Dermatol Ther (Heidelb) (2024) 14:671–684
https://doi.org/10.1007/s13555-024-01115-1

ORIGINAL RESEARCH

Readability of Patient Electronic Materials for Atopic Dermatitis in 23 Languages: Analysis and Implications for Dermatologists

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Received: January 27, 2024 / Accepted: February 8, 2024 / Published online: February 24, 2024

ABSTRACT

Introduction: Patients search on the Internet for information about various medical procedures and conditions. The main aim of this study was to evaluate the readability of online health information related to atopic dermatitis (AD). Online resources are becoming a standard in facilitating shared decision-making processes. With a pipeline of new therapeutic options like immunomodulators, understanding of the complexity of AD by the patients is crucial.

Methods: The term "atopic dermatitis" translated into 23 official European Union languages was searched using the Google search engine. The first 50 records in each language were evaluated for suitability. Included materials were barrier-free, focused on patient education, and were not categorized as advertisements. Article sources were classified into four categories: non-profit, online shops, pharmaceutical companies, and dermatology clinic. Readability was assessed with Lix score.

Results: A total of 615 articles in Swedish, Spanish, Slovenian, Slovak, Romanian, Portuguese, Polish, Lithuanian, Latvian, Irish, Italian, Hungarian, Greek, German, French, Finnish, Estonian, English, Dutch, Danish, Czech, Croatian, and Bulgarian were evaluated. The overall mean Lix score was 56 ± 8, which classified articles as very hard to comprehend. Significant differences in mean Lix scores were observed across all included languages (all $P < 0.001$). Articles released by non-profit organizations and pharmaceutical companies had the highest readability ($P < 0.001$). Low readability level was correlated with high article prevalence ($R^2 = 0.189$, $P = 0.031$).

Conclusions: Although there was an abundance of online articles related to AD, the readability of the available information was low. As online health information has become essential in making shared decisions between patients and physicians, an improvement in AD-related materials is needed.

Keywords: Atopic dermatitis; Internet content; Health information; Patient education

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Key Summary Points

Why carry out this study?

Little was known about the readability of atopic dermatitis (AD) online health information.

The goal of the study was to examine the comprehensibility of AD-related materials across multiple languages and their origins.

What was learned from the study?

Although there was abundance of AD-related materials in 23 included languages, their readability was classified as very hard.

Articles offered by pharmaceutical companies and non-profit organizations were the most comprehensible.

Dermatologist should take action to ensure readable AD-related materials on the Internet.

INTRODUCTION

Atopic dermatitis (AD) is a common inflammatory pruritic skin disease with complex pathophysiology and clinical presentation [1–3]. AD causes dry skin, itchy rash, and has a great impact on quality of life (QoL) [3, 4]. Social and financial costs caused by AD lead to the largest global burden of disability related to skin diseases [3, 5]. Recent data suggest that the prevalence of AD is approximately 20% in children, and 7% in adults in the European Union (EU) [6].

There is no cure for AD, but it can be effectively controlled [2]. In recent years, a continuously expanding understanding of AD pathogenesis has led to rapidly evolving new therapeutic options [7]. Treatment costs are one of the most troubling burdens of AD [2]. In addition to prescribed medications, lifestyle modification is a pillar of AD therapy [8]. Patients are encouraged to purchase specific clothing, soaps, detergents, and emollients [8]. Financial costs and indirect expenses such as time spent on doctor's appointments emphasize the need for optimal AD management [2]. In the USA and Europe, treatment adherence was described as poor [9, 10]. It was found in the USA that only 32% of patients followed their topical treatment in AD [9]. In the UK nearly 50% of patients and caregivers could not correctly identify the potency of commonly prescribed topical corticosteroids [10]. In Australia, poor understanding of the disease, lack of knowledge, and the complexity of treatment regimens were identified as factors responsible for poor treatment outcomes [11]. Patient education was identified by worldwide recommendations to be crucial in improving treatment adherence and patients' QoL in AD [12, 13].

