithatpasa Caddesi no:1606, Izmir 35330, Turkey

Email address: corresponding_author_erkanozduran@gmail.com

ABSTRACT

Background. The use of the Internet to access healthcare-related information is increasing day by day. However, there are concerns regarding the reliability and comprehensibility of this information. This study aimed to investigate the readability, reliability, and quality of Internet-based patient educational materials (PEM) related to "post-COVID pain."

Methods. One-hundred websites that fit the purposes of the study were identified by searching for the terms "post-COVID pain" and "pain after COVID" using the Google search engine on February 24, 2022. The website readability was assessed using the Flesch Reading Ease Score (FRES), Flesch–Kincaid Grade Level (FKGL), Simple Measure of Gobbledygook (SMOG), and Gunning FOG (GFOG). The reliability, quality, and popularity of the websites were assessed using the JAMA score, DISCERN score/Health on the Net Foundation code of conduct, and Alexa, respectively.

Results. Upon investigation of the textual contents, the mean FRES was 51.40 ± 10.65 (difficult), the mean FKGL and SMOG were 10.93 ± 2.17 and 9.83 ± 1.66 years, respectively, and the mean GFOG was 13.14 ± 2.16 (very difficult). Furthermore, 24.5% of the websites were highly reliable according to JAMA scores, 8% were of high quality according to GQS values, and 10% were HONcode-compliant. There was a statistically significant difference between the website types and reliability ($p = 0.003$) and quality scores ($p = 0.002$).

Conclusion. The readability level of PEM on post-COVID pain was considerably higher than grade 6 educational level, as recommended by the National Institutes of Health, and had low reliability and poor quality. We suggest that Internet-based PEM should have a certain degree of readability that is in accordance with the educational level of the general public and feature reliable content.

Keywords: Covid-19, Health information, Internet, Pain, Post-acute COVID-19 syndrome, Readability

INTRODUCTION

Coronavirus disease 2019 (COVID-19), which is caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pathogen, led to a worldwide medical and humanitarian crisis by late 2019. The symptoms associated with COVID-19 have not only been observed in the respiratory system but also in the muscular, neurological, and cardiovascular systems. In a Chinese study, the associated symptoms included fever (88.7%), cough (67.8%), and fatigue (38.1%), in order of prevalence (*Yang et al.,2020*). The World Health Organization declared that approximately 15% of the patients experienced myalgia and arthralgia in the scope of the symptoms associated with COVID-19 (*Fernández-de-Las-Peñas et al., 2021*). It was also suggested that myalgia and arthralgia were the fifth most prevalent symptoms in the acute period of COVID-19 and may become chronic (*Struyf et al.,2020*).

Despite the fact that COVID-19 was initially considered a short-term disease, it was subsequently revealed that many post-treatment symptoms persisted with manifestations called post-COVID or long COVID (*Nabavi, 2020*). The term "prolonged COVID" has been used for cases in which the patient survived COVID-19 but had persistent effects of infection or experienced symptoms lasting for more than 1 month (*Baig, 2021*). There is no consensus regarding the diagnosis, management, and follow-up of such conditions with prolonged complaints (*Greenhalgh et al, 2020*). It is evident that the correct treatment algorithm would help individuals with recovery given that pain symptoms adversely affect the quality of life during the post-COVID period.

Patients can rapidly access the desired healthcare content using Internet-based patient educational materials (PEM), which have recently been used as an important tool for acquiring further information. In 2018, it was reported that 90% of the adults in the United States used the Internet and that three-quarters performed healthcare-related searches (*Guo et al., 2019*). The National Institutes of Health, the US Department of Health and Human Services, and the American Medical Association reported that Internet-based PEM should be developed below the sixth-grade educational levelx (*Guo et al., 2019; Wang, Capo & Orillaza, 2009*). In case the readability of online information posted on a website is above the said grade, it may be considered difficult to read and understand for an average reader. Therefore, it is important that

the healthcare-related information on the websites are compliant with the average educational level of the readers and carefully evaluated before release. Access to online information increases daily, but this raises concerns about the accuracy, reliability, and quality of the said information and whether an appropriate level of readability is offered. Relevant studies in the literature investigated the quality and readability of the information included in Internet-based PEMs on a number of medical conditions (*Han & Carayannopoulos,2020; Basch et al.,2020*). A study by Worrall et al. reported that the readability level of online information about COVID-19 was poor and difficult to read (*Worrall et al., 2020*).

It is well established that patients furnished with information about the etiology, pathophysiology, treatment, and prevention methods would more likely participate in and comply with the disease prevention or treatment procedures. It is evident that providing individuals with reliable, high-quality, and readable online information about post-COVID-19 pain would help with the management of a condition that affects many people. This study aimed to investigate websites containing PEM on post-COVID-19 pain based on their readability, quality, and reliability. Furthermore, it aimed to investigate the website types that provided highly reliable information on post-COVID-19 pain.

MATERIALS & METHODS

Upon obtaining the necessary permission of the Ethics Committee for Non-Interventional Research on February 24, 2022 (GOA 2022/06-08), the terms “pain after COVID,” "post-COVID pain,” and “long COVID and pain” were searched by two authors (E.O. and S.B.) using the Google search engine (https://www.google.com.tr), which is the most popular search engine. A collective assessment was used to reach a final decision in case of any inconsistency between the authors during the assessment of the websites. Google search engine was used because based on data from December 2022, Google search engine led the sector with a market share of 86.19% (*Johnson, 2022*).

