Original Article

Both English- and Spanish-Language Anterior Cruciate Ligament Reconstruction Online Patient Education Materials Are Written at Higher-Than-Recommended Reading Levels

Jacob S. Ghahremani, B.A., Michael Chapek, B.A., Virginia Xie, B.A., Tanya Watarastaporn, B.S., M.S., Nala A. Al-Khatib, B.S., and Ronald A. Navarro, M.D.

Purpose: To examine the overall reading levels of anterior cruciate ligament reconstruction online patient education materials (OPEMs) written in English and Spanish. **Methods:** We conducted Google searches for OPEMs using "ACL surgery" and "*cirugía LCA*" as English and Spanish search terms, respectively. Several measures of readability were used to analyze 25 English-language OPEMs (Flesch Reading Ease, Flesch Reading Ease Grade Level, Flesch-Kincaid Grade Level, Coleman-Liau Index, Gunning Fog Index, and Simple Measure of Gobbledygook) and 25 Spanish-language OPEMs (Fernández-Huerta Index, Fernández-Huerta Grade Level, and Índice de Legibilidad de Flesch-Szigriszt). English- and Spanish-language OPEMs were compared based on mean overall grade level and number of OPEMs written below a seventh- or ninth-grade reading level. **Results:** English-language OPEMs showed a higher mean overall grade level than Spanish-language OPEMs (10.48 ± 1.86 vs 8.64 ± 1.22, $P < .001$). No significant differences were noted in the number of OPEMs written below a seventh-grade reading level. However, significantly more Spanish-language OPEMs were written below a ninth-grade reading level compared with English-language OPEMs (56% vs 16%, $P = .003$). **Conclusions:** Although Spanish-language OPEMs were written at a lower reading level, average readability for both English- and Spanish-language OPEMs was significantly higher than the recommended level. Across both languages, only a single English-language webpage met the American Medical Association—recommended sixth-grade reading level. More Spanish-language articles were written at or below the average adult reading level in the United States. **Clinical Relevance:** It is imperative that patient educational materials be written at a reading level that is understood by the most patients. This is especially true for OPEMs, when a medical provider is not present to answer questions. Therefore, it is important to evaluate the reading level of OPEMs to determine whether they are written at an appropriate level for the best patient understanding.

Health literacy is among the most important predictors of overall health.[1] Poor health literacy has been strongly associated with lower utilization of health services and poorer clinical outcomes.[2] Furthermore, patients with lower health literacy tend to have higher costs of care.[3] Written materials represent one of the most common means of conveying health information, but their utility is limited by the literacy of the patient accessing them.

Online patient education materials (OPEMs) have become a primary source of health information for the majority of patients in the United States, with most patients using these materials to inform their medical decisions.[4] "Readability," defined as how easy it is to read and comprehend a given piece of text, is a key feature of OPEMs that must be considered when creating educational materials.[5] In the United States, the average adult has an eighth-grade reading proficiency, with roughly one-fifth of U.S. adults classified as having low literacy skills.[6] In light of these numbers, governing medical organizations have proposed recommended readability levels for written educational materials. The American Medical Association (AMA)

From Kaiser Permanente Bernard J. Tyson School of Medicine, Pasadena, California, U.S.A. (J.S.G., M.C., V.X., T.W., N.A.A-K., R.A.N.); and Department of Orthopaedic Surgery, Kaiser Permanente Southern California Permanente Medical Group, Pasadena, California, U.S.A. (R.A.N.).

Received April 6, 2024; accepted July 13, 2024.

Address correspondence to Jacob S. Ghahremani, B.A., Kaiser Permanente Bernard J. Tyson School of Medicine, 98 S Los Robles Ave, Pasadena, CA 91101, U.S.A. E-mail: Jacob.S.Ghahremani@kp.org