A recent study emphasized that English-speaking patients are utilizing the Internet to gain knowledge about their medical concerns and treatment options, underscored the accessibility, user-friendly interface, and low cost of online health information [14]. In the English-speaking world, the Internet is widely recognized as a trustworthy source of health information [14]. Individuals from these nations utilize online resources to enhance their own understanding and expand their expertise [14]. The desire for self-education through online materials was strong among Anglophone patients [15]. The most widely used web search engine, Google, allows patients to enter specific terms and receive a list of potential websites to address their inquiries [15]. Online information found in Google is a mix of articles dedicated to the public, journalists, health professionals, and patients [16]. Presented content is not regulated and significant quality variations were demonstrated on websites dedicated to various health conditions [17]. Health-related articles aimed at the public and patients may use complex medical terminology, resulting in an overestimation of readers' understanding and therefore potential confusion [16, 18]. "Readability" is a term used to describe the level of ease with which written material can be read. This factor is of great importance when evaluating the

comprehensibility of a patient-focused resource, as higher readability is typically linked to better understanding [16, 18]. It could not be excluded that low readability of online materials related to AD contributes to its poor management. Lack of understanding of the AD pathogenesis such as the itch–scratch cycle, skin conditioning methods, and proper treatment application could lead to poor patient adherence and management outcomes.

A few studies have assessed readability of patient electronic materials dedicated to skin diseases [1, 19, 20]. Only one study assessed patient electronic materials dedicated to AD [1]. It involved only 30 articles, and all were written in English [1], thus its results might not be reliable and generalizable to wider populations. No study was found that evaluated readability of patient electronic materials related to AD in multiple languages. No study has evaluated these materials' readability by its source. The main aim of this study was to evaluate readability of Google-searched materials related to AD written in European languages with a validated measure. The secondary aim was to compare readability of those materials by their source. Prevalence of those materials in the included languages was also investigated. Finally, correlation between article readability and prevalence was examined.

METHODS

The methodology utilized in this study closely resembled that of one of the author's other published work [18].

Search Method

Google Translate services were utilized to translate search term "atopic dermatitis" to official languages of the EU. Each term was queried in new session of Google search engine and a list of the search results was generated. Private mode of web browser was used and the same preferred country of Google Services as the language of the searched term was set up to ensure the reliability of the generated results list. For each language the first 50 search results obtained with the search term were collected because Internet users typically stop searching after the first 50 hits [18, 21]. Articles related to AD in both children and adults, free to the public, and focused on patient education were included. Results in languages other than the searched term as well as password and/or paywall protected content were excluded. Scientific articles, videos, personal blogs, online forums, and advertisements were also excluded. Websites that primarily advertised a particular drug, medical facility, or doctor and did not emphasize patient education were classified as advertisements [14, 18]. Articles released by regulatory bodies, dedicated to physicians or medical professionals, related to veterinary medicine or alternative medicine were omitted from the analysis. The EU has 24 official languages: Swedish, Spanish, Slovenian, Slovak, Romanian, Portuguese, Polish, Maltese, Lithuanian, Latvian, Italian, Irish, Hungarian, Greek, German, French, Finnish, Estonian, English, Dutch, Danish, Czech, Croatian, and Bulgarian [22]. Google Services did not support Maltese as a preferred search language [23] and was therefore not included in the analysis.

Source Classification

Non-profit

The patient electronic material source was non-profit if the article met the following criteria: (1) issued by a hospital, practice, or clinic whose statutory aim was not profit generation; (2) released by a non-profit organization that aimed to support people with AD, e.g., International Society of Atopic Dermatitis (ISAD), Association of People Affected by Atopic Dermatitis; (3) was posted on a website whose main purpose was not to encourage the reader to buy a certain drug, laboratory test, book a physician consultation, or purchase other appliances such as soaps, detergents, or emollients.

Online Shop

Although evaluated electronic material was not considered to be an advertisement, it was released by a website that offered online purchase of drugs (online pharmacies),

prescriptions, laboratory tests, physician consultations, etc.

Pharmaceutical Company
Evaluated material was not considered to be an advertisement, had purely educational nature but was released by a pharmaceutical company website (e.g., Sanofi). These articles included brand names, company names, or pop-up adverts, thus their for-profit nature was clear. If a website offered a purchase option, it was classified as an "online shop".

