

Readability and Reliability of Online Information on Childhood Chest Pain: A Web-Based Quality Analysis

Ayhan Ceri

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Readability and Reliability of Online Information on Childhood Chest Pain: A Web-Based Quality Analysis

Ayhan Ceri¹

¹ A. Kemal Belviranlı Maternity and Children's Hospital Konya TR

Corresponding Author:

Ayhan Ceri

A. Kemal Belviranlı Maternity and Children's Hospital
Fatih Mahallesi, Y. Istanbul Caddesi, No: 30, 42285 Selcuklu
Konya
TR

Abstract

Background: Parents frequently turn to the internet for information regarding pediatric health symptoms such as chest pain. Although often benign, childhood chest pain is associated with high parental anxiety due to fears of underlying cardiac conditions. However, the readability, reliability, and overall quality of online resources on this topic remain largely unknown.

Objective: This study aimed to evaluate the readability, quality, and ethical certification of publicly available online information on childhood chest pain, and to determine whether these resources align with recommended health literacy standards.

Methods: A systematic web search was conducted using Google and Bing to identify websites addressing childhood chest pain. The first 200 search results from each engine were screened, and eligible English-language websites were assessed using validated readability formulas (Flesch-Kincaid Grade Level, SMOG Index, Gunning Fog Index, Automated Readability Index) and quality indicators (DISCERN score, JAMA benchmarks, HONcode certification). Websites were also categorized by type: government, professional organization, commercial, health portal, or scientific journal. Statistical analyses were conducted to compare readability and quality scores across website types.

Results: A total of 68 websites met inclusion criteria. Most sites exceeded the recommended sixth-grade reading level, with scientific journals and health portals displaying the highest complexity. Government and professional organization websites demonstrated significantly higher DISCERN and JAMA scores compared to commercial and health portal sites ($p < 0.05$). Only 18% of websites displayed HONcode certification, with the highest rates observed among government sources. Spearman correlation showed a negative relationship between readability complexity and quality metrics.

Conclusions: Online information on childhood chest pain often fails to meet readability and quality standards, potentially impairing informed decision-making among parents with limited health literacy. Improved content design—featuring simplified language, ethical certification, and digital readability tools—may help bridge gaps in pediatric health communication. Future research should explore culturally tailored, AI-supported solutions to enhance the accessibility and equity of online health resources. Clinical Trial: This study did not involve human participants, patient data, or any form of clinical intervention. It was based entirely on publicly accessible web-based content and did not include any interaction with individuals or the collection of personal or identifiable information. As such, ethical approval was not required in accordance with institutional and national research guidelines.

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Original Manuscript

INTRODUCTION

The internet has become an indispensable source of health information for parents navigating pediatric concerns. Among these, childhood chest pain represents a particularly anxiety-provoking symptom due to fears of serious underlying conditions such as heart disease, even though it is most often benign in nature. This anxiety frequently drives parents to search online before consulting healthcare providers, making the quality and accessibility of digital health content a matter of both public concern and clinical relevance (1,2)

Online health resources can play a crucial role in either alleviating or exacerbating parental anxiety, depending on their readability, reliability, and clarity. Research consistently shows that much of the available online health content is written at a reading level well above the sixth-grade standard recommended by the American Medical Association and the National Institutes of Health (3). This mismatch can lead to poor comprehension, particularly for populations with limited health literacy, ultimately impeding informed decision-making and potentially increasing unnecessary emergency department visits (4).

From a theoretical standpoint, parental engagement with online health content can be understood through frameworks such as the Health Belief Model (HBM) and the Elaboration Likelihood Model (ELM) (5). The HBM posits that perceived severity and susceptibility drive individuals to seek information—conditions that are often heightened in pediatric contexts(6). The ELM highlights how complex, jargon-heavy content may overwhelm users, leading to peripheral rather than central processing of health information (7). In both cases, content that is too difficult to read may impair understanding and fail to influence health-related behavior constructively (7).

While prior studies have explored the readability of online resources in various health domains—including asthma, diabetes, and mental health—little is known about the specific digital landscape surrounding childhood chest pain, a symptom that uniquely combines benign medical risk

with high emotional burden (8). Moreover, few studies have simultaneously evaluated readability, quality, and ethical certification across diverse website types, nor have they considered the growing role of AI-supported content simplification or HONcode adherence as potential solutions (9,10).

This study aims to evaluate the readability, reliability, and quality of publicly available online resources about childhood chest pain. Using validated assessment tools and a structured typology of website sources, we seek to determine whether the information parents find online meets health literacy standards and offers the clarity needed to support informed, confident healthcare decisions (11,12).

