EDITOR'S CHOICE

# Readability of the Most Commonly Used Patient-Reported Outcome Measures in Hand Surgery

Harjot Uppal, MBA,* Daniel Garcia, BS,* George Abdelmalek, MD,* Joseph Farshchian, MD,* Nikhil Sahai, MD,* Arash Emami, MD,* Andrew McGinniss, MD*

**Purpose** Patient-reported outcome measures (PROMs) assess surgical outcomes and patient perspectives on function, symptoms, and quality of life. The readability of patient-reported outcome measures is crucial for ensuring patients can understand and accurately complete them. The National Institutes of Health and American Medical Association recommend that patient materials be written at or below a sixth-grade reading level. We aimed to evaluate whether PROMs identified in the hand literature meet these recommended reading standards.

**Methods** We conducted a readability analysis of 22 PROMs referenced in the hand literature. Readability was assessed using the Flesch Reading Ease Score (FRES) and the Simple Measure of Gobbledygook (SMOG) Index. Scores were obtained using an online readability calculator. Patient-reported outcome measures meeting a FRES $\geq$ 80 or SMOG < 7 were considered at a sixth-grade reading level or lower, per the National Institutes of Health and American Medical Association guidelines.

**Results** Across all PROMs, the average FRES was 66 $\pm$ 12, and the average SMOG Index was 8 $\pm$ 1, corresponding to approximately an eighth- to ninth-grade reading level. Three PROMs met the target readability thresholds: Patient-Reported Outcome Measurement Information System—Physical Function Upper Extremity, Patient Evaluation Measure, and the 6-item Carpal Tunnel Syndrome Symptom Scale. Several PROMs, including the Southampton Dupuytren's Scoring Scheme, Hand Assessment Tool, and Manual Ability Measure 16, demonstrated relatively low readability scores.

**Conclusions** Most PROMs mentioned in the hand literature exceeded the recommended sixth-grade reading level, potentially affecting patient comprehension and data accuracy. Although improving readability may enhance patient understanding, altering PROM wording is not straightforward and may require extensive revalidation because changes risk affecting validity and reliability, underscoring the complexity of revising PROMs.

**Clinical relevance** These findings highlight the importance of raising awareness about PROM readability issues. Recognizing these readability challenges may encourage researchers, developers, and journal editors to consider recommended guidelines when proposing, modifying, or evaluating these measures. *(J Hand Surg Am. 2025;50(5):568–573.* 

**Key words** Hand, patient advocacy, patient-centered care, patient-reported outcome measures, readability.

*From the *Department of Orthopaedic Surgery, St. Joseph's University Medical Center, Paterson, NJ.*

Received for publication August 27, 2024; accepted in revised form February 12, 2025.

**Corresponding author:** Harjot Uppal, MBA, Department of Orthopaedic Surgery, St. Joseph's University Medical Center, 504 Valley Road, Suite 203, Wayne, NJ 07470; e-mail: hsuuppal12@gmail.com.

0363-5023/25/5005-0006$36.00/0
https://doi.org/10.1016/j.jhsa.2025.02.011

PATIENT-REPORTED OUTCOME measures (PROMs) are crucial in evaluating the effectiveness of surgical interventions and informing clinical decisions because they capture patients' perspectives on their functional abilities, symptoms, and quality of life. Ensuring that PROMs are easily understood is critical for accurate and meaningful data collection because patients must be able to comprehend and reliably complete these measures. This consideration holds true across all medical disciplines, including hand surgery, where patients often present with diverse backgrounds, varying levels of health literacy, and a range of language proficiencies.[1]

According to various studies, nearly one-fourth of American adults are functionally illiterate, with approximately 20% reading below a fifth-grade level and 50% unable to comprehend materials at an eighth-grade level.[2,3] In response to these literacy challenges, the National Institutes of Health (NIH) and the American Medical Association (AMA) have recommended that patient education materials be written at or below a sixth-grade reading level to ensure broad interpretability.[4] Despite these guidelines, many orthopedic PROMs and patient education materials exceed this threshold, often requiring a high school reading level.[5–9] Although patient education materials do not require patient responses, their complexity may limit patient understanding of health information. Extending this concern to PROMs, which do require completion, poor readability can contribute to misinterpretation, incomplete responses, or even noncompletion of these measures, potentially compromising data accuracy and influencing patient care and clinical outcomes.[7,9] Importantly, this issue is not confined to hand surgery but extends across various medical specialties, emphasizing the widespread need for improved readability in patient materials.