Dermatology Clinic
Included patient electronic material was posted by a group practice, individually practicing physician, hospital, or outpatient clinic. These did not promote a certain physician, clinic, or treatment option; however, their non-profit character could not be ensured. These web pages had a contact phone number, email, and address required to schedule a consultation or hospital admission. Similarly, if a website offered a purchase option (e.g., teleconsultation), it was classified as an "online shop".

Readability Assessment

The Lix formula, a proven measure of readability, was used to evaluate all included materials [24, 25]. In contrast to other metrics like the Gunning Fogg Index, Lix was demonstrated to be a trustworthy measure of readability in various languages (Swedish, Danish, English, French, German, Finnish, Italian, Spanish, Portuguese) [18, 24, 25]. It is considered by the scientific community to be a reliable readability measure for all European languages [18, 24, 25]. Not only is it easy to calculate and understand but it also overcomes challenges with syllabification, making it suitable for complex languages such as Chinese and Arabic [18, 24]. Evaluated text was copied into Microsoft Word and all extraneous text (e.g., affiliations, hyperlinks, figures, legends, disclaimers, adverts, author information, and copyright notices) was removed. The function "Save as Plain Text" was utilized. To check and correct spelling and grammar using Microsoft Word, the relevant language of the text was selected. Each article was saved as a separate file, and then text was copied to an online Lix calculator (https://haubergs.com/rix). The number of sentences, number of words, average number of words in a sentence, and Lix score were noted. To interpret the Lix score, the scale recommended by Anderson [25] was employed. Scores lower than 20 were labeled as very easy to understand, while those below 30 were categorized as easy, below 40 as a little hard, below 50 as hard, and below 60 as very hard to comprehend [25].

Statistical Analyses

Number of words, number of sentences, and mean Lix scores were compared across all analyzed languages with analysis of variance (ANOVA). Similarly, ANOVA was used to evaluate article parameters and their sources. Correlation between the mean Lix score of analyzed articles and the number of hits was examined with univariate linear regression analysis. Distribution of the data was evaluated with Shapiro–Wilk test. P value equal to or less than 0.05 was considered statistically significant. JASP version 0.17.1 (JASP Team, University of Amsterdam) was used to conduct analyses and Microsoft Word and Excel, version 16.59 (Redmont, USA) were used to aggregate the data.

Ethical Approval

This article is based on previously conducted studies and does not contain any new studies with human participants or animals performed by any of the authors.

RESULTS

Prevalence

Overall, 615 articles were included in the analysis. The most prevalent were articles in Italian (46 articles), Polish (38 articles), and Romanian (35 articles). Irish was the least popular language, with only one included material. The

Table 1 Number of hits and included articles per search term

Language	Search term	Total # of hits	Included articles *n* (%)
Bulgarian	атопичен дерматит	217,000	24 (48)
Croatian	atopijski dermatitis	1,190,000	21 (42)
Czech	atopická dermatitida	123,000	22 (44)
Danish	Atopisk dermatitis	480,000	15 (30)
Dutch	atopische dermatitis	439,000	21 (42)
English	atopic dermatitis	147,000,000	30 (60)
Estonian	atoopiline dermatiit	114,000	21 (42)
Finnish	atooppinen ihottuma	125,000	25 (50)
French	la dermatite atopique	918,000	29 (58)
German	atopische Dermatitis	433,000	26 (52)
Greek	ατοπική δερματίτιδα	507,000	33 (66)
Hungarian	atópiás dermatitisz	71,100	29 (58)
Irish	dheirmitíteas atópacha	218	1 (2)
Italian	dermatite atopica	4,520,000	46 (92)
Latvian	atopiskais dermatīts	N/A	22 (44)
Lithuanian	atopinis dermatitas	131,000	33 (66)
Polish	atopowe zapalenie skóry	5,890,000	38 (76)
Portuguese	dermatite atópica	2,760,000	26 (52)
Romanian	dermatita atopica	N/A	35 (70)
Slovak	atopická dermatitída	68,900	25 (50)
Slovenian	atopijski dermatitis	1,270,000	33 (66)
Spanish	dermatitis atópica	6,490,000	33 (66)
Swedish	atopisk dermatit	86,000	27 (54)

number, N/A not available. Percentage values were calculated out of 50 articles included in the search results list

numbers of hits were the highest for English (147,000,000), Spanish (6,490,000), and Polish (5,890,000). Irish had the lowest number of hits (218). Searched queries, number of search hits, and number of included websites for each language are presented in Table 1.