The cookies were removed and the computer's browser history was deleted during the website search to ensure that the search results were not affected (such as by Google Ads). In addition, the searches were made after signing off from all Google accounts. Following the searches, the uniform resource locators (URLs) of the first 100 websites were recorded, consistent with the methodologies of similar studies in the relevant literature (*Basch et al.,2020*, *Jayasinghe et al., 2013*). The 10 websites that appeared on the first page of the search results were considered the most viewed websites (*Eysenbach & Köhler, 2002*). Websites with non-English language content, those without information on post-COVID pain, those that required registration or subscription, repetitive websites, those with video or audio recording content but without text content, and journal articles were not included in the study. Furthermore, the graphics, images, videos, tables, figures, and list formats contained in the text, all punctuation marks, URL websites, author information, references to avoid erroneous results, addresses, and phone numbers were not included in the assessment (*Zeldman, 2001*).

In case there was no evaluation criterion on the home page, the three-click rule was applied during the assessment of the websites (*Charnock et al., 1999*). This rule states that the website user would find any information in up to three mouse clicks. Although it is not an official rule, it is considered that if the information cannot be accessed by three clicks, the user cannot reach one’s goal and would leave the website.

Website typology

Based on their type, the websites were classified into six categories by the two authors. Typologies were professional (websites created by organizations or individuals with professional medical qualifications), commercial(websites that sell product for profit), nonprofit (non-profit educational/charitable/supporting sites), health portals(websites that provide information about health issues), news (news and information created to provide magazine websites or newspaper), government (websites created, regulated or administered by an official government agency) (*Yurdakul, Kilicoglu & Bagcier, 2021*).

Journal of American Medical Association (JAMA)Benchmark Criteria

The JAMA benchmarks analyzes online information and resources under 4 criteria: authorship, attribution, disclosure, and currency. (JAMA score 0-4, Authorship (1 point): Authors and contributors, their affiliations,and relevant credentials should be provided; Attribution(1 point): References and sources for all content should be listed; Disclosure (1 point): Conflicts of interest, funding,sponsorship, advertising, support, and video ownership should be fully disclosed; Currency (1 point): Dates that on which the content was posted and updated should be indicated). JAMA is used to evaluate the accuracy and reliability of information. The scorer awards 1 point for each criterion in the text, and the final score ranges from 0 to 4. Four points represent the highest reliability and quality (Silberg, Lundberg & Musacchio, 1997). A website with a JAMA score of ≥3 points was considered highly reliable, whereas those with a JAMA score of ≤2 points were considered to have low reliability (Silberg, Lundberg & Musacchio, 1997).

DISCERN criteria

The DISCERN criteria, a tool used to indicate the quality of websites, consist of 16 items that are scored between 1 and 5 (*Weil et al., 2014*). The first item involves general website information, including “are the aims clear?” and “are citations used?” The next eight items assess the treatment-related knowledge, including “is it clear that there is more than one treatment option?” The two authors independently reviewed the websites based on the DISCERN criteria. The final DISCERN score for each website was reached after the scores by the two authors were averaged. The final DISCERN score ranged from 16 to 80. Based on the results, scores of 63 to 80 were considered excellent; 51 to 62, good; 39 to 50, fair; 28 to 38, poor; and 16 to 27, very poor (Boyer, Selby & Appel, 1998).

Global Quality Score (GQS)

The quality of the websites was rated based on the GQS criteria, which makes use of a 5-point scale to assess the overall quality of a website. The scores refer to the informative quality of the website and to what extent the reviewer considers it useful for the patients. Accordingly, 1 point indicates poor quality and 5 points indicate excellent quality (Agar & Sahin, 2021).

Health on the Net Foundation code of conduct (HONcode) certification

Established with an aim to promote the online distribution and efficient use of reliable and useful health information, The Health on the Net Foundation (HON) designed the HONcode to help standardize the reliability of healthcare-related information available on the Internet (*Boyer, Baujard & Geissbuhler, 2011*). To meet the HONcode criteria, the date and source of the content should be disclosed, the competencies of the authors should be specified, a privacy policy should be included, the website should complement the patient–physician relationship, the finances and advertising policy of the website should be transparent, and contact information should be provided (Walsh & Volsko, 2008). This study investigated whether there was a HONcode stamp posted on the main page or included in the related URL.

Readability

The Flesch Reading Ease Score (FRES), Flesch–Kincaid grade level (FKGL), Simple Measure of Gobbledygook (SMOG), Gunning FOG (GFOG), Coleman–Liau (CL) score, automated readability index (ARI), and Linsear Write (LW) readability formulas as retrieved from www.readibility–score.com were used for the purpose of assessing the readability of websites (*Basch et al.,2020*, *Jayasinghe et al., 2013*).

The readability formulas were used in the assessment of all the text contents, except for the aforementioned exclusions. The ranking values of all the websites were rated and recorded. The texts were saved in Microsoft Office Word 2007 (Microsoft Corporation, Redmond, WA, USA). The average readability level based on all the readability formulas was compared based on the sixth-grade educational level as recommended by the American Medical Association and the National Institutes of Health.

Popularity and visibility analysis

Alexa (https://www.alexa.com/) is a website popularity ranking that is often used to assess the visibility and popularity of the website (*Wald, Dube & Anthony, 2007*). It measures how often a website was clicked and visited during the past 3 months compared with other websites. Higher scores indicate higher popularity based on higher click rates.

Content Analyse

The websites were investigated and assessed by type based on whether a given website contained certain topics related to post-COVID pain, such as etiology, diagnosis, non-pain-related symptoms, treatment, exercise, prevention, risk factors, and vaccine–pain relationship.

Statistical analysis

For statistical analysis, data were uploaded to SPSS Windows 25.0 software (SPSS Inc., Chicago, IL). Continuous values are indicated as mean ±SD, while frequency variables are given as number (n) and percentage (%). For statistical analysis, the Mann–Whitney U or Kruskal Wallis tests were used to compare groups with continuous values such as readability indices and sixth class level. For comparison of frequency variables, the Chi-square or Fisher exact tests were used. A p value lower than 0.05 was accepted as statistically significant difference.

RESULTS

Upon comparing 100 websites that met the study's inclusion criteria by type, news (31%) and professional (29%) types were found to be the most common website types (Figure 1).