2666-061X/24559

https://doi.org/10.1016/j.asmr.2024.100982

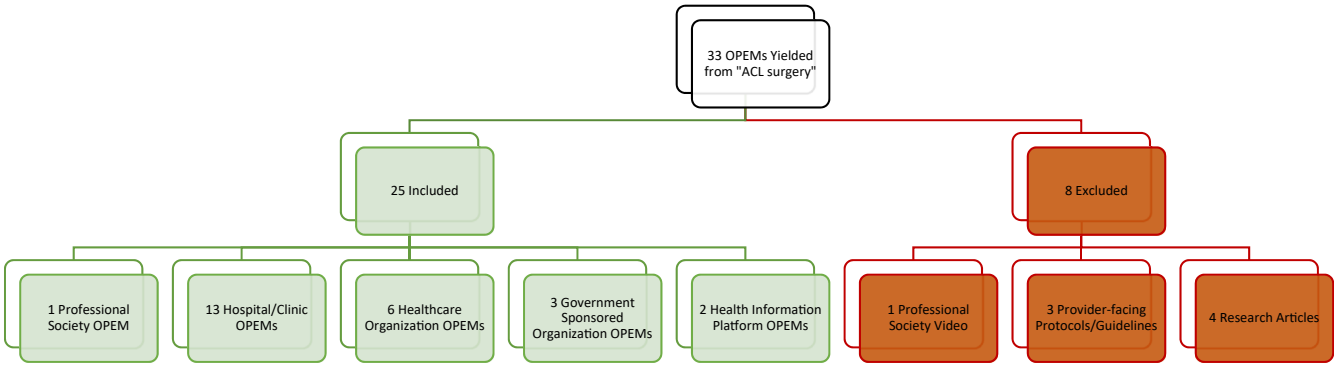

Fig 1. Distribution of English-language online patient education materials (OPEMs) by type. (ACL, anterior cruciate ligament.)

recommends that materials be written at no higher than a sixth-grade level.[7] Gao et al.[8] recently found that OPEMs on anterior cruciate ligament (ACL) surgery had poor readability, understandability, and actionability for patients, with no online resources meeting recommended reading levels; however, this analysis was not completed on Spanish-language materials.

Spanish is the second most spoken language in the United States, with roughly 41 million Americans preferring Spanish as their primary language.[9] There is a clear relationship between patients with limited English proficiency, poor patient-physician communication, and adverse health outcomes.[10,11] Given the clear disparities in care between Spanish- and English-speaking patients, it is critical that we identify gaps in care to determine how to best serve all patients. The purpose of this study was to examine the overall reading levels of ACL reconstruction OPEMs written in English and Spanish. We hypothesized that on the basis of overall mean grade levels, both English- and Spanish-language materials would be written at reading levels above the AMA-recommended level of sixth grade or below.

Methods

With previous studies showing comparable quality and readability of information yielded on search engines Google (Alphabet, Mountain View, CA), Bing (Microsoft, Redmond, WA), and Yahoo! (New York, NY), and with Google comprising roughly 90% of the online search market, the decision was made to search for education materials on www.google.com.[12,13] Gao et al.[8] showed that of several search terms used on Google to find information about ACL reconstruction, "ACL surgery" had the highest volume of searches over a 5-year period. Therefore, it was decided that "ACL surgery" would be used as the English search term (Fig 1). On November 5, 2023, a query was performed for the terms "*cirugía del ligamento cruzado anterior*," "*cirugía LCA*," "*reconstrucción del ligamento cruzado anterior*," "*reconstrucción LCA*," "*operación del ligamento cruzado anterior*," and "*operación LCA*" to determine which term was the most frequently searched over the past 5 years.[14] Unfortunately, there was not a high enough search volume for any of these terms to produce results, so "*cirugía LCA*" was selected as the Spanish search term because this is the Spanish translation of our English search term (Fig 2).

The methods of data collection and statistical analysis for this investigation were inspired by those in a similar study investigating the readability of shoulder instability OPEMs.[15] Two Google searches for each search term were performed independently by 3 investigators (J.S.G., M.C., and V.X.) who all speak and read Spanish at a level of professional working proficiency or full professional proficiency. The purpose of having 3 investigators conduct the searches was to ensure that all search results yielded from each search were identical and reproducible; for example, J.S.G. and M.C. would each search for the search term "*cirugía LCA*" to confirm equality in search results and J.S.G. and V.X. would do the same for the search term "ACL surgery." Searches were carried out on November 16, 2023, on personal laptops connected to home wireless networks. All searches were performed in incognito windows after deletion of cookies and caches, and care was taken to ensure that each reviewer was logged out of any personal online accounts so that personal search algorithms would not interfere with results. It has been shown that the vast majority of internet users do not click beyond the first 10 search results, with earlier search results tending to be of higher quality.[16,17] With this in mind, the first 25 eligible results were included in the analysis to ensure that nearly all the results that patients would likely encounter were analyzed without compromising result quality and specificity. The following types of websites were excluded: sites locked behind a paywall, audiovisual materials, news/journalism, personal blogs, reference materials for medical professionals, materials from peer-reviewed journals, and sites without sufficient text to complete a readability analysis. In excluding these sites, only pages