Readability Assessment

The articles examined had an overall mean of 56 ± 8 for Lix score, 1152 ± 834 for word count, 74 ± 60 for sentence count, and 16 ± 4 for average words per sentence. Statistical significance was found in all differences between languages ($P < 0.001$ for all). Table 2 provides the exact values for all included languages.

Table 2 Readability of atopic dermatitis related articles in EU languages

Language	Lix score	# Sentences	# Words	# Words/sentence
Bulgarian	56 ± 6	50 ± 43	831 ± 685	17 ± 3
Croatian	57 ± 6	92 ± 96	1445 ± 1488	16 ± 2
Czech	55 ± 6	69 ± 47	979 ± 686	15 ± 4
Danish	49 ± 8	69 ± 29	1214 ± 829	17 ± 5
Dutch	47 ± 5	97 ± 75	1383 ± 982	14 ± 2
English	42 ± 6	96 ± 63	1448 ± 991	16 ± 4
Estonian	63 ± 5	53 ± 30	677 ± 368	13 ± 3
Finnish	68 ± 6	75 ± 46	847 ± 544	12 ± 2
French	56 ± 5	66 ± 43	1182 ± 723	19 ± 3
German	54 ± 5	142 ± 155	1791 ± 1512	13 ± 2
Greek	57 ± 6	50 ± 38	943 ± 656	20 ± 5
Hungarian	65 ± 5	60 ± 39	814 ± 505	14 ± 3
Irish	54 ± N/A	19 ± N/A	425 ± N/A	22 ± N/A
Italian	60 ± 6	60 ± 39	1194 ± 756	21 ± 4
Latvian	62 ± 5	68 ± 36	1006 ± 494	15 ± 3
Lithuanian	64 ± 7	55 ± 31	708 ± 348	14 ± 4
Polish	61 ± 4	93 ± 71	1368 ± 901	15 ± 2
Portuguese	53 ± 3	71 ± 46	1324 ± 902	19 ± 3
Romanian	61 ± 7	61 ± 27	1212 ± 529	21 ± 5
Slovak	58 ± 5	100 ± 44	1485 ± 793	15 ± 3
Slovenian	54 ± 5	77 ± 44	1151 ± 586	15 ± 2
Spanish	50 ± 5	80 ± 51	1382 ± 926	18 ± 3
Swedish	47 ± 7	58 ± 39	888 ± 503	16 ± 4

Data are presented as mean ± standard deviation. # number, N/A not available. Only 1 article in Irish was included in the analysis, thus standard deviation calculation was irrelevant. Differences between Lix score, number of sentences, words, and words/sentence were statistically significant. All $P < 0.001$

English (42 ± 6), Dutch (47 ± 5), and Swedish (47 ± 7) were the languages that yielded the most readable articles. Articles in Finnish (68 ± 6), Hungarian (65 ± 5), and Lithuanian (64 ± 7) were the most challenging to understand. None of the articles in the included languages had a Lix score lower than 30 or 40; thus, they were not considered easy or a little hard to understand [18, 25, 26]. Articles in English, Dutch, Swedish and Danish were classified as hard to comprehend [18, 25, 26]. Articles in remaining languages were classified as very hard to comprehend. Figure 1 illustrates the mean Lix values.