METHODS

Search Strategy and Website Selection: A structured web search was conducted using two major search engines, Google and Bing, between January 1 and March 1, 2024, to identify websites providing information on childhood chest pain. The following keywords were used: “child chest pain causes,” “pediatric chest pain,” “chest pain in children,” and “children heart pain.” These terms were selected based on commonly searched phrases by parents, as reported in previous literature (4).

To minimize personalization bias, all searches were performed in incognito mode after clearing browser history and cookies. From each search engine, the first 200 results were screened (13). Duplicate entries and advertisements were removed. Eligible websites had to meet the following inclusion criteria:

- English-language content
- Contain at least 300 words of text specifically addressing childhood chest pain
- Freely accessible without registration or subscription

Websites were excluded if they were:

- Primarily audio or video with no transcribed content
- Discussion forums or social media posts
- News reports with no medical information

Website Classification: Included websites were categorized into five types based on authorship and purpose:

1. Government websites – Official public health agencies (e.g., CDC)
2. Professional organizations – Medical societies (e.g., American Academy of Pediatrics)
3. Commercial websites – Health-related companies offering products/services
4. Health portals – General health information platforms (e.g., WebMD)
5. Scientific journals – Open-access articles and case reports

This typology enabled comparative analysis across different content sources (14).

Assessment Tools: These tools collectively provided a comprehensive evaluation of the readability, quality, and reliability of the online materials.

Readability Metrics: Four validated readability formulas were used to assess text complexity:

- Flesch-Kincaid Grade Level (FKGL)
- Gunning Fog Index
- Simple Measure of Gobbledygook (SMOG)
- Automated Readability Index (ARI)

Each formula calculates the estimated U.S. grade level needed to understand the content (15).

Quality and Reliability Indicators: These indicators were selected to systematically assess the trustworthiness and transparency of the online content.

- DISCERN Instrument: Evaluates content quality related to treatment decisions (16-point scale)
- JAMA Benchmarks: Assesses authorship, attribution, disclosure, and currency (max score = 8)
- HONcode Certification: Indicates adherence to ethical web publishing standards (16)

All assessments were independently performed by two reviewers (with discrepancies resolved by discussion).

Use of AI in Web Content Screening: To streamline the web content screening process, ChatGPT-4.0 was used in a supportive role to assist with:

- Extracting relevant textual sections from webpages
- Suggesting preliminary readability scores
- Identifying presence/absence of authorship or certification markers

All AI-generated outputs were manually reviewed and verified by the authors to ensure accuracy and consistency (17).

Statistical Analysis: Data were analyzed using SPSS v27.0. Descriptive statistics (mean, standard deviation, range) were calculated for all readability and quality metrics. Group differences across website types were assessed using the Mann-Whitney U test and Kruskal-Wallis test, given non-parametric distribution of scores (18). Spearman's rank correlation was used to evaluate associations between readability scores and quality indicators (e.g., FKGL vs. DISCERN). Statistical significance was set at $p < 0.05$.

RESULTS

Website Inclusion and Characteristics: A total of 68 websites met the inclusion criteria and were included in the final analysis. These sites were distributed across five categories: Government (n=10), Professional Organizations (n=12), Commercial (n=18), Health Portals (n=16), and Scientific Journals (n=12). All websites provided publicly accessible information about childhood chest pain and met the minimum content length threshold(19).

Readability Scores: As shown in Table 1, the mean readability scores across all websites exceeded the sixth-grade level recommended by health authorities(20,21). Scientific Journals had the highest average readability level (mean FKGL = 12.5 ± 1.1), followed by Health Portals (11.0 ± 1.3), and Commercial websites (10.2 ± 1.0). Government and Professional Organization websites demonstrated relatively lower complexity, with FKGL means of 8.5 ± 0.9 and 9.1 ± 1.2 , respectively(21).

Statistical comparisons using the Kruskal-Wallis test indicated significant differences in FKGL scores across website types ($H = 27.4, p < .001$). Post hoc pairwise comparisons showed that Government and Professional Organization websites had significantly lower readability scores than Commercial and Journal websites ($p < .01$)(18).

Quality and Reliability Scores: Table 2 summarizes the DISCERN and JAMA scores by website type. Government websites achieved the highest quality ratings (mean DISCERN = 14.5 ± 1.2 ; JAMA = 7.5 ± 0.6), followed by Professional Organizations (DISCERN = 13.8 ± 1.4 ; JAMA = 7.0 ± 0.7). Commercial websites scored the lowest (DISCERN = 10.2 ± 2.0 ; JAMA = 5.0 ± 1.1), with high promotional tone and limited sourcing cited as contributing factors. Differences in DISCERN scores across website categories were statistically significant ($H = 21.9, p < .001$)(19,21).

