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How understandable are the patient education materials about flat foot on the Internet for parents?

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Abstract

Flat foot is a common reason for parents to visit orthopedic clinics. As the Internet has become an easy-search platform, parents often seek online educational materials before seeking out a professional. The aim of this study was to investigate the quality, readability, and understandability of such online materials for parents. An Internet search was performed for "flat foot" and "pes planus" using the Google search engine. The readability was evaluated using 6 different grading systems: Flesch Reading Ease Score, Flesch–Kincaid Grade Level, Simple Measure of Gobbledygook, Fry Readability score, Gunning Fog Index tests, and Automated Readability Index. The Patient Education Materials Assessment Tool test was used to assess the understandability. For quality assessment, the *Journal of American Medical Association* benchmark criteria and Health on the Net code were applied. One hundred nine websites were included and evaluated for readability, understandability, and quality. The mean readability grade for all websites was 10.5 ± 2.0. The mean Gunning Fog Index tests and Flesch–Kincaid Grade Level scores for all websites were 12.4 ± 2.2 and 9.7 ± 2.1 sequentially. The mean Coleman–Liau index score was 10.0 ± 1.5, and the average Fry Readability score was 9.9 ± 2.0. The automated readability index for all websites was 10.3 ± 2.5. The average Flesch Reading Ease score for all educational materials was 59.3 ± 10.1. The average Patient Education Materials Assessment Tool score for all educational materials was 81% (range, 70–87%). The mean *Journal of American Medical Association* benchmark criterion for all websites was 1.0, with a range from 1.0 and 2.0. Eighteen (16.5%) websites had Health on the Net certificates. Readability, understandability, and quality of patient education materials about flat feet on the Internet vary and are often worse than professional recommendations.

Abbreviations: FKGL = Flesch–Kincaid Grade Level, FRES = Flesch Reading Ease Score, FRY = Fry Readability score, GFOG = Gunning Fog Index tests, HON = Health on the Net, *JAMA* = *Journal of American Medical Association*, PEMAT = The Patient Education Materials Assessment Tool, SD = standard deviation.

Keywords: flat feet, online patient education, pes planus, quality, readability, understandability

1. Introduction

In the recent years, research by patients to obtain information from the Internet has increased undeniably before consulting a doctor for their complaints.[1] Therefore, healthcare providers, such as hospitals and physicians, often present informative texts regarding diseases on their websites.[2] However, the readability, understandability, and quality of these texts are not commonly assessed by professionals. This lack of control may cause such online texts to guide the wrong treatment practices of patients.

Flat foot (pes planus) is a common problem in pediatric orthopedic practice. Several families first observe this condition when their child starts walking. Most parents consult an orthopedic surgeon to solve this problem. All children have a flat-foot appearance during their newborn period. As adipose tissue on the sole of the foot becomes thinner over time, the medial arch of the foot begins to form. This situation becomes visible by the age of 3 years and continues until approximately 8 to 10 years of age spontaneously, with a rate of 85%.

Contrary to popular belief, pes planus is not a condition that always requires treatment, with a few exceptions.[3] Especially in the flexible type, treatment is unnecessary unless the child complains of fatigue and pain. It has been proven that insoles and orthopedic shoes, which are frequently used today, do not change the foot structure.[4] For this reason, it is important to inform families and observe children well. However, several dissatisfied parents either go to another physician or search the internet for a solution.

Previously, the inadequate quality of clinical information on the Internet was described by many authors in many specific

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clinical situations.[5,6] There are also some publications on orthopedic conditions.[7] However, most online patient education materials available in the field of orthopedics can be too complex to be understood by a significant part of the society.

Till date, there has been no publication on the readability, understandability, and quality of online materials on pediatric flat foot. We assumed that the readability, understandability, and quality of flat foot (pes planus) information available on the Internet might be at a more advanced reading level than that recommended for the general population. In this article, we plan to examine the readability, understandability, and quality of information on pediatric flat foot on the Internet.