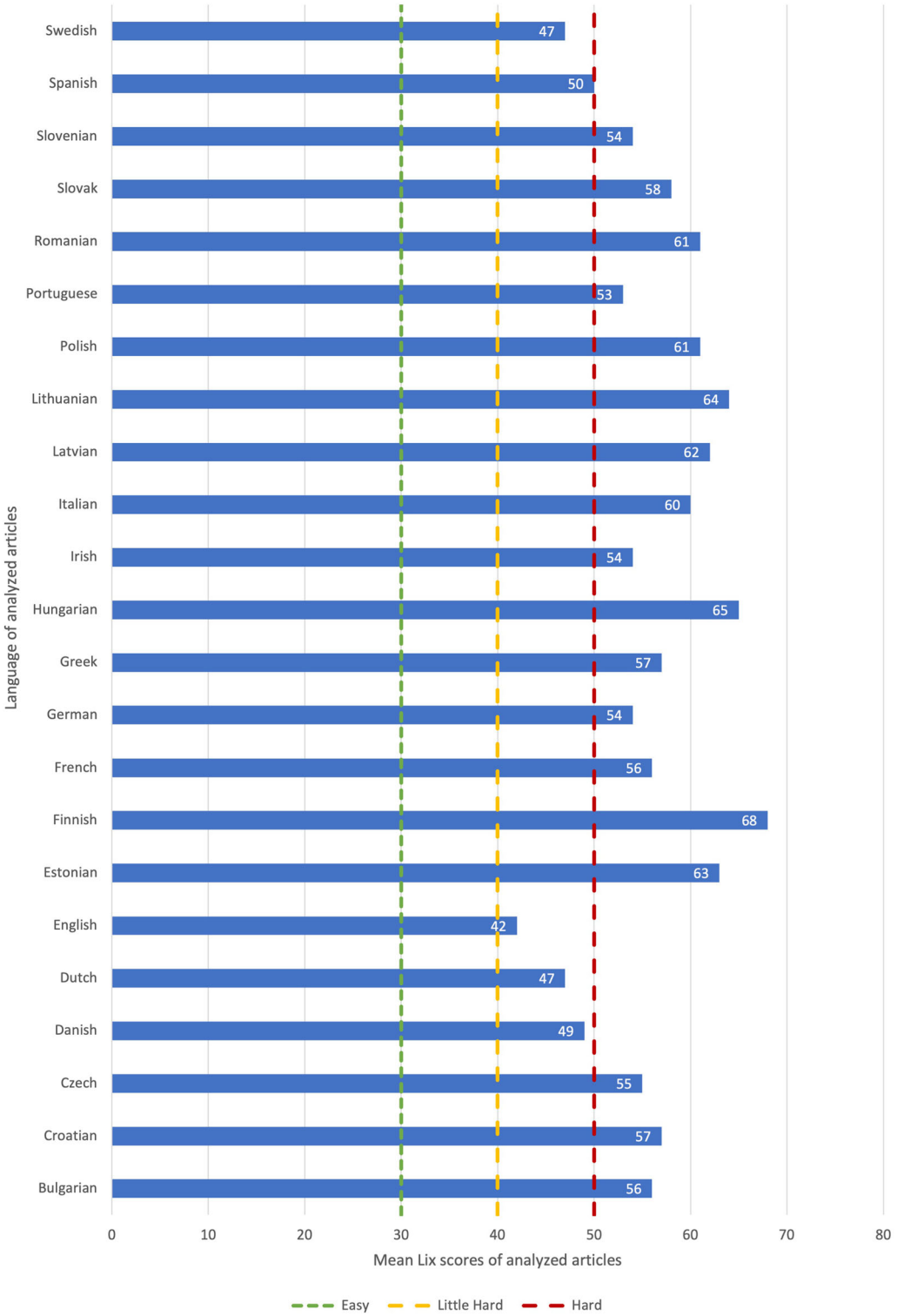

Fig. 1 Readability of atopic dermatitis-related online patient electronic materials in European languages. Mean Lix score was rounded to the nearest integer. Text is classified as easy to comprehend if Lix < 30, as a little hard if Lix < 40, as hard if Lix < 50

Articles in German (142 ± 155), Slovak (100 ± 44), and Dutch (97 ± 75) had the highest average number of sentencesArticles in Bulgarian (50 ± 43), Greek (50 ± 38), and Estonian (53 ± 30) had the lowest average number of sentences. Articles in German (1791 ± 1512), Slovak (1485 ± 793), and English (1448 ± 991) had the highest average number of words per article. The opposite was revealed for articles in Estonian (678 ± 368), Lithuanian (708 ± 348), and Hungarian (814 ± 505). Articles with the highest words/sentence ratios were in Italian (21 ± 4), Romanian (21 ± 5), and Greek (20 ± 5). The opposite was revealed for articles in Finnish (12 ± 2), Estonian (13 ± 3), and German (13 ± 2).