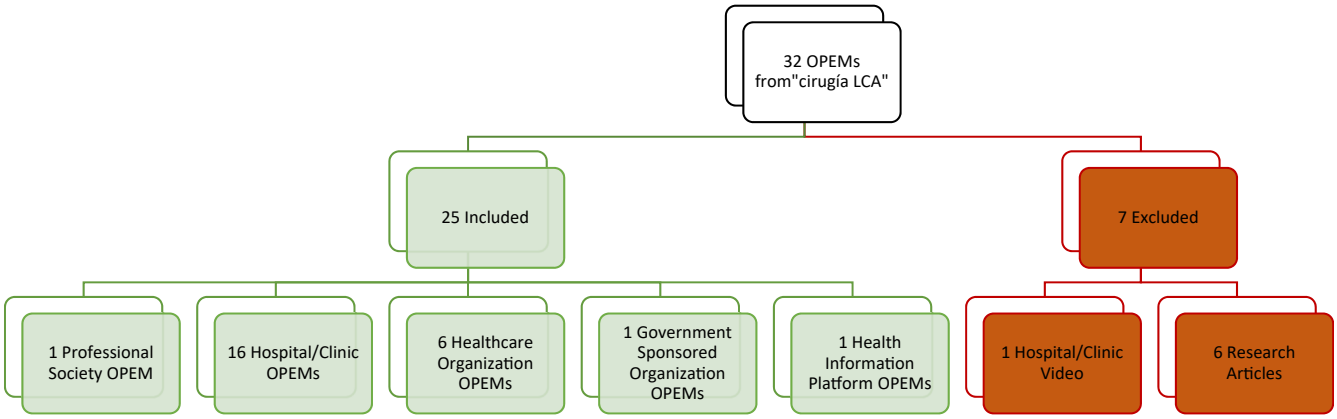

Fig 2. Distribution of Spanish-language online patient education materials (OPEMs) by type. (LCA, *ligamento cruzado anterior*.)

offering patient-centered educational materials were included.

Each English-language OPEM was analyzed using the following measures of readability: Flesch-Kincaid Grade Level (FKGL), Flesch Reading Ease (FRE), Gunning Fog Index (GFI), Coleman-Liau Index (CLI), and Simple Measure of Gobbledygook (SMOG).[18-21] To calculate each of these indices, we used an online calculator recommended by the National Institutes of Health for assessing the readability of health information.[22-24] Materials in Spanish were analyzed manually using the Fernández-Huerta Index (FHI), Fernández-Huerta Grade Level (FHG), and Índice de Legibilidad de Flesch-Szigriszt (INFLESZ); the FHI is the Spanish-language adaption of the FRE index and is measured according to the same scale (Tables 1 and 2).[25,26] Multiple scales were used for each language because of inherent variability in readability estimations, as well as previous recommendations that multiple formulas be used (Table 3).[27-29]

The primary outcome measure of our analysis was whether English- and Spanish-language OPEMs were written at or below the sixth-grade reading level as recommended by the AMA on the basis of overall grade level and the number of OPEMs adhering to the recommendation; secondarily, we evaluated for significant differences in readability scores and average reading levels between English- and Spanish-language resources. Data were analyzed using IBM SPSS Statistics for Macintosh, version 28.0.1.1 (IBM, Armonk, NY). The Student *t* test was used to determine significant differences in the average reading levels between languages, with $P < .05$ taken as significant; equal variances between the 2 language samples were not assumed if the Levene test of equality of variances yielded $P < .05$. The Fisher exact test was used to evaluate significant differences in the number of articles at the recommended reading level of a sixth-grade reading level or below (grade level between 0 and 6.99) and the number of articles written at or below the eighth-grade reading level of the average American (grade level between 0 and 8.99). Bivariate Pearson correlation analysis was performed for every English- and Spanish-language readability index.

Results

English-language readability measures were assessed for FRE, Flesch Reading Ease Grade Level (FRG), FKGL, CLI, GFI, and SMOG (Table 4). The analyses resulted in the following values for these measures: FRE, 58.04 ± 10.81; FRG, 10.24 ± 2.24; FKGL, 8.56 ± 1.92; CLI, 10.21 ± 2.04; GFI, 11.60 ± 1.81; and SMOG, 11.79 ± 1.55. The overall grade level for all measures resulted in a mean level of 10.48 ± 1.86. The median grade level for the measures was 10.66, and the 25th and 75th percentiles were 9.10 and 12.22, respectively. Of the English-language OPEMs, 4% were written at or below the sixth-grade level and 16% were written at or below the eighth-grade level.