2. Methods

Ethics committee approval was not obtained for this study, as it was not a clinical study involving human or animal subjects. The terms "flat foot" and "pes planus" were searched on Google in October 2021; the top 150 websites for each term were recorded. The online educational materials related to acquired and adult pes planus or adult flat foot were excluded from the study. In addition, non-patient education materials, materials on physician-related websites, such as UpToDate and ResearchGate, articles on websites containing academic reports, such as Google Scholar and PubMed, predominantly graphic or tabular explanations, and articles containing <10 sentences were excluded. Duplicates were eliminated by evaluating the same pages where 2 same terms were used. The text on these pages was examined for readability, understandability, and quality.

The readability was evaluated using the Flesch Reading Ease score (FRES), Flesch–Kincaid Grade Level (FKGL), Simple Measure of Gobbledygook readability score, Fry Readability score (FRY), Coleman–Liau index score, Automated Readability Index, and Gunning Fog Index tests (GFOG). These tests were conducted using the website http://readability-score.com. Although all of these tests automatically are used to measure the readability level of a text, they were used to increase the quality and consistency of the research because they use different items, such as word count, number of sentences, or the number of syllables.[8]

The Patient Education Materials Assessment Tool (PEMAT) was used to assess the understandability.[9] This test is a proven test that is used to measure the understandability of written and visual materials. It has different options, such as PEMAT for printable materials and PEMAT for audiovisual materials. The PEMAT for printable materials test was used because written materials were analyzed in this study. This test, in which a higher score signifies better-understandable text, was used to measure the understandability using 17 questions. In the study, this test was applied to 109 written texts by three different physicians, and the average value was used for statistical analysis.

For quality assessment, the *Journal of American Medical Association* (*JAMA*) benchmark criteria were applied. This test was performed to examine the quality by using 4 basic questions, which would be answered with yes/no. A "yes" response is considered as 1 and "no" response as 0, and the *JAMA* score is calculated by summing the points obtained.[10] Sites with ≥3 *JAMA* benchmark criteria were categorized as high quality, whereas sites with <3 of these criteria were categorized as low quality.[11] We also used the Health on the Net (HON) code tool (http://www.hon.ch/en/tools.html)[12] to assess the quality of information provided on the websites.

2.1. Statistical analyses

All statistical analyses were performed using IBM SPSS Statistics for Windows, version 22.0 (IBM Corp., Armonk, NY). The Shapiro–Wilk test was used to analyze the normal distribution of the variables. The mean readability level of patient educational materials in keeping with the US Department of Health and Human Services and National Institutes of Health recommended sixth-grade reading level was evaluated using 1-sample *t* tests. Continuous variables were defined as mean and standard deviation (SD) and compared using a one-way analysis of variance test, if distributed normally. To compute pairwise comparisons, Tukey post hoc test was used. Non-normally distributed data were analyzed using the Kruskal–Wallis test. Computed pairwise comparisons were performed using the Games–Howell post hoc test. Qualitative variables were presented as numbers and percentages and analyzed using chi-square tests. Spearman correlation coefficients were used to analyze the relationship among readability grades, total *JAMA* benchmark scores, and PEMAT scores. The statistical significance was set at $P < .05$.

3. Results

The first 150 websites were obtained in a Google search using the terms ""flat foot" and ""pes planus". A total of 109 websites that fulfilled the inclusion criteria were evaluated. The 109 websites related to "flat foot" and "pes planus" in children were divided into 4 sub-categories based on their source: hospital websites (n = 22), websites of doctors or groups of doctors (n = 40), institutional and governmental websites (n = 16), and private companies or foundations or media websites (n = 31). The readability level of the 109 educational materials was analyzed using 6 assessment techniques (Table 1, Fig. 1). The mean readability grade for all the websites was 10.5 ± 2.0, significantly higher than the recommended sixth-grade reading level. The mean GFOG and FKGL scores for all websites were 12.4 ± 2.2 and 9.7 ± 2.1, sequentially. The mean Coleman–Liau index score was 10.0 ± 1.5, and the average FRY score was 9.9 ± 2.0. The automated readability index for all the websites was 10.3 ± 2.5. The results showed that the readability grades were significantly higher than the recommended sixth-grade reading level in each group (all $P < .0001$, single-sample 1-tailed *t* test; Table 1); additionally, it was difficult for readers to read these websites.