Readability and Article Source

The highest numbers of words per article were observed for non-profit sources (1276 ± 992). Articles issued by pharmaceutical companies had the lowest number of words per article (735 ± 486). The difference between number of words per article and its source was statistically significant ($P = 0.023$). Differences between number of sentences and average number of words in a sentence per article were not statistically significant ($P = 0.101$ and $P = 0.490$, respectively). Mean values are presented in Table 3.

Articles issued by pharmaceutical companies (56 ± 8) and non-profit organizations (56 ± 9) had the highest readability. The lowest readability was revealed for articles released by source classified as dermatology clinic (59 ± 8) and online shop (58 ± 7). Articles in all sources had average Lix score > 50 and were classified as very hard to comprehend. The differences were statistically significant ($P < 0.001$). Mean Lix values by source class are presented in Fig. 2.

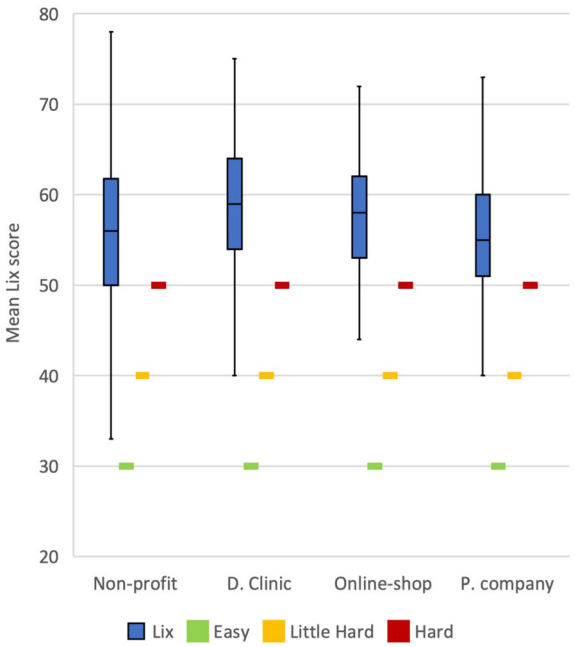

Fig. 2 Mean Lix values of analyzed articles by source. D = dermatology, P = pharmaceutical; text is classified as easy to comprehend if Lix < 30, as a little hard if Lix < 40, as hard if Lix < 50. $P < 0.001$

Table 3 Readability of atopic dermatitis related articles

Source	Lix score	# Sentences	# Words	# Words/sentence
Non-profit	56 ± 9	81 ± 76	1276 ± 992	17 ± 4
D. clinic	59 ± 8	68 ± 61	1043 ± 849	17 ± 4
Online shop	58 ± 7	65 ± 30	1009 ± 1160	16 ± 4
P. company	56 ± 8	75 ± 47	735 ± 486	16 ± 4
P value	< 0.001	0.101*	0.023	0.490*

P. pharmaceutical, D. dermatology, # number of. All values are presented as mean ± standard deviation. *P* was calculated with analysis of variance (ANOVA)

*These results were not statistically significant

Prevalence and Readability

Univariate linear regression was performed to examine correlation between readability of AD-related online materials and number of Google search hits. There was a weak positive correlation between mean Lix scores and number of hits ($R^2 = 0.189$, $P = 0.031$). The rise in prevalence of AD-related materials is associated with a decrease in their comprehensibility.

DISCUSSION

Although the Internet provides a great number of materials about AD, the comprehensibility of those information was revealed to be not optimal; no materials in any included languages were categorized as easy to comprehend, which highlighted this fact. Articles in 4 out of 23 included languages (English, Dutch, Swedish, and Danish) were classified as hard to comprehend. Articles in the majority of included languages (19 out of 23) were categorized as very hard. The presented results demonstrated also that articles released by non-profit organizations and pharmaceutical companies had the highest comprehensibility. The commercial background of AD-related materials was related to their lower readability. Articles issued by online shops and dermatology clinics had substantially lower comprehensibility levels. Quantity did not equate to readability in the context of online AD materials. The mean Lix scores did not correlate with number of hits.