Previous studies reported that users were particularly interested in the results that appeared on the first page of a search engine. Google provides 10 search results on the first page. There was a statistically significant difference in website site between the first 10 search results and the rest ($p = 0.043$). The fact that 60% of the first 10 websites were created by professional associations and institutions, whereas 31.4% of the remaining 90 websites were created by news websites, might account for the significant difference.

There was no significant difference in readability between the top 10 and the remaining websites (FRES, GFOG, GFOG, CL, SMOG; $p > 0.050$). There was also no significant correlation between the top 10 and the remaining websites in JAMA reliability ($p = 0.350$), DISCERN quality ($p = 0.613$), and HONcode compliance ($p = 0.267$) (Table 1). Nevertheless, there was a significant relationship between the top 10 and the remaining websites by GQS results ($p < 0.001$) (Table 1).

The mean JAMA score, DISCERN score, GQS score, and Alexa ranking of the 100 websites was 2 ± 0.76, 36.40 ± 14.70, 2.18 ± 0.85, and 287786.94 ± 798542.83, respectively. The results suggested that the websites had low reliability and poor quality. In the analysis of the text contents of the 100 websites, the mean FRES was 51.40 ± 10.65 (difficult), mean GFOG was 13.14 ± 2.16 (very difficult), mean FKGL and SMOG were 10.93 ± 2.17 and 9.83 ± 1.66 years of education, respectively, mean CL index was 10.62 ± 1.71 years of education, and mean ARI index was 11.03 ± 257 years of education. There was no significant relationship in a comparison of the website type and all the readability indices (FRES, $p = 0.669$; GFOG, $p = 0.520$; FKGL, $p = 0,467$; CL, $p = 0,860$; SMOG, $p = 0,447$; ARI, $p = 0,517$). There was a significant difference upon comparison of the mean readability index scores of the 100 websites and the sixth-grade reading level ($p < 0.001$) (Table 1).

There was no significant difference between the top 10 and the remaining websites upon content analysis (Etiology, $p = 0,160$; Diagnosis, $p = 0,981$; Non-pain-related symptoms, $p =$

0,059; Treatment, p = 0,572; Exercise, p = 0,081, Prevention, p = 0,149; Risk factors, p = 0,168; Vaccine–pain relationship, p = 0,186). (Table 2).

There was a significant relationship between the JAMA reliability scores ($p < 0.001$) and GQS values ($p < 0.001$) by website type among the 100 websites. This difference can be explained by the higher JAMA reliability scores of the websites created by nonprofit organizations and higher GQS values of the health portal-based websites. These scores were lower for the websites created by news channels. Further, 20% of the websites were rated as highly reliable based on a JAMA score of ≥3 and 8% were identified as being high quality based on GQS values. HONcode compliance was noted in only 10% of the websites. The highest rate of HONcode compliance was noted in the health portals (7%) (Table 3). There was no significant difference between the readability of the websites by type (Reading Level p = 0,850; Readers Age p = 0,646).

There was a correlation between the mean readability scores based on the readability formulas and JAMA reliability scores, DISCERN quality scores, and GQS values in an analysis of the relationship between the ranking of the websites and the mean scores of FRES, FKGL, SMOG, GFOG, CL, ARI, and LW readability formulas, JAMA DISCERN scores, and QGS scores (Table 4). There was a weak positive correlation between the JAMA and DISCERN scores ($r = 0.670$, $p < 0.001$) and GQS scores ($r = 0.411$ $p < 0.001$).

DISCUSSION

This study investigated whether Internet-based PEMs on pain after COVID-19 infection were reliable, of high quality, and readable. Furthermore, it also investigated which website types provided highly reliable and readable information. Accordingly, a comparison of the 10 most visited sites on the first page with the remaining websites that appeared on the search engine based on quality, reliability, and readability ratings was conducted. Finally, the relationship between the websites' readability and the quality and reliability thereof was assessed.

Pain is one of the important symptoms associated with COVID-19. Widespread organ and tissue damage, especially in the musculoskeletal system, and increased cytokine levels due to infection, have been suggested with regard to the etiology and pathogenesis of pain (*Su et al., 2020*). A meta-analysis suggested myalgia and headache as the most prevalent musculoskeletal and neurological symptoms, respectively (*Abdullahi et al. 2020*). In the case of long COVID, a term used for patients with symptoms persisting more than 1 month, it was noted that pain symptoms were among the other persistent symptoms that lasted for a prolonged duration. Şahin et al. reported that the pain symptoms associated with COVID-19 persisted for 1–11 weeks (*Sahin et al, 2021*). Tetik et al. (*2021*) found that the rate of post-COVID pain was 7.9%, and it was mostly observed in patients with advanced age and often with long-term clinical manifestations of body, lumbar, and joint pain and headache.

Written communication has been demonstrated to be an indispensable tool in times of crisis. It is imperative to ensure the comprehensibility of the emergency messages during such times. Relevant studies suggested that written messages could be more readily and accurately remembered than verbal messages (*Edworthy et al., 2015*). Whether they are verbal or written, accurate and reliable messages should be quickly disseminated across the society and easily understood by the majority (*Edworthy et al., 2015*). It was suggested that for healthcare-related information to be most effective for the general public, such information must be aligned to the sixth-grade readability level (*Basch et al.,2020*). Text contents comprised of long and complex sentences may impair the reader's self-confidence while trying to obtain medical information and cause them to give up reading the text. The National Literacy Institute of the US Department of Education reported that 32 million US adults were illiterate and 68 million Americans had a

reading level below the fifth grade (*Daraz et al., 2018*). Considering that the acquisition of Internet-based healthcare-related information has increased, providing more readable information on websites will help individuals protect against diseases and quickly assess diagnosis and treatment processes when they are ill. Basch et al. (*Basch et al.,2020*) suggested that the readability level of Internet-based information on COVID-19 was much higher and more difficult compared with that of an average American citizen.