The average FRES score for all educational materials was 59.3 ± 10.1, which corresponds to a "fairly difficult" reading level (Table 2). There was a major difference in the readability scores (Table 3). The educational materials from hospital websites and institutional and governmental websites were "fairly difficult"; however, those from doctors or groups of doctors, companies, foundations, or media websites were "difficult." The average FRY readability score ranged between 6.0 and 14.0 (Fig. 2).

The average PEMAT score for all educational materials was 81% (range, 70–87%). The mean understandability scores for educational materials from hospital websites, websites of doctors and groups doctors, institutional and governmental websites, and companies or foundations or media websites were 75 (range, 69–85%), 80.5 (range, 71.5–80%), 84 (range, 74–92.5%), and 83 (range, 69–93%), sequentially. The PEMAT scores were above the 70% understandability threshold in all subcategories, and there was no significant difference between subcategories. The understandability scores for the educational materials are summarized in Tables 2 and 3.

The mean *JAMA* benchmark criterion for all websites was 1.0, with a range between 1.0 and 2.0 (Table 2). Only 23.9% of all websites were "high quality" (score ≥ 3), based on the *JAMA* benchmark criteria. A significant difference was observed in the total *JAMA* benchmark scores. According to the *JAMA* criteria, 13.6% of articles from hospital websites were "high quality," 12.5% from websites of doctors or groups of doctors were "high quality," 56.3% from the governmental websites were "high quality," 29% from companies or foundations or media websites were "high quality." Notably, while 18 (16.5%) websites had the HON certificate, 91 (83.5%) websites did not have a certificate.

Table 1

Readability scores for web-based patient educational materials in English.

	All websites (n = 79)		Hospital websites (n = 17)		Doctors or group of doctors websites (n = 31)		Institutions, governmental websites (n = 10)		Companies or foundations or media websites (n = 21)	
Characteristics	Mean ± SD	Comparison to 6 grade reading level (*P* value)	Mean ± SD	Comparison to 6 grade reading level (*P* value)	Mean ± SD	Comparison to 6 grade reading level (*P* value)	Mean ± SD	Comparison to 6 grade reading level (*P* value)	Mean ± SD	Comparison to 6 grade reading level (*P* value)
Gunning FOG Index	12.4 ± 2.2	<.01	11.8 ± 2.1	<.01	13.2 ± 1.9	<.01	11.1 ± 2.5	<.01	12.5 ± 2.1	<.01
Flesch-Kincaid Grade	9.7 ± 2.1	<.01	9.4 ± 2.0	<.01	10.4 ± 1.9	<.01	8.3 ± 2.4	<.01	9.8 ± 2.1	<.01
Coleman–Liau Index	10.0 ± 1.5	<.01	10.0 ± 1.4	<.01	10.4 ± 1.4	<.01	9.1 ± 1.5	<.01	10.1 ± 1.4	<.01
SMOG test	9.1 ± 1.6	<.01	8.8 ± 1.5	<.01	9.6 ± 1.3	<.01	8.0 ± 1.9	<.01	9.1 ± 1.5	<.01
Linsear Write Formula	11.7 ± 3.2	<.01	11.2 ± 3.3	<.01	12.6 ± 3.0	<.01	10.1 ± 3.2	<.01	11.7 ± 3.0	<.01
FRY Readability Score	9.9 ± 2.0	<.01	9.7 ± 1.9	<.01	10.4 ± 2.0	<.01	8.6 ± 2.1	<.01	10.1 ± 1.9	<.01
Automated Readability Score	10.3 ± 2.5	<.01	10.1 ± 2.5	<.01	11.1 ± 2.4	<.01	8.7 ± 2.5	<.01	10.4 ± 2.4	<.01
Readability Grade Score	10.5 ± 2.0	<.01	10.2 ± 1.8	<.01	11.1 ± 1.7	<.01	9.1 ± 2.2	<.01	10.5 ± 1.9	<.01

The one-sample *t* test was used to compare readability scores for this manuscript. Scores represent a grade level (e.g., 12 = 12th grade, 13 = first year of college).
Fry = Fry graph readability formula, GFOG = Gunning Frequency of Gobbledygook, SD = standard deviation, SMOG = Simple Measure of Gobbledygook.