Overall mean Lix score was 56 ± 8, which corresponds to college-grade level [27]. In the EU, only 32% of the population had completed tertiary education [28]. These facts mean that only one out of three potential patients can understand AD-related information found on the Internet. It was demonstrated that reliable patient self-education improves AD therapy outcomes both in paper-based and online form [29, 30]. Booklets that contained information on important everyday patient-oriented aspects of AD significantly improved the emotional status of patients with AD [2, 29]. Similarly, online educational materials proved to be helpful in the management of patients with AD [2, 30]. Self-education with reliable online electronic materials led to significant improvement in AD symptoms and QoL [30]. Online materials demonstrated greater effectiveness of education in patients with AD [31].

In all included languages, low comprehensibility of online AD-related materials was revealed. Without sufficient understanding of the disease, its complexity, and treatment options, it is difficult for patients to maintain sufficient compliance. It seems reasonable to assume that introduction of comprehensible AD-related online educational materials would potentially improve AD treatment outcomes and reduce social and economic global burden of the disease. Although articles released by non-profit organizations and pharmaceutical companies were found to have the greatest readability, both had readability level classified as very hard. Similar results were revealed in other medical specialties such as gynecology and ophthalmology [32–34]. These facts have implications, which are discussed below.

First, non-profit organizations and clinics, such as major associations focused on AD or academic hospitals, should improve comprehensibility of distributed information. Although associations often aim to educate health professionals, they could focus more on reliable patient education. Tertiary hospitals that teach students and medical professionals could also spread their expertise to the public in the form that layman can understand. In the age of disinformation, trusted sources should offer materials that meet the needs of the average Internet user.

Although articles released by pharmaceutical companies had higher levels of comprehensibility, there is scope for further improvement. Comprehensible online educational materials associated with certain manufacturers would benefit both company and patients. Patients with a good understanding of their therapy would have a better treatment adherence. It seems reasonable that with good compliance, satisfactory treatment outcomes could be associated with the company that released a certain article.

Secondly, reliable materials must be chosen by patients to fulfil their functions. Web

promotion is possible through Google's search engine [18, 35]. Internet users were more likely to visit websites that were promoted and were positioned at the top of search results [18, 35]. Encouraging the circulation of reliable and engaging online content could prove beneficial for the average Internet user. Top-searched materials written in European languages potentially would improve AD treatment outcomes. The economic and social burden of AD could be not only reduced in European countries but also in countries whose official languages are the same as in the EU (e.g., Portuguese in Brazil).

The present investigation revealed a correlation between readability and material abundance: greater prevalence of materials was associated with lower comprehensibility. This correlation was very weak ($R^2 = 0.189$). Although it is contrary to results within other specialties [14, 18], it can reasonably be assumed that greater quantity is related to worse readability.

Articles in Italian, Polish, and Romanian were the most prevalent. Irish was the least popular language with only one included article. These observations could be explained by the following facts. Irish is a decaying language with only a few people speaking Irish [36]. It seems reasonable that there was little or no interest in creating materials that were dedicated to a very limited group of patients. In Italy, Poland, and Romania, the public sector is limited and an ambulatory practice such as dermatology is run on a private ownership basis [37–39]. Consequently, private practices could release more online materials, to grab the attention of potential patients and ensure an adequate volume of visits.

Several other readability investigations dedicated to other dermatoses demonstrated similar deficits and highlighted the need for the improvement of online health materials [20, 40]. With the emerging pipeline of immunomodulators in AD treatment, it is increasingly important for online health information to reflect new therapeutic options [40]. Online resources are becoming a standard in patient care and facilitate successful shared decision-making processes between physicians and patients [41]. All of these suggest an overwhelming need for improved readability of online materials related to AD.