Despite the critical importance of this issue, there is a notable gap in research assessing the readability of PROMs associated with hand surgery. Previous analyses within the hand literature have focused primarily on patient education materials and surgical consent forms, but there is limited information on the readability of outcome measures used in research or clinical practice related to hand conditions.[5,6,10–13] Therefore, this study aimed to evaluate a selection of PROMs mentioned in the hand literature to determine if they meet the recommended reading levels set by the NIH and AMA.

## MATERIALS AND METHODS

We analyzed PROMs referenced in the hand surgery literature. We collected a list of PROMs reported by Sierakowski et al[14] from their systematic review of outcome measures used in hand surgery research. We then included any additional PROMs suggested by the senior author's (A.M.) clinical experience. Although not all of these PROMs may be routinely used today, our goal was to assess a broad set of measures that have been associated with the field. We excluded any PROMs intended for completion only by physicians and measures that are primarily visual rather than text-based (eg, visual analog scale). Any PROMs with physician and patient components were edited so that only the patient component was evaluated in our readability analysis. The final list of PROMs is shown in Table 1.

The primary variables of interest included the Flesch Reading Ease Score (FRES) and Simple Measure of Gobbledygook (SMOG) Index. The FRES is widely used and assesses syllables-per-word and words-per-sentence, reported on a scale of 0 to 100, with higher scores indicating that a text is easier to read.[15,16] We did not use the Flesch-Kincaid Reading Grade because it does not account for understandability in patients with lower educational backgrounds.[17] The SMOG Index calculates the years of education necessary to understand a given text by evaluating polysyllabic words.[18] It has been shown to estimate reading difficulty in the medical literature more accurately.[19] The threshold for a sixth-grade or lower reading level was set as a FRES $\geq$ 80 or SMOG $<$ 7, following NIH and AMA guidelines.[4]

Each PROM was categorized as upper extremity, hand/wrist, or condition specific. They were uploaded to Readable.com, a readability calculator, to collect FRES and SMOG scores. This software has been shown to accurately and reliably evaluate medical text readability.[20,21] Any text not directly related to the PROM questionnaire was excluded.

## RESULTS

We identified 22 PROMs for inclusion. Ten were upper extremity=specific, six were hand/wrist-specific, and six were condition-specific. Although the mean FRES of all PROMs was 66 $\pm$ 12 (range, 44–84), corresponding to an eighth- to ninth-grade reading level, and the mean SMOG Index was 8 $\pm$ 1 (range, 6–9), corresponding to an eighth-grade reading level, these averages obscure the wide range of readability scores. Therefore, we focused on the proportion of PROMs that exceeded the recommended sixth-grade reading level according to the NIH and AMA guidelines (FRES $\geq$ 80 or SMOG $<$ 7).

**TABLE 1. Summary of Most Commonly Used Hand and Upper Extremity Patient-Reported Outcomes**

| PROM Category | PROM | FRES* | US Grade Level Per FRES | SMOG Index† | US Grade Level Per SMOG |
|---|---|---|---|---|---|
| Upper extremity | DASH | 63 | 8–9 | 9 | 9 |
| | M2DASH | 60 | 8–9 | 8 | 8 |
| | MAM-16 | 54 | 10–12 | 9 | 9 |
| | MAM-36 | 65 | 8–9 | 8 | 8 |
| | POS-HA | 72 | 7 | 8 | 8 |
| | PROMIS-PF-UE | 83 | 6 | 7 | 7 |
| | QD | 64 | 8–9 | 9 | 9 |
| | UEFI | 58 | 10–12 | 8 | 8 |
| | UEFI-15 | 53 | 10–12 | 9 | 9 |
| | ULFI | 64 | 8–9 | 9 | 9 |
| Hand wrist | BMHQ | 70 | 8–9 | 8 | 8 |
| | HAT | 44 | College | 9 | 9 |
| | MASS07 | 61 | 8–9 | 9 | 9 |
| | MHQ | 78 | 7 | 8 | 8 |
| | PEM | 84 | 6 | 7 | 7 |
| | PRWHE | 73 | 7 | 9 | 9 |
| Condition specific | 6-CT SS | 81 | 6 | 6 | 6 |
| | BCTQ | 79 | 7 | 7 | 7 |
| | NELSON SCORE | 57 | 10–12 | 9 | 9 |
| | SDSS | 44 | College | 8 | 8 |
| | TASD | 77 | 7 | 8 | 8 |
| | TDX | 66 | 8–9 | 8 | 8 |