Spanish-language readability measures were assessed for FHI, INFLESZ, and FHG (Table 5). This analysis resulted in mean values of 59.95 ± 6.29 for FHI and 55.21 ± 6.45 for INFLESZ. Analysis of FHG resulted in a mean grade level of 8.64 ± 1.22; a median level of 8; and 25th and 75th percentiles of 7.00 and 9.00, respectively. Of the Spanish-language OPEMs, 0%

Table 1. Corresponding Reading Grade Levels According to Flesch Reading Ease and Fernández-Huerta Index Scores

Flesch Reading Ease/Fernández-Huerta Index Score	Corresponding Reading Grade Level
90.00-100	Grade 5
80.00-89.99	Grade 6
70.00-79.99	Grade 7
60.00-69.99	Grade 8-9
50.00-59.99	Grade 10-12
30.00-49.99	College
0-29.99	College graduate

Table 2. Corresponding Difficulty Categorizations According to Flesch Reading Ease, Fernández-Huerta Index, and INFLESZ Scores

	Difficulty
Flesch Reading Ease/Fernandez-Huerta Index score	
70.00-100	Easy
60.00-69.99	Standard
50.00-59.99	Fairly difficult
30.00-49.99	Difficult
0-29.99	Very difficult
INFLESZ score	
80.00-100	Very easy
65.00-79.99	Somewhat easy
55.00-64.99	Normal
40.00-54.99	Somewhat difficult
0-39.99	Very difficult

INFLESZ, Índice de Legibilidad de Flesch-Szigriszt.

were written at or below the sixth-grade level and 56% were written at or below the eighth-grade level.

All English-language readability measures were significantly correlated with one another according to bivariate Pearson correlation analysis ($P < .001$ for all bivariate relations). FRG, FKGL, CLI, GFI, and SMOG were all positively correlated with one another, whereas FRE was negatively correlated with FRG, FKGL, CLI, GFI, and SMOG. Similarly, all Spanish-language readability measures were significantly correlated with one another according to bivariate Pearson correlation analysis ($P < .001$ for all bivariate relations). FHI and INFLESZ were positively correlated with one another, whereas FHG was negatively correlated with FHI and INFLESZ.

In addition, we performed multiple comparisons between English- and Spanish-language OPEMs to assess variation in readability (Table 6). On evaluation of the overall grade level, English-language OPEMs showed a statistically higher mean overall grade level than Spanish-language OPEMs (10.48 vs 8.64, $P < .001$). When we investigated the number of OPEMs written at or below the sixth-grade reading level, there was no significant difference based on Fisher exact test analysis. Only 1 of 25 English-language articles and 0 of 25 Spanish-language articles were written at or below the sixth-grade reading level (4% vs 0%, $P > .999$). In terms of OPEMs written at or below the eighth-grade reading level, there was an increase in the number of articles in both English and Spanish that met this criterion. On the basis of Fisher exact test analysis, there were significantly more Spanish-language OPEMs written at or below the eighth-grade reading level, with 14 of 25 Spanish articles meeting this criterion, compared with English-language OPEMs, with only 4 of 25 articles having been written at or below the eighth-grade reading level (56% vs 16%, $P = .003$).

Discussion

In this study, we found that, on average, both English- and Spanish-language ACL reconstruction OPEMs were written above the AMA recommendation of OPEMs to be written at or below the sixth-grade level, with mean overall grade levels of 10.48 ± 1.86 and 8.64 ± 1.22, respectively. In fact, Spanish-language OPEMs were written at or above the seventh-grade level in every case, and English OPEMs were written at or above this level in all but one case.

These results showing poor readability of ACL surgery OPEMs, regardless of language, align with those of other studies in the literature pertaining to OPEM readability. Despite the importance of high-quality patient education to outstanding health outcomes, the readability of English-language OPEMs across a multitude of medical conditions often exceed the AMA recommendation for patient materials, making it difficult for patients to fully comprehend the materials presented.[30-39] Unfortunately, OPEMs written in Spanish are similar, with studies reporting that educational materials are also written at a higher level than is recommended.[40,41] Comprehension of OPEMs is further complicated when materials contain content about complex procedures or instructions to be followed over an extensive period, such as materials on orthopaedic surgery. Multiple investigations have concluded that educational materials used in

Table 3. Formulas for English- and Spanish-Language Readability Measures

Readability Index	Formula
English language	
FRE	206.835 − [1.015 × (Total words/Total sentences)] − [84.6 × (Total syllables/Total words)]
FKGL	[0.39 × (Total words/Total sentences)] + [11.8 × (Total syllables/Total words)] − 15.59
GFI grade level	[0.4 × (Total words/Total sentences)] + [100 × (Total words with ≥3 syllables/Total words)]
CLI grade level	(0.0588 × Average number of letters per 100 words) − (0.296 × Average number of sentences per 100 words) − 15.8
SMOG grade level	From first 10 sentences, middle 10 sentences, and last 10 sentences: (1.0430 × √ Total words with ≥3 syllables) + 3.1291
Spanish language	
FHI	206.84 − (0.6 × Total syllables) − (1.02 × Total words)
INFLESZ	206.835 − (62.3 × Total syllables/Total words) − (Total words/Total phrases)

CLI, Coleman-Liau Index; FKGL, Flesch-Kincaid Grade Level; FHI, Fernández-Huerta Index; FRE, Flesch Reading Ease; GFI, Gunning Fog Index; INFLESZ, Índice de Legibilidad de Flesch-Szigriszt; SMOG, Simple Measure of Gobbledygook.