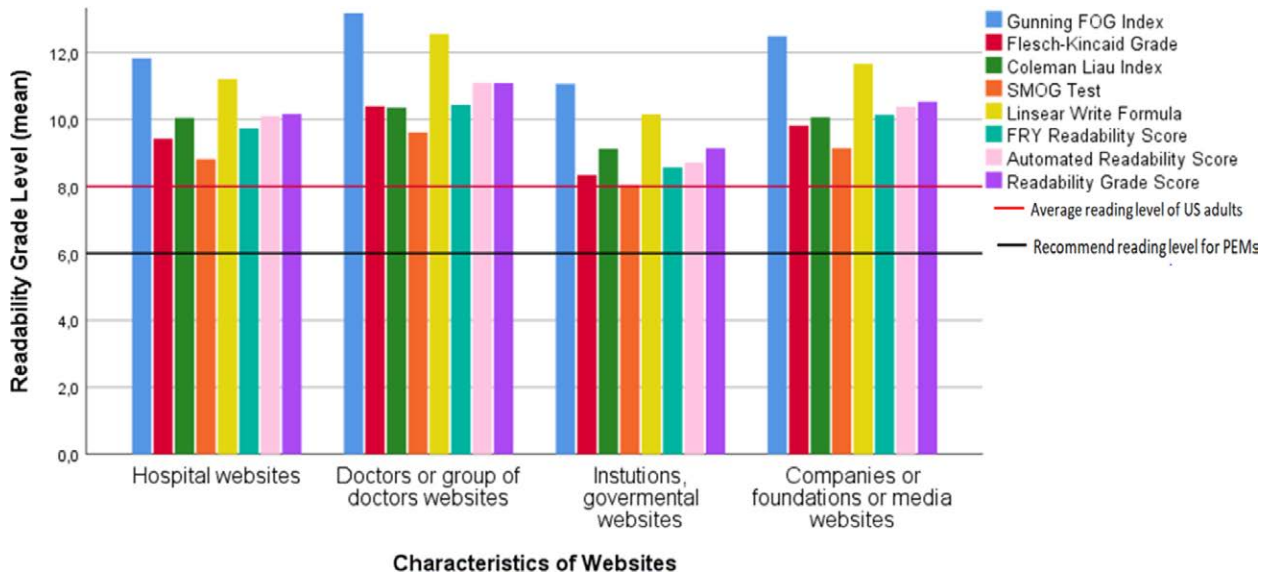

Figure 1. Breakdown of readability of online patient education materials at different scales and breakdown of readability with an average grade level using numeric scales of 6 and 8.

Of all websites, 34.9% fulfilled the authorship criteria, 25.7% included attributions, 72.5% included disclosures, and 37.6% fulfilled the currency benchmark (Table 2). No correlations were found between the *JAMA* benchmark criteria and readability grades ($r = -0.119$, $P = .218$; Fig. 3) or between the *JAMA* benchmark criteria and PEMAT scores ($R = 0.074$, $P = .445$, Fig. 4).

4. Discussion

The main reason for the visit of the patients to the pediatric orthopedic outpatient clinic is the parents' concerns regarding whether their children have flat feet. As it has become more accessible in the recent years, the patients try to obtain information from educational materials on the Internet before consulting a doctor.[11]

The parents' ability to obtain information from these texts depends on the health literacy of the person reading the text. The patient should be able to receive, process, and understand basic health information, defined by the Institute of Medicine as "health literacy".[8] However, several studies in which texts in online resources in recent years were examined confirm that the readability and understandability levels of these texts vary; however, most of them are higher than community standards.[13] This is the first study to assess the readability, understandability, and quality of educational materials about flat foot in children

Table 2

Readability, understandability, and quality results for all websites.