6-CT SS, 6-Item Carpal Tunnel Syndrome Symptom Scale; BCTQ, Boston Carpal Tunnel Questionnaire; BMHQ, Brief Michigan Hand Outcomes Questionnaire; DASH, Disabilities of the Arm, Shoulder, and Hand; HAT, Hand Assessment Tool; M2DASH, Manchester Modified DASH; MAM-16, Manual Ability Measure 16; MAM-36, Manual Ability Measure 36; MASS07, Modernized Activity Subjective Survey; MHQ, Michigan Hand Outcomes Questionnaire; Nelson Score, Nelson Hospital Score; PEM, Patient Evaluation Measure; POS-HA, Patient Outcome of Surgery Hand-Arm; PRWHE, Patient-Rated Wrist/Hand Evaluation; PROMIS-PF-UE, Patient-Reported Outcome Measurement Information System–Physical Function Upper Extremity; QD, *Quick*Dash; SDSS, Southampton Dupuytren's Scoring Scheme; TASD, Trapeziometacarpal Arthorsis Symptoms and Disability Questionnaire; TDX, Thumb Disability Index; ULFI, Upper Limb Functional Index.

*FRES is scored on a scale of 0–100, with higher scores translating to easier readability.

†The SMOG Index assigns lower scores to more readable texts, with higher scores transplanting to difficult readability.

We found that 19 of 22 (86.4%) PROMs had a FRES $< 80$, and 21 of 22 (95.5%) had a SMOG $\geq 7$. Thus, only 3 PROMs, including the Patient Evaluation Measure (FRES: 84, SMOG: 7), the Patient-Reported Outcome Measurement Information System–Physical Function Upper Extremity (FRES: 83, SMOG: 7), and the 6-Item Carpal Tunnel Syndrome Symptom Scale (FRES: 81, SMOG: 6) met at least one of the readability thresholds for a sixth-grade reading level (Figs. 1 and 2). Among these, only the 6-Item Carpal Tunnel Syndrome Symptom Scale achieved a SMOG $< 7$ (Table 1).

## DISCUSSION

Patient-reported outcome measures are crucial for evaluating the effectiveness of surgical interventions in hand surgery. Although their use has increased alongside a broader emphasis on patient-centered care, few studies have examined the readability of PROMs in this domain.[22] Previous investigations primarily focused on patient education materials and surgical consent forms, leaving a gap in understanding the readability of PROMs used in the hand literature.[5,6,10–13] Our findings indicated that most hand surgery PROMs were written at the eighth- to ninth-grade reading level, higher than current guidelines recommend for optimal patient comprehension.[4]

Although health literacy is increasingly recognized as an important determinant of patient outcomes, the readability of PROMs may currently play a limited role because these instruments are often used in research rather than routine clinical practice.[23]