Table 4. English-Language Readability Measures for FRE, FRG, FKGL, CLI, GFI, and SMOG

English-Language Readability Index	Mean	Median	25th Percentile	75th Percentile	SD
FRE	58.04	58.80	48.60	64.50	10.81
FRG	10.24	11.00	8.50	13.00	2.24
FKGL	8.56	8.40	7.10	9.90	1.92
CLI grade level	10.21	10.00	9.00	11.40	2.05
GFI grade level	11.60	11.60	10.20	13.50	1.81
SMOG grade level	11.79	11.60	10.70	12.90	1.55
Overall grade level	10.48	10.66	9.10	12.22	1.86

CLI, Coleman-Liau Index; FKGL, Flesch-Kincaid Grade Level; FRE, Flesch Reading Ease; FRG, Flesch Reading Ease Grade Level; GFI, Gunning Fog Index; SD, standard deviation; SMOG, Simple Measure of Gobbledygook.

orthopaedic surgery, across virtually all subspecialties, routinely exceed the recommended reading level promoted by health educators.[8,42-49] With respect to materials pertaining to sports-related injuries, one systematic review concluded that OPEMs on common sports injuries exceeded the readability levels recommended by the AMA.[45]

Even though Spanish-language OPEMs were significantly more readable than English-language OPEMs, further improvement in their readability is necessary to ensure maximal patient understanding. With respect to primary language spoken, health disparities are further exacerbated for non—English-speaking patient populations in the United States. Spanish-speaking populations in particular are prone to experience health disparities in multiple disciplines, including ACL tear management. Studies have shown that compared with their Asian or white counterparts, Hispanic patients underwent significantly lower numbers of physical therapy visits, which may correlate to a longer return-to-play time and diminished quadriceps strength.[50] Other investigations have also noted that Spanish-speaking patients were significantly less likely to pursue ACL reconstruction or they experienced an increased delay to surgery after injury.[51] With Spanish being reported as one of the leading non-English languages in the United States, limited proficiency in English is one contributing factor to health disparities faced by Hispanic patients. With the Hispanic population having one of the lowest health literacy rates in the United States, availability and readability of patient education materials can be effective measures of addressing health care disparities in this population.[52]

ACL reconstruction is a complex procedure that requires proper preoperative and postoperative care to ensure safety and effectiveness.[53] OPEMs provide accessible information about the expected course and outcomes of surgery. Preoperative care often includes a "prehabilitative" exercise regimen to reduce swelling and pain given that surgery is generally delayed until swelling subsides to prevent excessive scar tissue. For nonsurgical patients, these exercises still improve knee function and reduce swelling. After surgery, similar exercises help rebuild muscle and restore range of motion, while specific exercises such as open-chain quadriceps strengthening are avoided early in the rehabilitation process.[54] Throughout this continuum of care, OPEMs may reinforce many of the key preoperative and postoperative steps and improve patient engagement in health care decision making. This is particularly crucial for athletes given that the return to sport typically takes 8 to 12 months, depending on the sport and rehabilitation compliance. Given the vital importance of OPEMs in offering crucial information on key components of health optimization, readability is vital for patient understanding and engagement.

Taking advantage of recent technological advancements poses a promising solution, with recent studies using artificial intelligence to improve the readability of OPEMs. In one study, ChatGPT (Open AI, San Francisco, CA) was used to write articles for patients with dermatologic conditions.[55] Another recent study evaluated the use of artificial intelligence to improve the readability of OPEMs for aortic stenosis.[56] This interest in using artificial intelligence in OPEMs is gaining traction in the field of orthopaedics; for example, a recent study applied artificial intelligence to improve the readability of OPEMs across multiple orthopaedic institutions and orthopaedic surgery specialty organizations.[57] Given existing disparities in orthopaedic

Table 5. Spanish Readability Measures for FHI, INFLESZ, and FHG

Spanish-Language Readability Index	Mean	Median	25th Percentile	75th Percentile	SD
FHI	59.948	60.58	38.29	64.25	6.29
INFLESZ	55.21	55.61	32.78	59.62	6.45
FHG	8.64	8	7	9	1.22

FHG, Fernández-Huerta Grade Level; FHI, Fernández-Huerta Index; SD, standard deviation.