Characteristics			All websites
FRES readability score			59.3 ± 10.1
PEMAT score (%)			81.0 (70.0–87.0)
Total *JAMA* benchmark score			1.0 (1.0–2.0)
Quality of websites. n (%)	High (≥3 total *JAMA* benchmark score)		26(23.9%)
	Low (3 > total *JAMA* benchmark score)		83 (76.1%)
JAMA benchmark criteria. n (%)	Authorship	Yes	38 (34.9%)
		No	71 (65.1%)
	Attribution of refences	Yes	28 (25.7%)
		No	81 (74.3%)
	Disclosure	Yes	79 (72.5%)
		No	30 (27.5%)
	Currency	Yes	41 (37.6%)
		No	68 (62.4%)
HONcode, n (%)	Yes		18 (16.5%)
	No		91 (83.5%)
Characteristics of websites, n (%)	Hospital websites		22 (20.2%)
	Doctors or group of doctors websites		40 (36.7%)
	Institutions, governmental websites		16 (14.7%)
	Companies or foundations or media websites		31 (28.4%)

Variables are presented as means ± standard deviations, medians (Q1–Q3), or frequencies (%).

FRES = Flesch Reading Ease Score, Fry = Fry graph readability formula, PEMAT = Patient Education Materials Assessment Tool. HONcode = Health on the Net certification. *JAMA* = *Journal of American Medical Association*.

Table 3

Evaluation of educational materials for patients classified by source.

Characteristics			Hospital websites (n = 22)	Doctors or group of doctors websites (n = 40)	Instutions, govermental websites (n = 16)	Companies or foundations or media websites (n = 31)	*P* value
FRES readability score			60.6 ± 88*,†	56.2 ± 8.9*	66.2 ± 11.9†	58.8 ± 10*,†	<.01
Gunning FOG Index			11.8 ± 2.1*,†	13.2 ± 1.9*	11.1 ± 2.5†	12.5 ± 2.1*,†	<.01
Flesch–Kincaid Grade			9.4 ± 2.0*,†	10.4 ± 1.9*	8.3 ± 2.4†	9.8 ± 2.1*,†	.01
Coleman Liau Index			10.0 ± 1.4*,†	10.4 ± 1.4*	9.1 ± 1.5†	10.1 ± 1.4*,†	.04
SMOG Test			8.8 ± 1.5*,†	9.6 ± 1.3*	8.0 ± 1.9†	9.1 ± 1.5*,†	<.01
Linsear Write Formula			11.2 ± 3.3	12.6 ± 3.0	10.1 ± 3.2	11.7 ± 3.0	.06
FRY Readability Score			9.7 ± 1.9*,†	10.4 ± 2.0*	8.6 ± 2.1†	10.1 ± 1.9*,†	.02
Automated Readability Score			10.1 ± 2.5*,†	11.1 ± 2.4*	8.7 ± 2.5†	10.4 ± 2.4*,†	.01
Readability Grade Score			10.2 ± 1.8*,†	11.1 ± 1.7*	9.1 ± 2.2†	10.5 ± 1.9*,†	<.01
PEMAT score (%)			75 (69–85)	80.5 (71.5–80.0)	84 (74.0–92.5)	83.0 (69.0–93.0)	.07
Total *JAMA* benchmark score			1.00 (.00–2.00)†	1.00 (1.00–2.00)†	2.00 (2.00–4.00)*	2.00 (1.00–3.00)*,†	<.01
Quality of websites	High (≥3 Total *JAMA* benchmark score)		3 (13.6%)*	5 (12.5%)†	9 (56.3%)*	9 (29.0%)*	<.01
	Low (3 > Total *JAMA* benchmark score)		19 (86.4%)*	35 (87.5%)†	7 (43.8%)*	22 (71.0%)*	
JAMA benchmark criteria, n (%)	Authorship	Yes	6 (27.3%)	10 (25.0%)	8 (50.0%)	14 (45.2%)	.149
		No	16 (72.7%)	30 (75.0%)	8 (50.0%)	17 (54.8%)	
	Attribution of refences	Yes	6 (27.3%)*	1 (2.5%)†	10 (62.5%)‡	11 (35.5%)*‡	<.01
		No	16 (72.7%)*	39 (97.5%)†	6 (37.5%)‡	20 (64.5%)*‡	
	Disclosure	Yes	16 (72.7%)*,†	34 (85.0%)†	12 (75.0%)*,†	17 (54.8%)*	.04
		No	6 (27.3%)*,†	6 (15.0%)†	4 (25.0%)*,†	14 (45.2%)*	
	Currency	Yes	3 (13.6%)*	6 (15.0%)*	14 (87.5%)†	18 (58.1%)‡	<.01
		No	19 (86.4%)*	34 (85.0%)*	2 (12.5%)†	13 (41.9%)‡	
HONcode, n (%)	Yes		4 (18.2%)*	0 (0.0%)†	6 (37.5%)*	8 (25.8%)*	<.01
	No		18 (81.8%)*	40 (100.0%)†	10 (62.5%)*	23 (74.2%)*	