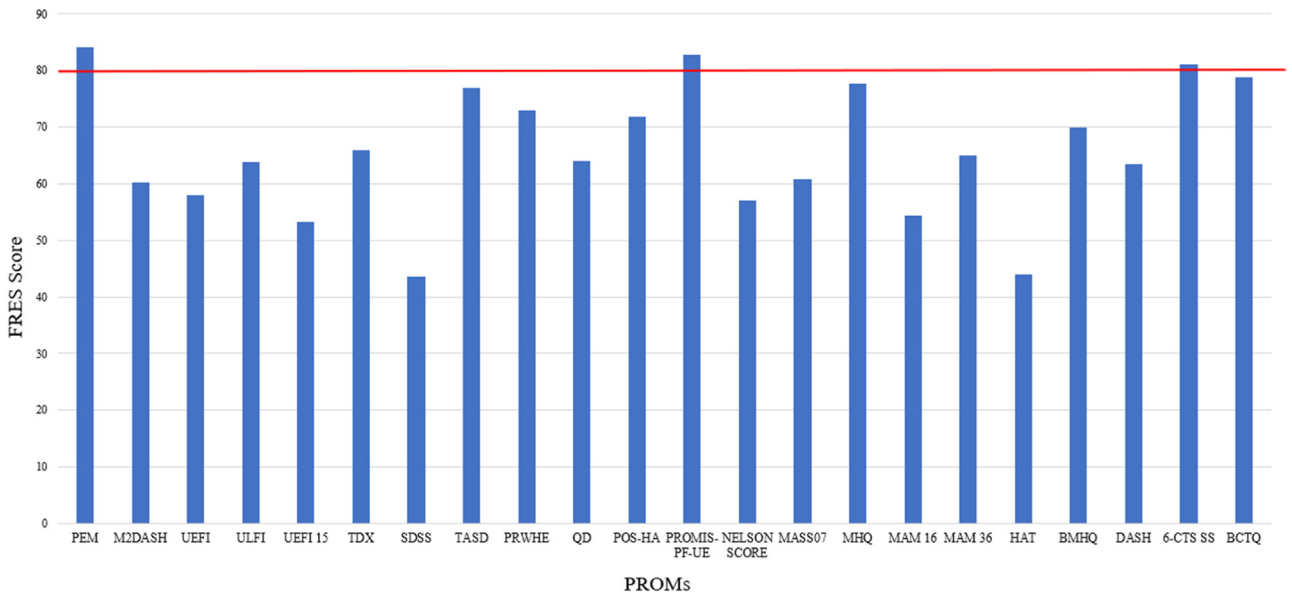


**FIGURE 1:** Flesch Reading Ease Score of 22 PROMs commonly used in hand surgery. The red line indicates the threshold for a sixth-grade reading level (FRES = 80), in which scores above this threshold are at or below a sixth-grade reading level.

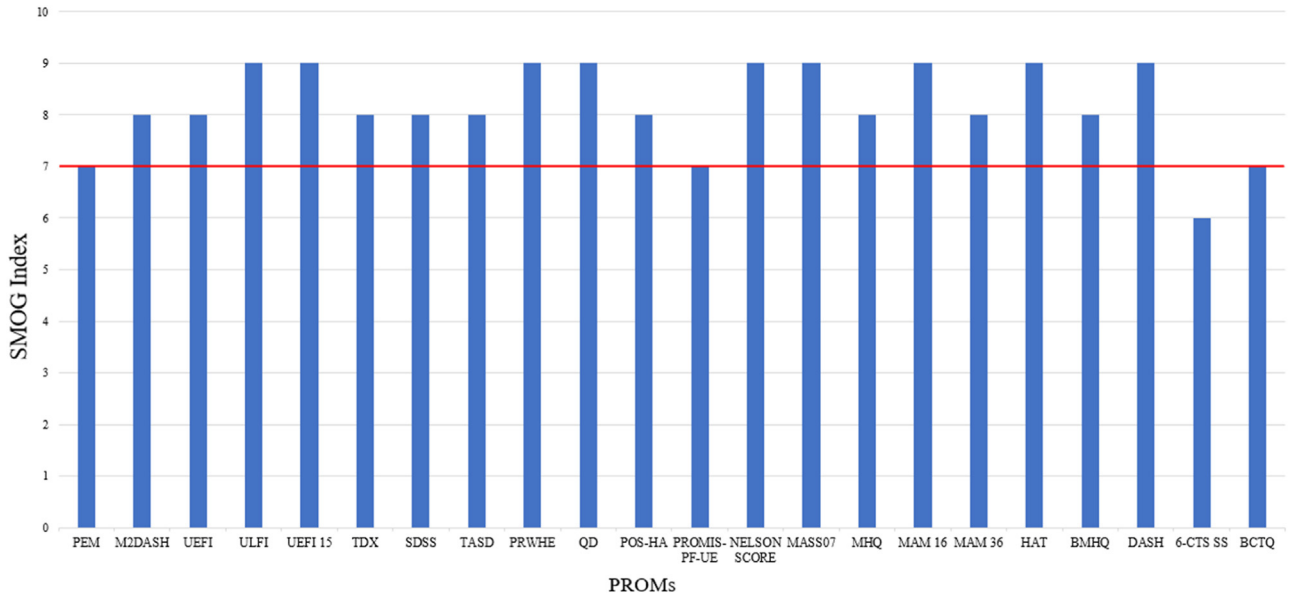


**FIGURE 2:** Simple Measure of Gobbledygook of 22 PROMs commonly used in hand surgery. The red line indicates the threshold for a sixth-grade reading level (SMOG < 7), in which scores below this threshold are at or below a sixth-grade reading level.

