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REVIEW

Quality and readability of online information and materials on post-surgery breast seroma

Alexander Bald[1]

Harriet Richardson[1]

Ahmad Al Samaraee[1]

Tarannum Fasih[1]

Author details can be found at the end of this article

Correspondence to:
Ahmad Al Samaraee;
ahmadas@doctors.org.uk

Abstract

Aims/Background Seroma formation is the most common complication following breast surgery. However, there is little evidence on the readability of online patient education materials on this issue. This study aimed to assess the accessibility and readability of the relevant online information.

Methods This systematic review of the literature identified 37 relevant websites for further analysis. The readability of each online article was assessed through using a range of readability formulae.

Results The average Flesch-Reading Ease score for all patient education materials was 53.9 (± 21.9) and the average Flesch-Kincaid reading grade level was 7.32 (± 3.1), suggesting they were 'fairly difficult' to read and is higher than the recommended reading level.

Conclusion Online patient education materials regarding post-surgery breast seroma are at a higher-than-recommended reading grade level for the public. Improvement would allow all patients, regardless of literacy level, to access such resources to aid decision-making around undergoing breast surgery.

Key words: Breast surgery; Patient information; Post-breast surgery seroma; Readability; Seroma

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Introduction

Breast cancer is the most diagnosed cancer worldwide, with over a third of breast cancers occurring in females over the age of 70 and one in five females under the age of 50 at diagnosis (Wilkinson and Gathani, 2022). 1 out of 3 patients undergo a mastectomy making it one of the most frequently performed surgical procedures (Bray et al, 2018). The most common complication following a mastectomy is seroma formation, with an incidence rate reported between 15–90% (Gonzalez et al, 2003; Van Bemmel et al, 2011). This condition is associated with higher pain levels, prolonged admission, delayed wound healing, repeated visits to the hospital, infections, increased health care costs and delaying adjuvant treatments, all of which affect the recovery process (Gonzalez et al, 2003; Kuroi et al, 2005; Van Bemmel et al, 2011). It is, therefore, key to ensure that patients are aware of the risks and the impact on quality of life that is associated with post-surgery breast seroma (PSBS).

The internet continues to be a key source of health information, with its available content growing and changing each day (McMullan, 2006; Bojazar et al, 2020). Therefore, it is not unexpected for patients in this current era to undertake online searches before seeking a diagnosis from a health professional (Flynn et al, 2006; Thomson and Hoffman-Goetz, 2007; Miles et al, 2019). The odds of accessing online resources are further increased among patients with a cancer diagnosis compared to those without (McMullan, 2006; Miles et al, 2019). As part of *The NHS Long Term Plan*, shared responsibility, and the importance of empowering patients in the decision-making process is emphasised throughout (Bojazar et al, 2020; The King's Fund, 2023).

Accessing online information has been shown to decrease and uncertainty around a diagnosis, improve health-decision making and increase confidence to ask more informed

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questions of health professionals (Baker et al, 1997; Weiss, 2014). This then empowers people to actively engage throughout the treatment process (Surani et al, 2017), further highlighting the importance that health information visible to internet users enables patients to do this.

Social media offers the opportunity to reach a wider audience and enhance public health literacy. Given easier and increased access to social media, including the increasing use of smartphones across all demographics, the limitation of distributing information is reducing (McInnes and Haglund, 2011; Rowlands et al, 2015). Increased access to information, however, has led to unprecedented public health risks (McInnes and Haglund, 2011; Rowlands et al, 2015). Despite social media being shown to be beneficial for health promotion (McGloin and Eslami, 2014; Sama et al, 2014), studies suggest it is easier for false or misleading health information to spread than scientific knowledge through these platforms, which affects all groups of people (Latte-Naor, 2019). This can lead to raised patient expectations and confusion due to different viewpoints in treating certain conditions, particularly when the available related evidence or experiences are sparse, based on weak evidence and/or if a condition is rare (Suarez-Lledo and Alvarez-Galvez, 2021). There is a lack of control over what health information is spread on social media and its validity (Surani et al, 2017). Hence, it is imperative that valid health information sources are written at a level that is accessible to all in order to counter this.

Health literacy is defined as 'the degree to which individuals have the capacity to obtain, process and understand basic health information to make appropriate health decisions'. Poor health literacy is associated poor engagement with health services, a lack of shared decision making and worse health outcomes (Surani et al, 2017).