Each subscript letter denotes a subset of "Webpage Class" categories whose column proportions are not significantly different from each other at the 0.05 level. Within each row, percentages that do not share a subscript are significantly different.

Variables are presented as means ± standard deviations, medians (Q1–Q3), or frequencies (%). The tests used are one-way analysis of variance, Kruskal–Wallis and chi-square.

FRES = Flesch Reading Ease Score, Fry = Fry graph readability formula, GFOG = Gunning Frequency of Gobbledygook, HONcode = Health on the Net certification, *JAMA* = *Journal of American Medical Association*, PEMAT = Patient Education Materials Assessment Tool, SMOG = Simple Measure of Gobbledygook.

on the Internet. Our results showed that most websites did not fulfill the criteria for high quality. Moreover, most websites were written at a reading level above that of the average parent.

Readability involves an objective evaluation of the reading skills that the reader must have to understand a written text. The American Medical Association and the US Department of Health and Human Services recommend that the community can easily understand texts written for sixth-grade level and lower; therefore, the readability levels of the mentioned texts should be sixth-grade level or lower.[14] In a study[5] in which the readability of information on the Internet about developmental dysplasia of the hip was investigated, the readability levels were

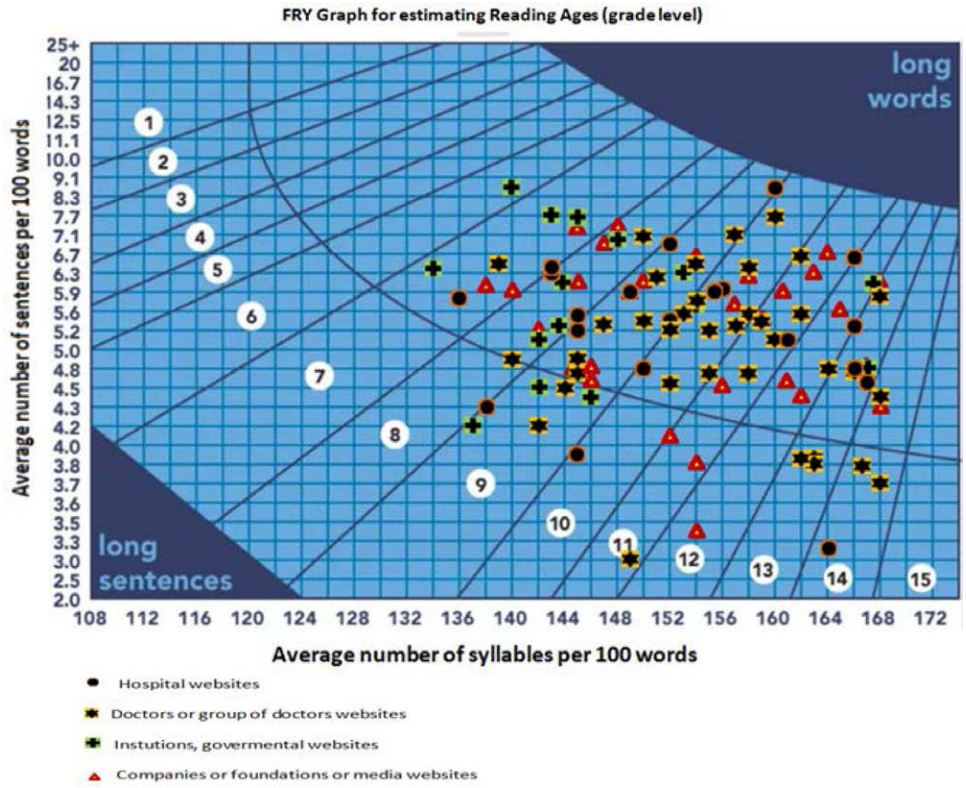

Figure 2. The Fry readability graph visually shows the readability of articles through the intersection of the number of syllables per 100 words and the number of sentences per 100 words. Circles demonstrates reading levels (Software: inkspace).