In the present study, there was a significant difference between the top 10 and the remaining websites in a comparison of the websites based on their type. Websites that were classified in the news and professional types most frequently appeared in the search results. Nevertheless, websites created by professional institutions constituted the majority of the top 10 searches that appeared on the first page on the Google search engine. A significant difference was found between the website types and reliability scores. It was concluded that this difference was associated with higher JAMA scores in the websites created by nonprofit organizations. There was also no significant difference in reliability between the top 10 and the remaining websites. Nevertheless, there was a significant difference in quality based on the GQS values between the top 10 and the remaining websites. It was noted that 70% of the top 10 websites were of medium quality, whereas 72% of the remaining 90 sites were of low quality. There was no significant difference between the websites by type in an assessment of readability indices. There was no significant difference between the top 10 and the remaining websites in terms of readability indices.

The majority of the websites included in the present study were created by news channels. In a study of online information about COVID-19, Klak et al.(*2022*) reported that news websites constituted the largest group, similar to the results of the present study. All COVID-19-related developments, daily case and death figures, and vaccination statistics were shared instantly by news channels and news websites during the pandemic. The audience statistics suggest that news websites also maintain their ranking with regard to the topic of post-COVID pain. Content on COVID-19-related epidemiology and isolation are frequently shared on news websites. This raises social concerns and lack of trust. People try to remedy their lack of trust by accessing information via the Internet. Governments have taken steps to compensate for the lack of Internet-based information, and accordingly, government-affiliated websites were introduced

(e.g., Robert Koch Institute in Germany). A study by Okan et al. (*2020*) spanning from March to April 2020 reported that the information made available by local authorities prevented information pollution .

In the present study, 10 of the 100 websites were HONcode-compliant. Haghi et al. (*Valizadeh-Haghi, Khazaal & Rahmatizadeh, 2021*) investigated the credibility of health websites on COVID-19 and found that 12.8% of the websites included in their study were HONcode-compliant. The results of the present study are consistent with those reported in the relevant literature. HONcode is the earliest and most frequently used code of ethics and reliability intended for medical and healthcare-related information available on the Internet (*Valizadeh-Haghi, Khazaal & Rahmatizadeh, 2021*). Accordingly, the HONcode-compliant websites had higher DISCERN and JAMA scores in the present study. An implication of the above is that healthcare professionals may advise their patients to prefer HONcode-compliant websites when seeking Internet-based information about post-COVID pain.

In the present study, the overall mean DISCERN score of the websites was considered "poor" (36.40 ± 14.70). Similar to the present study, Halboub et al. (*2021*) reported the same score as 31.5 ± 12.55 in a study on healthcare information related to COVID-19. The fact that certain web sources, including academic or scientific journals, were not excluded in such studies in the relevant literature as the study by Klak et al.,(*2022*) which reported high DISCERN scores, may result in higher DISCERN scores as well as high in readability scores. It is well established that patients prefer sources with less medical terminology and better readability when they need to access Internet-based healthcare-related information. Whereas, academic resources are intended for use among the healthcare professionals and aim to make a scientific contribution.

There was no significant difference in a comparison of the website types and readability. The average readability results were found to be well above the sixth-grade reading level recommended by the National Institutes of Health (*Klak et al., 2020*). Jayasinghe et al., (2020) who excluded academic websites in their investigation of the quality and readability of online information about COVID-19, reported moderate-to-low readability scores. Ensuring easier readability levels may help with reaching wider audiences, and the power of information can be presented more effectively based on an appropriate readability level matching that of the general public.

An assessment based on the content indicated that most of the websites (85%) included information about non-pain symptoms, followed by 60% of the websites with information on treatment. There was no significant difference between the website types and topics. The most frequent topics were pulmonary symptoms, followed by social distancing in the relevant literature, which investigated online information about COVID-19. Pain and other non-respiratory symptoms were ranked fifth in their studies (*Jayasinghe et al., 2013*). Considering that the topics of prevention, treatment and vaccination were alternated during the COVID-19 pandemic, up-to-date popular topics were reflected on the websites during each period and presented to the attention of visitors.

There are limitations to this study. These limitations include the search of websites in English language, use of a single search engine, and inclusion of websites that use the data network of a single country. There is no consensus on the gold standard readability index in the assessment of the readability of Internet-based patient education materials; nevertheless, the indices used in this study were among the most frequently used formulas, which, in the present study, indicated that the websites were intended for an educational level far above the recommended level.

CONCLUSION

The readability level of Internet-based PEMs on post-COVID pain was considerably higher than the sixth-grade level recommended by the National Institutes of Health. The website contents had low reliability and poor quality. The websites of nonprofit organizations provided more reliable information, the health portals offered information of higher quality, and the news websites ranked lowest in all the parameters. The correlation between JAMA and DISCERN scores and HONcode compliance suggested that reliable websites also provided high-quality information. During the development of healthcare-related websites intended for the general public on the COVID-19 pandemic in the first quarter of the 21st century, the language of the website should be checked against the relevant readability indices, the website should maintain a readability level that fits the average education level of the relevant country or countries that are the intended recipient of the information, and the website should contain high-quality and reliable information.