However, multiple studies have demonstrated that orthopedic PROMs frequently exceed recommended reading levels. For example, an investigation of Spanish-language PROMs found that nearly half were written above the sixth-grade reading level, with translation methodologies such as forward and backward translation insufficiently addressing readability concerns.[9] This observation aligns with evidence that cultural and linguistic differences can substantially influence the validity of translated instruments, as even minor alterations in wording, whether introduced during translation or as part of cultural adaptation, may compromise their reliability and validity.[9]

Another study examining spine surgery PROMs reported that most required an eighth- to ninth-grade reading level.[7] These findings underscore that although the impact of PROM readability on clinical outcomes may be limited at present, its importance is likely to increase as these measures become more

integrated into routine care, particularly in the context of reimbursement models prioritizing patient-centered metrics.[22] Ensuring the linguistic fidelity and cultural appropriateness of translated PROMs may be essential to safeguard their validity and utility in diverse clinical populations.

In our evaluation, PROMs referenced in the hand literature, such as the Upper Extremity Functional Index, Upper Extremity Functional Index 15, Southampton Dupuytren's Scoring Scheme, Nelson Score, Manual Ability Measure 16, and Hand Assessment Tool, were all written above the recommended sixth-grade reading level. Although these instruments are primarily used in research rather than routine clinical care, adopting stricter readability standards may improve comprehension among study participants who complete them. Given that nearly 54% of Americans read below a sixth-grade level, such an approach may be beneficial.[24] Furthermore, if a SMOG Index below 7 is considered the more appropriate threshold, as recommended for medical texts, only 1 (4.5%) PROM meets the readability threshold.[19]

Readability is just one facet of health literacy and reflects only part of the broader scope of patient understanding. In research settings, where PROMs are predominantly used, patients who struggle with text readability may be less able to complete these instruments accurately.[23] Readability formulas such as FRES and SMOG assess structural complexity but cannot capture other important factors, including layout, font size, medical jargon, and patient-specific attributes such as self-efficacy or motivation.[25,26] Low health literacy can also discourage patients from asking clarifying questions, potentially leading to unreliable responses because of fear of embarrassment.[27] Moreover, literacy is frequently influenced by socioeconomic and demographic factors, including housing instability, lower education levels, non-native English-speaking status, and unemployment.[28] Although poor readability of PROMs does not appear to affect day-to-day clinical outcomes at this time, ensuring these instruments are as accessible as possible may become increasingly relevant if PROMs are integrated more widely into patient care or reimbursement models in the future.[22]

Developing new PROMs or modifying existing ones to meet readability standards set by the NIH and AMA may help ensure that patients can better understand and accurately complete these measures. Using shorter sentences, simpler words, and following recommendations from the Centers for Disease Control and Prevention such as using 1- or 2-syllable words and keeping sentences to around 8 to 10 words may improve FRES and SMOG scores.[29] Reducing medical jargon and providing explanations when no simpler terms exist can further enhance patient comprehension.

This study has several limitations. Although a validated online readability calculator was used to assess PROM readability, the readability was not directly evaluated with hand surgery patients. The FRES, although widely used, is not the only readability metric. The SMOG Index was also used to enhance the validity of our results. These two measures focus on text and do not account for other factors such as PROM questionnaire structure that affect comprehension. Despite these limitations, this study comprehensively evaluates hand surgery PROM readability using two validated measures. Future research should explore how readability affects PROM completion rates, as this remains an important area for further investigation.

## CONFLICTS OF INTEREST

No benefits in any form have been received or will be received related directly to this article.