HONcode Certification: Only 12 of the 68 websites (17.6%) displayed valid HONcode certification. Certification was most common among Government (50%) and Professional Organization (42%) websites. Commercial (15%) and Health Portal (20%) sites showed much lower adoption rates. No Scientific Journal websites evaluated in this study carried HONcode certification (22).

Correlation Between Readability and Quality: Spearman correlation analysis demonstrated a negative association between readability complexity and quality measures. Specifically:

- FKGL was negatively correlated with DISCERN ($\rho = -0.41, p < .01$)
- Gunning Fog Index was negatively correlated with JAMA scores ($\rho = -0.35, p < .01$)

These results suggest that as readability decreases (i.e., content becomes more complex), quality and transparency also tend to decline (21).

DISCUSSION

This study underscores significant disparities in the readability, reliability, and quality of online resources on childhood chest pain. Despite the topic's clinical benignity, parental anxiety about potential cardiac causes often triggers online searches, emphasizing the importance of

accessible and trustworthy information. The findings align with earlier research showing that most online health content exceeds the recommended sixth-grade readability level, which can disproportionately impact individuals with lower health literacy (23,24).

From a theoretical perspective, the study's findings resonate with the Health Belief Model (HBM) and the Elaboration Likelihood Model (ELM). According to the HBM, parents perceiving chest pain as a serious threat may engage in information-seeking behavior, particularly if they perceive the health system as inaccessible or delayed. However, if the information encountered is too complex or unreliable, this could hinder rather than support health decision-making. Similarly, the ELM suggests that information processed through a central route—requiring cognitive effort and comprehension—may fail to influence behavior if readability is low, especially in anxious contexts (25,26).

Government and professional organization websites demonstrated relatively higher quality and reliability compared to commercial or portal sites. This suggests that institutional credibility correlates with content trustworthiness. However, even among these reputable sources, the readability scores often exceeded the ideal threshold, highlighting a persistent disconnect between information quality and accessibility. This gap is not merely technical; it reflects a broader issue of health equity and information justice (27–29).

Another critical issue is the lack of cultural tailoring and linguistic inclusiveness. The study was limited to English-language websites, omitting potentially valuable sources in other widely spoken languages such as Spanish, Arabic, or Turkish. This represents a missed opportunity to evaluate how health communication adapts—or fails to adapt—to culturally diverse populations. As previous research suggests, culturally congruent and language-sensitive content significantly enhances health comprehension and engagement (30–32).

Furthermore, the findings call attention to the low adoption of HONcode certification, even among frequently visited websites. Although HONcode adherence is not mandatory, it offers a

structured framework to improve transparency, authorship credibility, and ethical standards in digital health communication (23,33). The barriers to adoption—such as cost, lack of awareness, or technical complexity—deserve closer investigation and targeted policy responses.

In response to the observed challenges, innovative strategies are urgently needed. For example, AI-driven text simplification tools, such as those based on natural language processing (NLP), offer potential to automatically adapt complex content into lay-friendly formats without compromising accuracy (34–37). Such technologies can be embedded into content management systems or browser extensions to personalize health communication based on users' literacy profiles. Additionally, the integration of visual aids, interactive elements, and multimedia content can enhance engagement and retention, especially among visual and low-literacy learners.

Looking ahead, future research should adopt mixed-method designs that combine content analysis with parental interviews or surveys to understand how online information is interpreted and used. Moreover, longitudinal studies could explore whether exposure to readable and high-quality online resources leads to measurable improvements in parental decision-making, reduced anxiety, or decreased unnecessary healthcare visits.

In summary, while online resources represent a vital tool in parental health decision-making, their current state—often overly complex, inconsistently reliable, and culturally narrow—limits their effectiveness. Bridging this gap will require a multidisciplinary effort encompassing health communication theory, digital literacy policy, user-centered design, and ethical standardization. By aligning readability, quality, and cultural relevance, online health communication can become a true ally in promoting informed, confident, and equitable parenting.

Future Research and Recommendations: Given the limitations and findings of this study, several future directions are warranted to improve the accessibility and impact of online health information regarding childhood chest pain and similar pediatric concerns:

1. Multilingual and Culturally Inclusive Research: Future studies should incorporate non-

English websites to reflect the global and multicultural nature of digital health information seekers. Evaluating resources in other widely used languages such as Spanish, Mandarin, Arabic, or Turkish can illuminate disparities in health information access among linguistic minorities. Additionally, assessing the cultural appropriateness of website content—beyond language—can offer critical insights into message effectiveness across diverse populations (38–40).