REFERENCES

Abdullahi A, Candan SA, Abba MA, Bello AH, Alshehri MA, Afamefuna Victor E, Umar NA, Kundakci B. 2020. Neurological and Musculoskeletal Features of COVID-19: A Systematic Review and Meta-Analysis. Front Neurol. 26;11:687. DOI 10.3389/fneur.2020.00687

Agar A, Sahin A. 2021. Kyphosis-Related Information On The Internet Is the Quality, Content and Readability Sufficient for the Patients? Global Spine J. 12:21925682211015955. DOI 10.1177/21925682211015955

Baig AM. 2021. Chronic Covid syndrome: needfor an appropriate medical terminology for long- Covid and Covid long-haulers. J Med Virol. 93:2555-6 DOI 10.1002/jmv.26624

Basch CH, Mohlman J, Hillyer GC, Garcia P. 2020. Public Health Communication in Time of Crisis: Readability of On-Line COVID-19 Information. Disaster Med Public Health Prep. 14(5):635-637 DOI 10.1017/dmp.2020.151

Boyer, C., Baujard, V., Geissbuhler, A. 2011. Evolution of health web certification through the HONcode experience. Studies in health technology and informatics, 169, 53–57 DOI 10.3233/978-1-60750-806-9-53

Boyer, C., Selby, M., Appel, R. D. 1998. The Health On the Net Code of Conduct for medical and health web sites. Studies in health technology and informatics, 52 Pt 2, 1163–1166 DOI 10.1016/s0010-4825(98)00037-7

Charnock D, Shepperd S, Needham G, Gann R. 1999. DISCERN: an instrument for judging the quality of written consumer health information on treatment choices. J Epidemiol Community Health. 53(2):105-11 DOI 10.1136/jech.53.2.105

Daraz L, Morrow AS, Ponce OJ, Farah W, Katabi A, Majzoub A, Seisa MO, Benkhadra R, Alsawas M, Larry P, Murad MH. 2018. Readability of Online Health Information: A Meta-Narrative Systematic Review. Am J Med Qual. 33(5):487-492 DOI 10.1177/1062860617751639

452 Edworthy J, Hellier E, Newbold L, Titchener K. 2015. Passing crisis and emergency risk
453 communications: the effects of communication channel, information type, and
454 repetition. Appl Ergon. 48:252-262 DOI 10.1016/j.apergo.2014.12.009

455 Eysenbach, G., Köhler, C. 2002. How do consumers search for and appraise health
456 information on the world wide web? Qualitative study using focus groups, usability tests, and
457 in-depth interviews. BMJ (Clinical research ed.), 324(7337), 573–577 DOI
458 10.1136/bmj.324.7337.573

459 Fernández-de-Las-Peñas, C., Navarro-Santana, M., Plaza-Manzano, G., Palacios-Ceña, D.,
460 Arendt-Nielsen, L. 2021. Time course prevalence of post-COVID pain symptoms of
461 musculoskeletal origin in patients who had survived to severe acute respiratory syndrome
462 coronavirus 2 infection: a systematic review and meta-analysis. Pain,
463 10.1097/j.pain.0000000000002496 DOI 10.1097/j.pain.0000000000002496

464 Greenhalgh T, Knight M, A'Court C, Buxton M, Husain L. 2020. Management of post-acute
465 covid-19 in primary care. BMJ. 370:m3026 DOI 10.1136/bmj.m3026

466 Guo WJ, Wang WK, Xu D, Qiao Z, Shi YL, Luo P. 2019. Evaluating the Quality, Content,
467 and Readability of Online Resources for Failed Back Spinal Surgery. Spine (Phila Pa 1976).
468 44(7):494-502 DOI 10.1097/BRS.0000000000002870

469 Halboub E, Al-Ak'hali MS, Al-Mekhlafi HM, Alhajj MN. 2021. Quality and readability of
470 web-based Arabic health information on COVID-19: an infodemiological study. BMC Public
471 Health. 2021;18;21(1):151 DOI 10.1186/s12889-021-10218-9

472 Han A, Carayannopoulos AG. 2020. Readability of Patient Education Materials in Physical
473 Medicine and Rehabilitation (PM&R): A Comparative Cross-Sectional Study. PM R.
474 12(4):368-373 DOI 10.1002/pmrj.12230

475 Jayasinghe R, Ranasinghe S, Jayarajah U, Seneviratne S. 2020. Quality of online information
476 for the general public on COVID-19. Patient Educ Couns. 7;103(12):2594–7 DOI
477 10.1016/j.pec.2020.08.001

Johnson, 2022. Worldwide desktop market share of leading search engines from January 2010 to January 2022 Available at https://www.statista.com/statistics/216573/worldwide-market-share-of-search-engines/ (accessed 01 March 2022).

Kłak A, Grygielska J, Mańczak M, Ejchman-Pac E, Owoc J, Religioni U, Olszewski R. 2022. Online Information of COVID-19: Visibility and Characterization of Highest Positioned Websites by Google between March and April 2020-A Cross-Country Analysis. Int J Environ Res Public Health. 28;19(3):1491. DOI 10.3390/ijerph19031491

Nabavi N. 2020. Long covid: How to define it and how to manage it. BMJ. 370:m3489 DOI 10.1136/bmj.m3489

Okan O, Bollweg TM, Berens EM, Hurrelmann K, Bauer U, Schaeffer D. 2020. Coronavirus-Related Health Literacy: A Cross-Sectional Study in Adults during the COVID-19 Infodemic in Germany. Int J Environ Res Public Health. 30;17(15):5503 DOI 10.3390/ijerph17155503

Silberg, W. M., Lundberg, G. D., Musacchio, R. A. 1997. Assessing, controlling, and assuring the quality of medical information on the Internet: Caveant lector et viewor--Let the reader and viewer beware. JAMA, 277(15), 1244–1245 DOI 10.1001/jama.1997.03540390074039

Struyf, T., Deeks, J. J., Dinnes, J., Takwoingi, Y., Davenport, C., Leeflang, M. M., Spijker, R., Hooft, L., Emperador, D., Dittrich, S., Domen, J., Horn, S., Van den Bruel, A. 2020. Cochrane COVID-19 Diagnostic Test Accuracy Group. Signs and symptoms to determine if a patient presenting in primary care or hospital outpatient settings has COVID-19 disease. Cochrane Database Syst Rev. 7(7):CD013665 DOI 10.1002/14651858.CD013665