## REFERENCES


1. Roy M, Corkum JP, Urbach DR, et al. Health literacy among surgical patients: a systematic review and meta-analysis. *World J Surg*. 2019;43(1):96−106.
2. Cave A, Yekovich FR. Improving the literacy of young urban learners: closing the achievement gap. *JSCH*. 2010;5:1−14.
3. Muir KW, Lee PP. Literacy and informed consent: a case for literacy screening in glaucoma research. *Arch Ophthalmol*. 2009;127(5):698−699.
4. Thomas ND, Mahler R, Rohde M, Segovia N, Shea KG. Evaluating the readability and quality of online patient education materials for pediatric ACL tears. *J Pediatr Orthop*. 2023;43(9):549−554.
5. Foster BK, Callahan C, Dwyer CL. Readability of online hand and upper extremity patient resources. *Cureus*. 2023;15(3):e36031.
6. Zhang D, Earp BE, Kilgallen EE, Blazar P. Readability of online hand surgery patient educational materials: evaluating the trend since 2008. *J Hand Surg Am*. 2022;47(2):186.e1−186.e8.
7. Issa TZ, Lee Y, Mazmudar A, et al. Readability of patient reported outcomes in spine surgery and implications for health literacy. *Spine*. 2024;49(11):811−817.
8. Akinleye SD, Garofolo-Gonzalez G, Montuori M, Culbertson MD, Hashem J, Edelstein DM. Readability of the most commonly accessed online patient education materials pertaining to pathology of the hand. *Hand (N Y)*. 2018;13(6):705−714.
9. Garavito JA, Rodarte P, Navarro RA. Readability analysis of Spanish-language patient-reported outcome measures in orthopaedic surgery. *J Bone Joint Surg Am*. 2024;106(20):1934−1942.
10. Kayastha A, Lakshmanan K, Valentine MJ, et al. A readability study of carpal tunnel release in 2023. *Hand (N Y)*. 2024:15589447241232095.
11. Baldwin AJ. Readability of online patient education materials for congenital hand differences. *Hand (N Y)*. 2024;19(7):1146−1153.
12. Lim B, Sen S. A cross-sectional quantitative analysis of the readability and quality of online resources regarding thumb carpometacarpal joint replacement surgery. *J Hand Microsurg*. 2024;16(4):100119.
13. Mertz K, Burn MB, Eppler SL, Kamal RN. The reading level of surgical consent forms in hand surgery. *J Hand Surg Glob Online*. 2019;1(3):149−153.

14. Sierakowski KL, Evans Sanchez KA, Damarell RA, Dean NR, Griffin PA, Bain GI. Measuring quality of life and patient satisfaction in hand conditions. *Australas J Plast Surg*. 2018;1(2):85−97.
15. Stockmeyer NO. Using Microsoft Word's readability program. *Mich Bar J*. 2009;88:46.
16. Brewer J. Measuring text readability using reading level. In: *Adv Methodol Technol Mod Educ Deliv*. 2017:1499−1507.
17. Roberts HJ, Zhang D, Earp BE, Blazar P, Dyer GSM. Patient self-reported utility of hand surgery online patient education materials. *Musculoskelet Care*. 2018;16(4):458−462.
18. McLaughlin GH. SMOG grading - a new readability formula. *J Read*. 1969;12(8):639−646.
19. Fitzsimmons PR, Michael BD, Hulley JL, Scott GO. A readability assessment of online Parkinson's disease information. *J R Coll Physicians Edinb*. 2010;40(4):292−296.
20. 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.
21. Golan R, Ripps SJ, Reddy R, et al. ChatGPT's ability to assess quality and readability of online medical information: evidence from a cross-sectional study. *Cureus*. 2023;15(7):e42214.
22. de Silva U, Connell S, Tapela N, Bright J. Driving value through standardized measurement of patient-reported outcomes. *J Patient Exp*. 2023;10:23743735231202373.
23. Zhang Y, Zang Y, Ren J, et al. Use of patient-reported outcome measures in lower extremity research. *Int J Sports Phys Ther*. 2023;18(3):645−652.
24. Rothwell J. Assessing the Economic Gains of Eradicating Illiteracy Nationally and Regionally in the United States. Barbara Bush Foundation for Family Literacy. Accessed April 28, 2023. https://www.barbarabush.org/reports
25. Taylor S, Guirguis M, Raney EM. Can patients and families read the questionnaires for patient-related outcome measures? *J Pediatr Orthop*. 2019;39(5):e397−e401.
26. Katz MG, Jacobson TA, Veledar E, Kripalani S. Patient literacy and question-asking behavior during the medical encounter: a mixed-methods analysis. *J Gen Intern Med*. 2007;22(6):782−786.
27. Menendez ME, van Hoorn BT, Mackert M, Donovan EE, Chen NC, Ring D. Patients with limited health literacy ask fewer questions during office visits with hand surgeons. *Clin Orthop Relat Res*. 2017;475(5):1291−1297.
28. Lans A, Bales JR, Tobert DG, Rossi LP, Verlaan JJ, Schwab JH. Prevalence of and factors associated with limited health literacy in spine patients. *Spine J*. 2023;23(3):440−447.
29. Centers for Disease Control and Prevention. Simply Put: A Guide for Creating Easy-to-Understand Materials. Accessed August 2, 2024. https://www.cdc.gov/healthliteracy/pdf/simply_put.pdf