Table 6. Comparison of Overall Grade Level of English- Versus Spanish-Language OPEMs

English- vs Spanish-Language OPEM Comparison	English (n = 25)	Spanish (n = 25)	*P* value
Overall grade level, mean	10.48	8.64	<.001
No. of OPEMs written below seventh-grade reading level (%)	1 (4)	0 (0)	>.999
No. of OPEMs written below ninth-grade reading level (%)	4 (16)	14 (56)	.003

OPEM, online patient education material.

surgery affecting Spanish-speaking patients, identifying whether there are significant differences in the readability of OPEMs written in English versus Spanish provides insight to improve orthopaedic outcomes of ACL tears for this population.

Limitations

This study is not without limitations. First, the readability formulas used in this study are only approximations based primarily on sentence and word length, rather than word definition and topic complexity. Similarly, these formulas were unable to assess the readability of non-print media, such as audio, video, or illustrative materials, on which patients of all languages heavily rely. Additionally, we did not perform readability analysis on personal blogs; this may have limited our analysis because many physicians' personal blogs contain valid and comprehensive information. Furthermore, this study relied on 6 English-language measures but only 3 Spanish-language measures to evaluate the readability of OPEMs in each language. Regarding the search results of our queries, it is not possible to ascertain whether materials that appear within the first 25 search results appear earlier than other materials because of their quality and/or popularity versus the degree to which they respect the search engine's tips to boost visibility. As such, the number of search results analyzed may be limited in its ability to represent all OPEMs pertaining to ACL reconstruction.

The overall premise of this study was to ascertain whether resources are written at reading levels too high for the average patient; however, this study did not evaluate whether OPEMs may be written at too low a reading level for certain populations, such as patients with higher education levels and health literacy who desire more in-depth information. It must also be acknowledged that OPEMs are not the sole source of information on which patients base medical decisions. Communities with limited literacy or access to the internet would be expected to heavily base medical decisions on word of mouth through friends and family. Finally, although there does seem to be a correlation between patients with limited literacy and adverse health outcomes, there are many other factors that contribute to patients' health; therefore, it cannot be concluded that elevated OPEM reading levels directly lead to adverse health outcomes.

Conclusions

Although Spanish-language OPEMs were written at a lower reading level, average readability for both English- and Spanish-language OPEMs was significantly higher than the recommended level. Across both languages, only a single English-language webpage met the AMA-recommended sixth-grade reading level. More Spanish-language articles were written at or below the average adult reading level in the United States.

Disclosures

All authors (J.S.G., M.C., V.X., T.W., N.A.A-K., R.A.N.) declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

1. Baker DW, Parker RM, Williams MV, Clark WS, Nurss J. The relationship of patient reading ability to self-reported health and use of health services. *Am J Public Health* 1997;87:1027-1030.
2. Berkman ND, Sheridan SL, Donahue KE, Halpern DJ, Crotty K. Low health literacy and health outcomes: An updated systematic review. *Ann Intern Med* 2011;155:97-107.
3. Weiss BD, Blanchard JS, McGee DL, et al. Illiteracy among Medicaid recipients and its relationship to health care costs. *J Health Care Poor Underserved* 1994;5:99-111.
4. Berland GK, Elliott MN, Morales LS, et al. Health information on the Internet: Accessibility, quality, and readability in English and Spanish. *JAMA* 2001;285:2612-2621.
5. Tekfi C. Readability formulas: An overview. *J Doc* 1987;43:261-273.
6. U.S. Department of EducationNational Center for Education Statistics. U.S. Adults With Low Literacy and Numeracy Skills: 2012/14 to 2017 Program for the International Assessment of Adult Competencies (PIAAC). U.S. PIAAC. https://nces.ed.gov/pubs2022/2022004/ Published May 2022. Accessed October 2, 2023.
7. Weiss BD. *Health literacy: A manual for clinicians*. Chicago, IL: American Medical Association Foundation and American Medical Association, 2003.
8. Gao B, Shamrock AG, Gulbrandsen TR, et al. Can patients read, understand, and act on online resources for anterior cruciate ligament surgery? *Orthop J Sports Med* 2022;10:23259671221089977.