Su S, Cui H, Wang T, Shen X, Ma C. 2020. Pain: A potential new label of COVID-19. Brain Behav Immun. 87:159-160 DOI 10.1016/j.bbi.2020.05.025

Şahin T, Ayyildiz A, Gencer-Atalay K, Akgün C, Özdemir HM, Kuran B. 2021. Pain Symptoms in COVID-19. Am J Phys Med Rehabil. 1;100(4):307-312 DOI 10.1097/PHM.0000000000001699

505 Tetik B. Demir G, Kurt O, Derya S. 2021. Post-Covid pain frequency and affecting factors.
506 Medicine Science | International Medical Journal. 10. 1304.
507 10.5455/medscience.2021.05.183 DOI 10.5455/medscience.2021.05.183

508 Valizadeh-Haghi S, Khazaal Y, Rahmatizadeh S.2021. Health websites on COVID-19: are
509 they readable and credible enough to help public self-care? J Med Libr Assoc. 1;109(1):75-
510 83 DOI 10.5195/jmla.2021.1020

511 Wald, H. S., Dube, C. E., Anthony, D. C. 2007. Untangling the Web--the impact of Internet
512 use on health care and the physician-patient relationship. Patient education and
513 counseling, 68(3), 218–224 DOI 10.1016/j.pec.2007.05.016

514 Walsh T, Volsko T. 2008. Readability Assessment of Internet-Based Consumer Health
515 Information. Respiratory Care 53(10): 1310-5

516 Wang SW, Capo JT, Orillaza N. Readability and comprehensibility of patient education
517 material in hand-related web sites. J Hand Surg Am. 2009;34(7):1308-1315 DOI:
518 10.1016/j.jhsa.2009.04.008

519 Weil, A. G., Bojanowski, M. W., Jamart, J., Gustin, T., & Lévêque, M. 2014. Evaluation of
520 the quality of information on the Internet available to patients undergoing cervical spine
521 surgery. World neurosurgery, 82(1-2), e31–e39 DOI 10.1016/j.wneu.2012.11.003

522 Worrall AP, Connolly MJ, O'Neill A, O'Doherty M, Thornton KP, McNally C, McConkey
523 SJ, de Barra E. 2020. Readability of online COVID-19 health information: a comparison
524 between four English speaking countries. BMC Public Health. 13;20(1):1635 DOI
525 10.1186/s12889-020-09710-5

526 Yang J, Zheng Y, Gou X, Pu K, Chen Z, Guo Q, Ji R, Wang H, Wang Y, Zhou Y. 2020.
527 Prevalence of comorbidities and its effects in patients infected with SARS-CoV-2: a
528 systematic review and meta-analysis. Int J Infect Dis. 94:91-95. DOI
529 10.1016/j.ijid.2020.03.017

530 Yurdakul OV, Kilicoglu MS, Bagcier F. 2021. Evaluating the reliability and readability of
531 online information on osteoporosis. Arch Endocrinol Metab. 1;65(1):85-92 DOI
532 10.20945/2359-3997000000311

533 Zeldman J. 2001. Taking Your Talent to the Web: A Guide for the Transitioning Designer.
534 Indianapolis: New Riders

535

Figure 1

Types of websites in the whole search

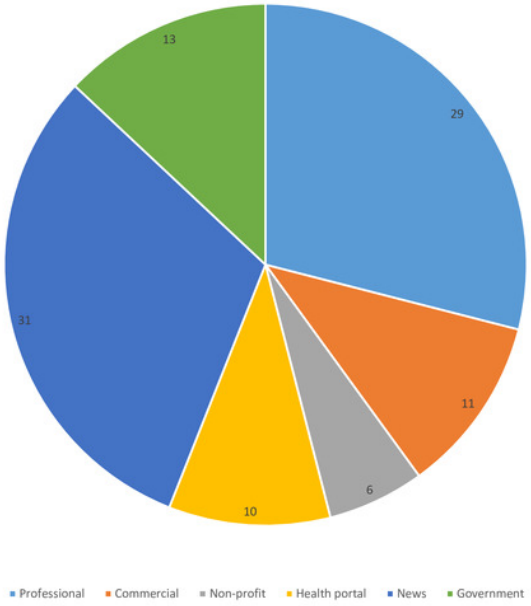

Table 1(on next page)

Content analysis by typology

		Professional	Commercial	Non-Profit	Health Portal	News	Government	p
Etiology	+	8(27,6%)	1(9,1%)	3(50%)	1(10%)	13(41,9%)	3(23,1%)	0,160
	-	21(72,4%)	10(90,9%)	3(50%)	9(90%)	18(58,1%)	10(76,9%)	
Diagnosis	+	9(31%)	3(27,3%)	2(33,3%)	3(30%)	7(22,6%)	4(30,8%)	0,981
	-	20(69%)	8(72,7%)	4(66,7%)	7(70%)	24(77,4%)	9(69,2%)	
Non-pain symptoms	+	28(96,6%)	8(72,7%)	5(83,3%)	6(60%)	27(87,1%)	11(84,6%)	0,059
	-	1(3,4%)	2(18,2%)	1(16,7%)	4(40%)	4(12,9%)	1(7,7%)	
Treatment	+	17(58,6%)	9(81,8%)	4(66,7%)	7(70%)	16(51,6%)	7(53,8%)	0,572
	-	12(41,4%)	2(18,2%)	2(3,3%)	3(30%)	15(48,4%)	6(46,2%)	
Exercise	+	7(24,1%)	6(54,5%)	3(50%)	5(50%)	6(19,4%)	2(15,4%)	0,081
	-	22(75,9%)	5(45,5%)	3(50%)	5(50%)	25(80,6%)	11(84,6%)	
Prevention	+	3(10,3%)	1(9,1%)	1(16,7%)	10(100%)	6(19,4%)	5(38,5%)	0,149
	-	26(89,7%)	10(90,9%)	5(83,3%)	0(0%)	25(80,6%)	8(61,5%)	
Risk Factors	+	6(20,7%)	0(0%)	2(33,3%)	3(30%)	4(12,9%)	5(38,5%)	0,168
	-	23(79,3%)	11(100%)	4(66,7%)	7(70%)	27(87,1%)	8(61,5%)	
Vaccine-pain relationship	+	6(20,7%)	0(0%)	1(16,7%)	1(10%)	4(12,9%)	5(38,5%)	0,186
	-	23(79,3%)	11(100%)	5(83,3%)	9(90%)	27(87,1%)	8(61,5%)	