2. User Behavior and Information Use Studies: While content analysis reveals the structure and quality of available information, it does not capture how parents interpret, trust, or act upon that information. Qualitative interviews, surveys, or digital ethnography could reveal how readability and source credibility shape parental decision-making during health-related uncertainty. This user-centered approach would enhance the ecological validity of digital health research (41,42).

3. Integration of AI and Personalization Tools: Emerging technologies, particularly artificial intelligence and natural language processing (NLP), offer opportunities to improve health communication in real time. Tools such as automated readability simplifiers, adaptive reading platforms, or chatbot-guided support systems could be tested in clinical or public settings to assess their effectiveness in enhancing comprehension and reducing anxiety. Collaborations between computer scientists, health educators, and medical professionals are needed to validate these tools ethically and equitably (43,44).

4. Standardization and Certification Incentives: The persistently low rate of HONcode certification highlights the need for broader adoption of ethical content standards. Future policy work could explore ways to incentivize health websites to comply with international quality benchmarks through accreditation systems, digital badges, or public health partnerships. Integrating such standards into Google search algorithms or web browser plugins may improve user navigation toward trustworthy sources (28,29).

5. Dynamic Evaluation Tools for Public Health Agencies: Government and professional organizations should invest in live monitoring systems that regularly evaluate and adapt their web

content according to readability, user engagement, and evolving communication trends. These tools could employ AI to flag outdated or overly complex content, ensuring that official sources remain both accurate and accessible (35,45).

CONCLUSION

This study highlights critical gaps in the readability, quality, and ethical transparency of online resources addressing childhood chest pain—a common concern that often drives parental information-seeking behavior. Despite the benign nature of most pediatric chest pain cases, the complexity of online content frequently exceeds recommended readability levels, potentially limiting access and understanding among parents with lower health literacy.

Websites from government agencies and professional organizations were more likely to meet quality and ethical benchmarks, yet even these sources often failed to achieve ideal readability standards. Conversely, commercially-driven sites tended to prioritize accessibility over accuracy or transparency, while scientific journal content remained largely inaccessible to lay audiences due to its technical language.

The observed inverse relationship between readability and quality underscores the need for balanced health communication: content that is both accurate and accessible. To promote informed, equitable decision-making among parents, future online resources should integrate plain language principles, adhere to certification standards such as HONcode, and leverage AI-based simplification tools to adapt content for diverse literacy levels.

Improving the digital ecosystem for pediatric health information will require collaboration among health professionals, web developers, and communication scientists. By prioritizing readability and reliability, stakeholders can bridge the gap between health content availability and actual comprehension—ultimately reducing unnecessary healthcare visits and supporting better health outcomes for children and families.

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Table 2. Quality and Reliability Scores by Website Type

Website Type	DISCERN (Mean $\pm$ SD)	JAMA (Mean $\pm$ SD)	HONcode Certified (n/%)
Government	14.5 $\pm$ 1.2	7.5 $\pm$ 0.6	5 (50%)
Professional Org	13.8 $\pm$ 1.4	7.0 $\pm$ 0.7	5 (42%)
Commercial	10.2 $\pm$ 2.0	5.0 $\pm$ 1.1	3 (15%)
Health Portal	11.0 $\pm$ 1.6	5.8 $\pm$ 0.9	3 (20%)
Scientific Journal	12.2 $\pm$ 1.5	6.2 $\pm$ 1.0	0 (0%)

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Health Portal	11.0 $\pm$ 1.6	5.8 $\pm$ 0.9	3 (20%)
Scientific Journal	12.2 $\pm$ 1.5	6.2 $\pm$ 1.0	0 (0%)