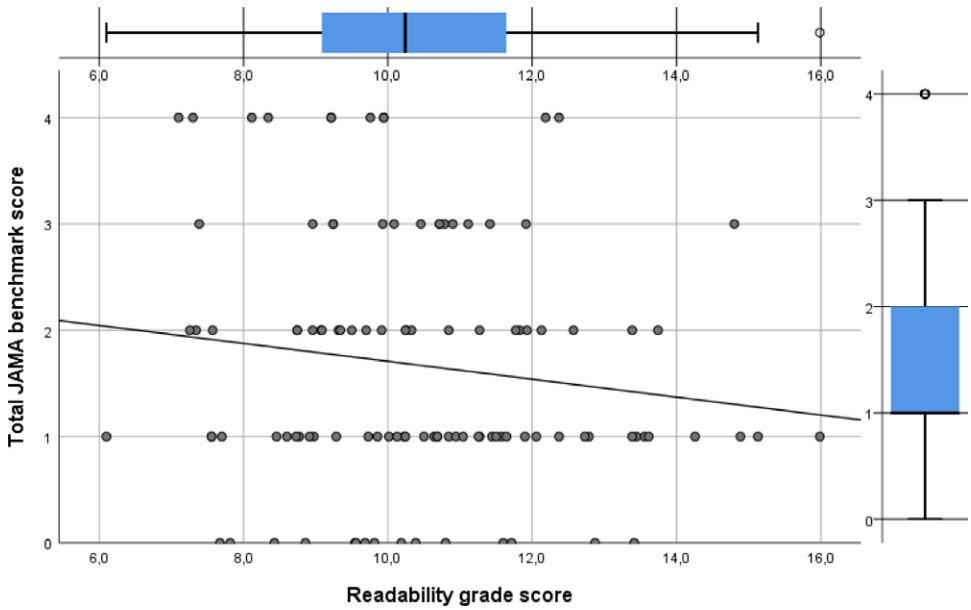

Figure 3. The correlation between whole *JAMA* benchmark criteria and readability grade levels. *JAMA = Journal of American Medical Association*.

evaluated with the FKGL score, and the readability levels were found to be 9.3, 10.8, and 11.6, on average, for three different terms searched. These levels indicate that the texts are much more difficult, with a higher readability level than the recommended readability level.

The mean FRES, Simple Measure of Gobbledygook, FRY, automated readability index, and GFOG scores were 9.7, 9.1, 9.9, 10.3, and 12.4, respectively. The scores showed that the readability level of educational materials on the Internet was higher than the recommended sixth-grade reading level. In 2020, Arslan et al found similar scores in a study in which the readability of online materials for chest pain in children was evaluated.[15] Our study showed that the information provided on the Internet is very difficult to read for a substantial proportion of the population.

We used the PEMAT, which evaluates the overall understandability,[9] to determine whether patients may understand educational materials about flat foot. In contrast to the threshold