1 Statistically different($p<0,05$)

2

Table 2(on next page)

All group of websites' mean results and statistical comparison of text content to 6th grade reading level

	Top 10 (n=10)	Others(n=90)	Total(n=100)	Comparison of text content to 6th grade reading level **(p)**
Readability Indexes	**Mean±SD**	**Mean±SD**	**Mean±SD**	
FRES	55,73±10,13	50,92±10,65	51,40±10,65	**<0.001**
GFOG	12,58±2,32	13,20±2,15	13,14±2,16	**<0.001**
FKGL	10,22±2,24	11,01±2,16	10,93±2,17	**<0.001**
The CL Index	10,10±1,72	10,67±1,71	10,62±1,71	**<0.001**
The SMOG Index	9,09±1,74	9,91±1,64	9,83±1,66	**<0.001**
ARI	10,46±2,69	11,09±2,56	11,03±2,57	**<0.001**
LW Formula	11,78±3,19	12,59±2,87	12,51±2,90	**<0.001**
Grade Level	10,40±2,17	11,05±2,09	10,99±2,10	**<0.001**
Popularity Index				
Alexa Rank	48387,77±56870,73	312552,37±835155,40	287786,94±798542,83	
JAMA Mean±SD	1,80±1,03	2,02±0,73	2±0,76	
DISCERN Mean±SD	38,20±10,68	36,20±15,11	36,40±14,70	

GQS Mean±SD		2,70±0,48	2,12±0,87	2,18±0,85	
JAMA		**n(%)**	**n(%)**		
Insufficient Data		4(40%)	19(21,1%)	23(23%)	
Partially Sufficient Data		6(60%)	67(74,4%)	73(73%)	
Completely Sufficient Data		0(0%)	4(4,4%)	4(4%)	
DISCERN		**n(%)**	**n(%)**	**n(%)**	
Very Poor n(%)		0(0%)	16(17,8%)	16(16%)	
Poor n(%)		7(70%)	48(53,3%)	55(55%)	
Fair n(%)		2(20%)	13(14,4%)	15(15%)	
Good n(%)		1(10%)	11(12,2%)	12(12%)	
Excellent n(%)		0(0%)	2(2,2%)	2(2%)	
HONcode n(%)	+	2(20%)	8(8,9%)	10(10%)	
	-	8(80%)	82(91,1%)	90(90%)	
GQS		**n(%)**	**n(%)**	**n(%)**	
Low Quality		3(30%)	72(80%)	75(75%)	

Medium Quality	7(70%)	10(11,1%)	17(17%)	
High Quality	0(0%)	8(8,9%)	8(8%)	
Typology	**n(%)**	**n(%)**	**n(%)**	
Professional	6(60%)	23(25,6%)	29(29%)	
Commercial	0(0%)	11(12,2%)	11(11%)	
Non-profit	0(0%)	6(6,7%)	6(6%)	
Health portal	1(10%)	9(10%)	10(10%)	
News	0(0%)	31(34,4%)	31(31%)	
Government	3(30%)	10(11,1%)	13(13%)	

Flesch reading ease score(FRES), Flesch-Kincaid grade level(FKGL), Simple Measure of Gobbledygook(SMOG), Gunning FOG(GFOG), Coleman-Liau score(CL), automated readability index(ARI) ve Linsear Write(LW), JAMA: Journal of American Medical Association Benchmark Criteria**,** HONcode :The Health on the Net Foundation Code of Conduct (HONcode), Global Quality Score(GQS), Bold character; statistically different ($p<0,05$)

Table 3(on next page)

Correlation relationships between rank and readability formulas, JAMA, DISCERN scores, HONcode precenses

Rank	Alexa Rank		Google Rank		JAMA		DISCERN		GQS		HONcode	
	r	p	r	p	r	p	r	p	r	p	r	p
Mean FRES	0,178	0,084	-0,007	0,946	**-0,222**	**0,027**	**-0,223**	**0,026**	**-0,293**	**0,003**	-0,190	0,058
Mean GFOG	-0,133	0,197	0,015	0,885	**0,269**	**0,007**	**0,215**	**0,032**	**0,307**	**0,002**	**0,217**	**0,030**
Mean FKGL	**-0,211**	**0,039**	0,007	0,945	**0,226**	**0,024**	**0,200**	**0,046**	**0,275**	**0,006**	0,185	0,066
Mean CL Index	-0,134	0,191	-0,043	0,670	0,166	0,099	**0,205**	**0,041**	**0,261**	**0,009**	0,133	0,189
Mean SMOG index	-0,174	0,091	0,079	0,436	**0,257**	**0,010**	**0,210**	**0,036**	**0,272**	**0,006**	0,172	0,088
Mean ARI	**-0,220**	**0,032**	-0,015	0,881	**0,209**	**0,037**	0,189	0,060	**0,262**	**0,009**	0,159	0,114
Mean LW Formula	**-0,221**	**0,031**	0,022	0,829	**0,230**	**0,021**	0,172	0,087	**0,237**	**0,018**	0,153	0,128