Although the present study evaluated the readability of online educational materials related to AD, the quality of the presented information remained unknown. DISCERN and JAMA instruments were designed to assess the quality of the data found on the Internet [42, 43]. As a result of the number of languages evaluated, the authors focused only on readability. These instruments require fluency in the language of the assessed article, something that the authors could not ensure for all included languages. Low readability and quality of online materials have been the subject of debate since the Internet became popular. It was always difficult to encourage enhancement of the materials presented on the Internet. One initiative was Health On the Net (HON) certification [44, 45]. Website administrators applied to the HON organization and sent source code of the website [45]. When the certification was granted, the webpage could display the HON logo [45]. If presented information did not adhere to the HON policy, the organization asked administrator to amend presented data [45]. Patients could identify trustworthy website by the HON logo, which facilitated reliable information finding on the Internet [45]. Unfortunately, this initiative was almost unknown and was permanently discontinued in December 2022 [46]. Now, the problem of reliability of the online information is even more critical than at the beginning of the Internet era. With the introduction of artificial intelligence models such as ChatGPT, the Internet is being flooded with unreliable materials [47]. These are often undistinguishable from human-written materials and often lead to patient disinformation [47].

All included materials were evaluated with Lix score. Lix was originally designed to evaluate readability of newspapers articles written in Swedish [25]. The accuracy of this readability measure was tested and approved in a variety of languages (Danish, English, Finnish, French, German, Italian, Portuguese, Swedish, Spanish) [24–26, 48]. There were no studies that evaluated Lix for other included languages. This

could potentially limit the presented investigation. However, Lix is considered by the scientific community as a reliable readability measure for all European languages [24, 25]. Although levels of comprehensibility applied in this study were designed for Danish, Swedish, Norwegian, and Dutch [24–26, 48], it could not be excluded that different cutoffs would be more suitable for other included languages. The Google search results are dynamic and could vary according to the geographic location of the search time and date. This study was conducted in Poland. Google search results were generated and evaluated between 26 December 2023 and 11 January 2024. It could not be excluded that data collection conducted in another country would bring different results. Similarly, the selection of Google as the search engine could bias the results. Quality evaluation of the analyzed articles with validated instruments was not performed, which is also important in the context of online health information. Nevertheless, this was beyond the designated scope of the study and may warrant further investigation in the future.

CONCLUSION

Although the Internet provides plenty of easily accessible materials related to AD, the readability of the presented information is low. Only one out of three patients could understand AD-related online health information. Non-profit organizations and pharmaceutical companies released online materials with the lowest Lix scores; however, the comprehensibility of their materials was classified as very hard. Online materials are becoming a standard in patient care and essential in making shared decisions between patients and physicians. An improvement in online AD-related online materials is needed.

Authors Contributions. Conceptualization: Tomasz Skrzypczak and Jacek C Szepietowski; methodology: Tomasz Skrzypczak; software: Tomasz Skrzypczak; formal analysis: Tomasz Skrzypczak; data acquisition: Tomasz Skrzypczak, Anna Skrzypczak; investigation: Tomasz Skrzypczak, Anna Skrzypczak and Jacek C. Szepietowski; writing – original draft preparation: Tomasz Skrzypczak, Anna Skrzypczak and Jacek C. Szepietowski; writing – review and editing: Tomasz Skrzypczak and Jacek C. Szepietowski; visualization: Tomasz Skrzypczak; supervision: Jacek C. Szepietowski.

Funding. No funding or sponsorship was received for this study or publication of this article.

Data Availability. The datasets generated and analyzed during the current study are available in the Google Drive repository, https://drive.google.com/drive/folders/1MbnFeDq6f8M8Xy1Y9iBvZCNZ-dk9HpIG?usp=share_link.

Declarations

Conflict of Interest. Jacek C. Szepietowski has served as an advisor for AbbVie, LEO Pharma, Menlo Therapeutics, Novartis, Pierre Fabre, Sienna Biopharmaceuticals, and Trevi; has received speaker honoraria from AbbVie, Eli Lilly, Janssen, LEO Pharma, Novartis, Sanofi-Genzyme, Sun Pharma, and Berlin-Chemie Men-narini; has served as an investigator; and has received funding from AbbVie, Amgen, Galapagos, Holm, Incyte Corporation, InflaRX, Janssen, Menlo Therapeutics, Merck, Boehringer Ingelheim, Novartis, Pfizer, Regeneron, Trevi, and UCB. Tomasz & Anna Skrzypczak report no conflict of interest.

Ethical Approval. This article is based on previously conducted studies and does not contain any new studies with human participants or animals performed by any of the authors.

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