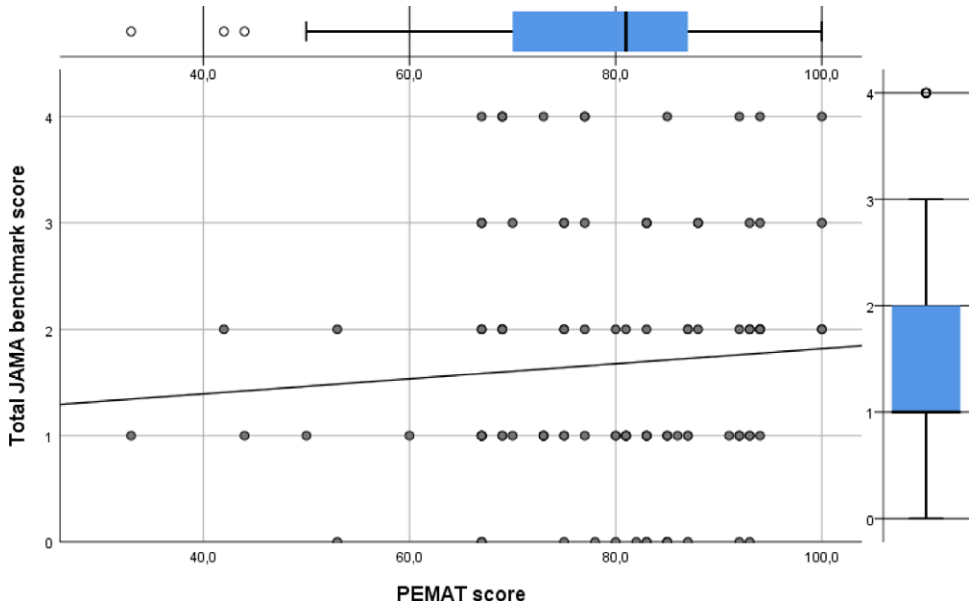

Figure 4. The correlation between Patient Education Materials Assessment Tool (PEMAT) scores and total *JAMA* benchmark criteria. *JAMA = Journal of American Medical Association*.

level of 70% set up by the authors of the PEMAT questionnaire, the mean overall understandability in our study was 81%. This shows that the understandability rates of the websites we evaluated were above the recommended threshold. A study published in 2019 showed that the average PEMAT score for online educational materials related to diabetes care was 58.5%.[16] Similarly, a study published in 2016[17] showed that the average PEMAT score for online education materials on vocal cord paralysis was 53%. In another study, Doruk et al[18] found that an average overall understandability score of 59% for online materials on vocal cord nodules. Skalitzky et al evaluated health literacy in club foot and showed that the mean understandability and actionability scores were 67.2% (SD: 12.6) and 25.4% (SD: 25.2), sequentially, and overall, 13 (n = 35%) online materials met the understandability threshold of 70%.[19] Arslan et al reported that the average overall understandability score was 74.6% in their evaluation of online materials on heart murmurs.[20] These studies show that online educational materials differ according to patient complaints in terms of their understandability.

The quality of the websites was determined by the *JAMA* benchmark in the study. The mean *JAMA* benchmark score was 1.0, indicating that the websites did not meet the high-quality criteria. 76.1% of the websites we evaluated had a low *JAMA* benchmark score. Similarly, a recently published study in which the quality of articles on websites on epiretinal membranes was evaluated showed that no website achieved all the *JAMA* benchmarks.[21] Several studies have also shown that online resources for various diseases are of low to medium quality.[11,22] However, Arslan et al reported a median *JAMA* benchmark score of 4.34 (3–5), indicating good-to-excellent quality of information.[20] However, in this study, similar to our study, few websites had HON certification. Similarly, we also detected a small number of websites with good to excellent quality information about pediatric flat foot.

5. Limitations

This study has several limitations. First, we did not evaluate non-English patient education materials on the Internet; these findings may have been influenced by selection bias. Websites returned in a search may have regional differences, and the quality of information available on non-English-language websites may differ. Second, the readability rating methods used in our study could not be used to evaluate features, such as illustrations, which may assist in the comprehension of written material. Another limitation is that as the Internet is dynamic in nature, the websites are updated frequently, which can have an impact on the repeatability of search results and their ranking order. The use of the HON code to evaluate the quality of websites creates a separate limitation. Because it is binary, it does not look at the content and simply checks the editorial policies, and since 2015, it requires websites to pay a fee to maintain accreditation.

6. Conclusions

The readability, understandability, and quality of patient education materials about flat foot on the Internet vary and are often worse than recommended. The editors and authors preparing content for people who research their problems on the Internet should be trained to produce more efficient materials because these materials may influence people's decisions and may mislead them.

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