Grade Level	-0,193	0,059	0,001	0,995	**0,226**	**0,024**	**0,205**	**0,041**	**0,274**	**0,006**	-0,161	0,109
JAMA	-0,032	0,100	0,088	0,385	**-**	**-**	**0,670**	**0,001>**	**0,411**	**0,001>**	0,131	0,194
DISCERN	-0,028	0,784	-104	0,302	**0,670**	**0,001>**	**-**	**-**	**0,765**	**0,001>**	**0,287**	**0,004**
GQS	-0,063	0,539	-0,222	0,027	**0,411**	**0,001>**	**0,765**	**0,001>**	**-**	**-**	**0,362**	**0,001>**
HONcode	-0,114	0,268	-0,076	0,451	0,131	0,194	**0,287**	**0,004**	**0,362**	**0,001>**	-	-

Flesch reading ease score(FRES), Flesch-Kincaid grade level(FKGL), Simple Measure of Gobbledygook(SMOG), Gunning FOG(GFOG), Coleman-Liau score(CL), automated readability index(ARI) ve Linsear Write(LW)

HONcode :The Health on the Net Foundation Code of Conduct (HONcode), JAMA: Journal of American Medical Association Benchmark Criteria

Bold character; statistically different ($p<0,05$)

Table 4(on next page)

Comparison of JAMA, DISCERN scores, HONcode presences and reading levels according to the typologies of the websites

	Professional	Commercial	Non-Profit	Health Portal	News	Government	p
N(%)	29(29%)	11(11%)	6(6%)	10(10%)	31(31%)	13(13%)	
JAMA(Mean± SD)	2,03±0,73	1,63±0,5	2,5±1,22	2,4±0,84	2,06±0,57	1,53±0,87	**0,049**
Insufficient Data n:23	7(24,1%)	4(36,4%)	1(16,7%)	1(10%)	3(9,7%)	7(53,8%)	
Partially Sufficient Data n:73	22(75,9%)	7(63,6%)	3(50%)	8(80%)	27(87,1%)	6(46,2%)	
Completely Sufficient Data n:4	0(0%)	0(0%)	2(33,3%)	1(10%)	1(3,2%)	0(0%)	
DISCERN(Mean±SD)	36,13±14,22	32±14,31	42±18,5	47,40±17,91	34,96±13,69	33,07±11,73	0,249
Very Poor n:16	5(17,2%)	4(36,4%)	1(16,7%)	0(0%)	4(12,9%)	2(15,4%)	
Poor n:55	15(51,7%)	3(27,3%)	2(33,3%)	5(50%)	21(67,7%)	9(69,2%)	
Fair n:15	5(17,2%)	4(36,4%)	1(16,7%)	1(10%)	3(9,7%)	1(7,7%)	
Good n:12	4(13,8%)	0(0%)	2(33,3%)	3(30%)	2(6,5%)	1(7,7%)	
Excellent n:2	0(0%)	0(0%)	0(0%)	1(10%)	1(3,2%)	0(0%)	
HONcode							0,152
+ n:10	4(13,8%)	0(0%)	1(16,7%)	7(70%)	1(3,2%)	1(7,7%)	
- n:90	25(86,2%)	11(100%)	5(83,3%)	3(30%)	30(96,8%)	12(92,3%)	
Reading Level							0,850
Fairly easy to read	0(0%)	2(18,2%)	0(0%)	1(10%)	3(9,7%)	1(7,7%)	
Standart/Avarage n(%)	4(13,8%)	1(9,1%)	2(33,3%)	0(0%)	2(6,5%)	1(7,7%)	
Fairly difficult to read n(%)	11(37,9%)	4(36,4%)	1(16,7%)	3(30%)	13(41,9%)	5(38,5%)	
Difficult to read n(%)	13(44,8%)	4(36,4%)	2(33,3%)	6(60%)	13(41,9%)	6(46,2%)	
Very Diffucult to read n(%)	1(3,4%)	0(0%)	1(16,7%)	0(0%)	0(0%)	0(0%)	
Readers Age							0,646
8- 9 Years old (Fourth and Fifth Graders) n(%)	0(0%)	0(0%)	0(0%)	0(0%)	1(3,2%)	0(0%)	
10-11 Years old	0(0%)	0(0%)	0(0%)	0(0%)	2(6,5%)	0(0%)	

(Fifth and Sixth graders) n(%)							
11-13 Years old (Sixth and Seventh Graders) n(%)	2(8,3%)	1(9,1%)	0(0 %)	1(10 %)	0(0%)	0(0%)	
12-14 Years old (Seventh and Eighth Graders) n(%)	1(3,4%)	2(18,2%)	0(0%)	0(0%)	1(3,2%)	1(7,7%)	
13-15 Years old (Eighth and Ninth Graders) n(%)	3(10,3%)	1(9,1%)	2(33,3%)	1(10%)	2(6,5%)	2(15,4%)	
14-15 Years old (Ninth to Tenth Graders) n(%)	5(17,2%)	2(18,2%)	1(16,7%)	1(10%)	4(12,9%)	4(30,8%)	
15-17 Years old (Tenth to Eleventh Graders) n(%)	8(27,6%)	3(27,3%)	0(0%)	1(10%)	10(32,3%)	0(0%)	
17-18 Years old (Twelfth Graders) n(%)	11(37,9%)	0(0%)	0(0%)	3(30%)	6(19,4%)	2(15,4%)	
18-19 Years old (College Level Entry) n(%)	0(0%)	2(18,2%)	1(16,7%)	1(10%)	1(3,2%)	2(15,4%)	
21-22 Years Old(college level)	0(0%)	0(0%)	1(16,7%)	1(10%)	4(12,9%)	0(0%)	
College Graduate n(%)	1(3,4%)	0(0%)	1(16,7%)	1(10%)	0(0%)	2(15,4%)	

1 JAMA: Journal of American Medical Association Benchmark Criteria**,** HONcode :The Health on
2 the Net Foundation Code of Conduct (HONcode), Statistically different($p<0,05$)

3