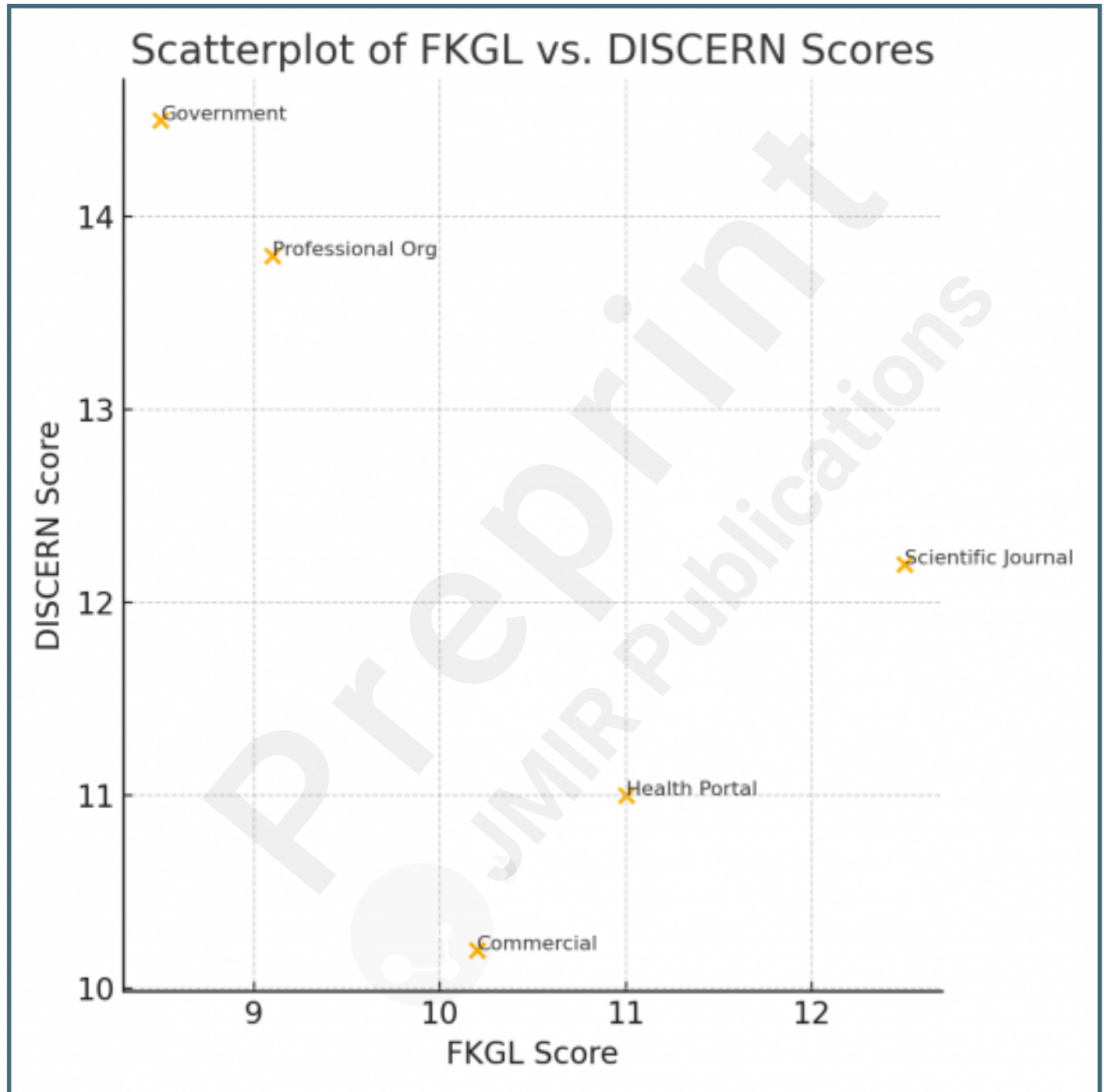
Table 3. Summary Matrix of Readability, Quality, and Certification by Website Type

Website Type	FKGL	SMOG	Fog Index	ARI	DISCERN	JAMA	HONcode Certified
Government	8.5	8.9	10.1	7.8	14.5	7.5	5 (50%)
Professional Org	9.1	9.3	10.8	8.4	13.8	7.0	5 (42%)
Commercial	10.2	10.5	11.2	9.2	10.2	5.0	3 (15%)
Health Portal	11.0	11.2	12.0	10.1	11.0	5.8	3 (20%)
Scientific Journal	12.5	12.8	13.3	11.4	12.2	6.2	0 (0%)

Supplementary Files

Figures

Scatterplot of Flesch-Kincaid Grade Level (FKGL) versus DISCERN quality scores across website types. A negative trend is observed, with higher FKGL scores (indicating more complex text) generally associated with lower DISCERN scores (indicating lower quality). Government and professional organization websites clustered in the top-left quadrant, reflecting high quality and greater readability, whereas scientific journals and commercial sites displayed higher complexity with lower quality ratings.



Mean Flesch-Kincaid Grade Level (FKGL) scores by website type. Scientific journal websites exhibited the highest average FKGL, indicating the most complex language, followed by health portals and commercial sites. Government and professional organization websites demonstrated comparatively lower readability levels, though all categories exceeded the recommended sixth-grade readability threshold for health information.