9. Dietrich S, Hernandez E. What languages do we speak in the United States? Nearly 68 million people spoke a language other than English at home in 2019. U.S. Census Bureau. https://www.census.gov/library/stories/2022/12/languages-we-speak-in-united-states.html. Accessed October 2, 2023. Published December 6, 2022.
10. Al Shamsi H, Almutairi AG, Al Mashrafi S, Al Kalbani T. Implications of language barriers for healthcare: A systematic review. *Oman Med J* 2020;35:e122.
11. Chauhan A, Walton M, Manias E, et al. The safety of health care for ethnic minority patients: A systematic review. *Int J Equity Health* 2020;19:118.
12. Heap JC, Dezfuli B, Bennett DM, Chapman E, DeSilva GL. The internet as a source of information for De Quervain's tendinitis. *Hand (N Y)* 2015;10:131-136.
13. Statista. Worldwide desktop market share of leading search engines from January 2010 to July 2019. https://www.statista.com/statistics/216573/worldwide-marketshare-of-search-engines/. Accessed November 6, 2023.
14. Google Trends. https://trends.google.com/trends/. Accessed November 5, 2023.
15. Ghahremani JS, Ogi JE, Kody MT, Navarro RA. Readability of online patient education materials for shoulder instability surgery in English and Spanish. *J Shoulder Elbow Surg* 2024;33:2220-2229.
16. Fox S, Rainie L. Main report: The search for online medical help. Pew Research Center. https://www.pewresearch.org/internet/2002/05/22/main-report-the-search-for-online-medical-help/. Accessed June 28, 2023. Published 2002.
17. Meyer C. The top 5 results in Google get almost 70% of all clicks. Advance Metrics. https://www.advance-metrics.com/en/blog/the-top-5-results-in-google-get-almost-70-of-all-clicks/. Accessed June 28, 2023. Published July 10, 2014.
18. Coleman M, Liau TL. A computer readability formula designed for machine scoring. *J Appl Psychol* 1975;60:283.
19. Gunning R. *The technique of clear writing*. New York, NY: McGraw-Hill, 1952.
20. Kincaid JP, Fishburne RP Jr, Rogers RL, Chissom BS. *Derivation of new readability formulas (Automated Readability Index, Fog count and Flesch Reading Ease Formula) for Navy enlisted personnel*. University of Central Florida: Orlando, FL: Institute for Simulation and Training, 1975.
21. McLaughlin GH. SMOG grading—A new readability formula. *J Reading* 1969;12:639-646.
22. National Institutes of Health Office of Communications & Public Liaison. Clear & simple. https://www.nih.gov/institutes-nih/nih-office-director/office-communications-public-liaison/clear-communication/clear-simple. Accessed June 28, 2023. Published July 7, 2021.
23. Readable. Readability score/readability test/reading level calculator/readable. https://readable.com/. Accessed October 2, 2023. Published April 19, 2020.
24. Reddy RV, Golan R, Loloi J, et al. Assessing the quality and readability of online content on shock wave therapy for erectile dysfunction. *Andrologia* 2022;54:e14607.
25. Fernández Huerta J. Medidas sencillas de lecturabilidad. *Consigna* 1959;214:29-32 [in Spanish].
26. Rao SJ, Nickel JC, Navarro NI, Madden LL. Readability analysis of Spanish language patient-reported outcome measures in laryngology. *J Voice* 2024;38:487-491.
27. Freda MC. The readability of American Academy of Pediatrics patient education brochures. *J Pediatr Health Care* 2005;19:151-156.
28. Ley P, Florio T. The use of readability formulas in health care. *Psychol Health Med* 1996;1:7-28.
29. Walsh TM, Volsko TA. Readability assessment of internet-based consumer health information. *Respir Care* 2008;53:1310-1315.
30. Abdullah Y, Alokozai A, O'Connell S, Mulcahey MK. Online patient education materials for common sports injuries are written at too-high of a reading level: A systematic review. *Arthrosc Sports Med Rehabil* 2022;4:e861-e875.
31. Fowler GE, Baker DM, Lee MJ, Brown SR. A systematic review of online resources to support patient decision-making for full-thickness rectal prolapse surgery. *Tech Coloproctol* 2017;21:853-862.
32. Hecht CJII, Burkhart RJ, McNassor R, Mistovich RJ. Readability of online patient educational materials in pediatric orthopaedics: A systematic review. *J Pediatr Orthop* 2023;43:e591-e599.
33. Morony S, Flynn M, McCaffery KJ, Jansen J, Webster AC. Readability of written materials for CKD patients: A systematic review. *Am J Kidney Dis* 2015;65:842-850.
34. Okuhara T, Okada H, Goto E, Kiuchi T. Readability assessment of HPV vaccination and cervical cancer information: A systematic scoping review. *Healthcare (Basel)* 2021;9:1246.
35. Okuhara T, Ishikawa H, Ueno H, Okada H, Kato M, Kiuchi T. Readability assessment of vaccine information: A systematic review for addressing vaccine hesitancy. *Patient Educ Couns* 2022;105:331-338.
36. Roshan A, Choo J, Lim C. Readability, understandability, and actionability of online cardiovascular risk assessment tools and patient educational material: A systematic review. *Glomerular Dis* 2022;3:56-68.
37. Sideris GA, Vyllioti AT, Dima D, Chill M, Njuguna N. The value of web-based patient education materials on transarterial chemoembolization: Systematic review. *JMIR Cancer* 2021;7:e25357.
38. Williams AM, Muir KW, Rosdahl JA. Readability of patient education materials in ophthalmology: A single-institution study and systematic review. *BMC Ophthalmol* 2016;16:133.
39. Hutchinson N, Baird GL, Garg M. Examining the reading level of internet medical information for common internal medicine diagnoses. *Am J Med* 2016;129:637-639.
40. Mazmudar RS, Sheth A, Tripathi R, Scott JF. Readability of online Spanish patient education materials in dermatology. *Arch Dermatol Res* 2021;313:201-204.
41. Novin SA, Huh EH, Bange MG, Hui FK, Yi PH. Readability of Spanish-language patient education materials from RadiologyInfo.org. *J Am Coll Radiol* 2019;16:1108-1113.
42. Foster BK, Callahan C, Dwyer CL. Readability of online hand and upper extremity patient resources. *Cureus* 2023;15:e36031.

43. Ghanem D, Covarrubias O, Harris AB, Shafiq B. Readability of the Orthopaedic Trauma Association patient education tool. *J Orthop Trauma* 2023;37:e307-e311.
44. Luciani AM, Foster BK, Hayes D, DelSole EM. Readability of online spine patient education resources. *World Neurosurg* 2022;162:e640-e644.
45. Ó Doinn T, Broderick JM, Clarke R, Hogan N. Readability of patient educational materials in sports medicine. *Orthop J Sports Med* 2022;10:23259671221092356.
46. Stelzer JW, Wellington IJ, Trudeau MT, et al. Readability assessment of patient educational materials for shoulder arthroplasty from top academic orthopedic institutions. *JSES Int* 2021;6:44-48.
47. Abdullah Y, Alokozai A, Mathew AJ, Stamm MA, Mulcahey MK. Patient education materials found via Google search for shoulder arthroscopy are written at too-high of a reading level. *Arthrosc Sports Med Rehabil* 2022;4:e1575-e1579.
48. Beutel BG, Danna NR, Melamed E, Capo JT. Comparative readability of shoulder and elbow patient education materials within orthopaedic websites. *Bull Hosp Jt Dis* 2015;73:249-256.
49. Gulbrandsen TR, Skalitzky MK, Ryan SE, et al. Total knee arthroplasty: A quantitative assessment of online patient education resources. *Iowa Orthop J* 2022;42:98-106.
50. Bram JT, Talathi NS, Patel NM, DeFrancesco CJ, Striano BM, Ganley TJ. How do race and insurance status affect the care of pediatric anterior cruciate ligament injuries? *Clin J Sport Med* 2020;30:e201-e206.
51. Devana SK, Solorzano C, Nwachukwu B, Jones KJ. Disparities in ACL reconstruction: The influence of gender and race on incidence, treatment, and outcomes. *Curr Rev Musculoskelet Med* 2022;15:1-9.
52. Gorrepati PL, Smith GP. Contrasting readability and availability of Spanish language with English language patient education materials. *Pediatr Dermatol* 2021;38:142-143 (suppl 2).
53. Shelbourne KD, Patel DV. Rehabilitation after autogenous bone-patellar tendon-bone ACL reconstruction. *Instr Course Lect* 1996;45:263-273.
54. Evans J, Mabrouk A, Nielson JL. *Anterior cruciate ligament knee injury*. Treasure Island, FL: StatPearls Publishing, 2024.
55. Mondal H, Mondal S, Podder I. Using ChatGPT for writing articles for patients' education for dermatological diseases: A pilot study. *Indian Dermatol Online J* 2023;14:482-486.
56. Rouhi AD, Ghanem YK, Yolchieva L, et al. Can artificial intelligence improve the readability of patient education materials on aortic stenosis? A pilot study. *Cardiol Ther* 2024;13:137-147.
57. Kirchner GJ, Kim RY, Weddle JB, Bible JE. Can artificial intelligence improve the readability of patient education materials? *Clin Orthop Relat Res* 2023;481:2260-2267.