Readability is a key indicator of health literacy. Those with poor health literacy have difficulty reading and understanding material written with reading and comprehending material written with a reading age of 11–12 years (8th grade level), with those with limited health literacy having difficulty understanding the material for age 15–16 years (12th grade level) (Nash et al, 2023). The National Literacy Trust estimates that nearly 7.1 million adults in the UK are illiterate; this figure represents approximately 16.4% of the adult population (Teravainen-Goff et al, 2022). A UK nationwide survey found that around 1 in 6 adults have levels of general literacy below that expected of an 11-year old. This indicates that a sixth of adults have a reading age of 11 years and below, when the text is only comprehended if it is straightforward, short and on a familiar topic (Nash et al, 2023).

This is recognised by the *National Institute for Health and Care Excellence*, who state that health literacy is a fundamental component of shared decision making (Cavallo et al, 2014). 4 in 10 adults struggle to comprehend and interpret health information targeted at the general population, with those at risk of socioeconomic deprivation more likely to be in this group (McGloin and Eslami, 2014). This then creates a 'digital divide' in a group with an increased likelihood of poorer health outcomes following breast surgery (McGloin and Eslami, 2014; Weiss, 2014).

It is therefore pertinent that online health information resources consider differences in health literacy to improve overall accessibility. Improving readability is one way to address accessibility, with several studies demonstrating that online resources are not suitable for a large proportion of the general population(Miles et al, 2019).

This study aimed to assess the accessibility and readability of online health information sources, with a comparison between National Health Service (NHS) and non-NHS resources.

Methods

This systematic review of the literature was based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses protocol (**Figure 1**). The keywords/terms used were seroma; breast surgery; post-breast surgery seroma; readability and patient information. The leading UK search engine is Google, with a market share of 93.7%, thus the analysis used results from this search engine (Bianchi, 2023). And no other search engine was included. Two of the authors conducted the review using the online search engine Google. Cookies and cache were cleared before each search and websites were accessed in incognito mode to reduce the bias caused by location and any interaction of algorithms. The search was

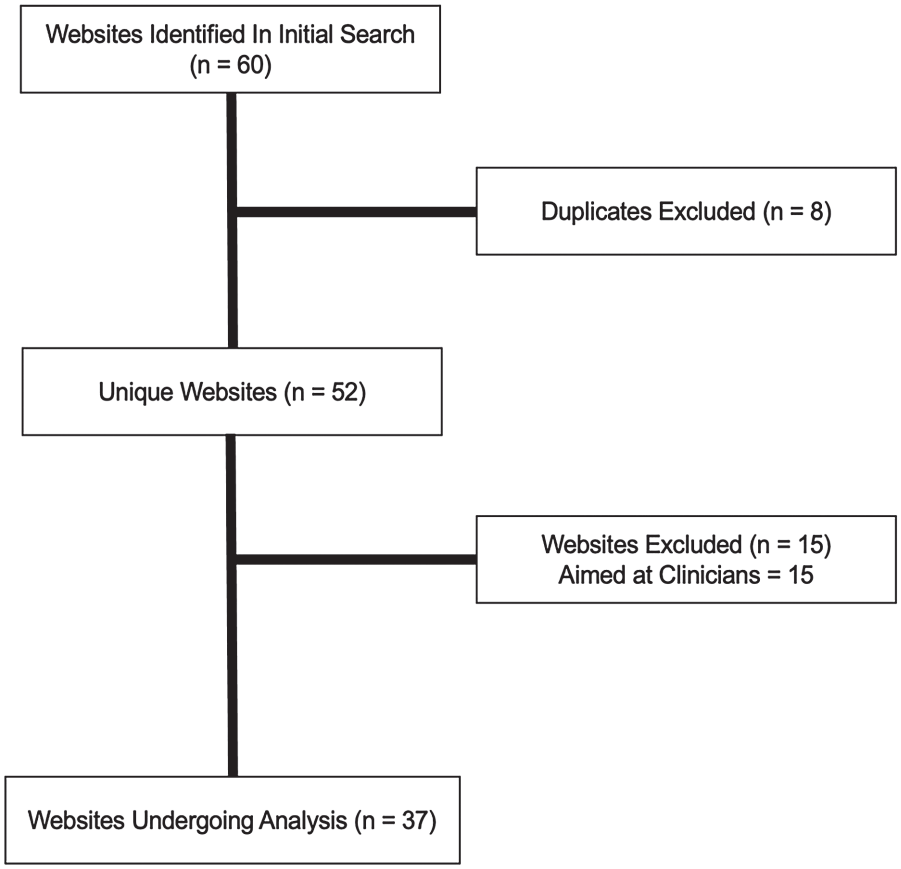

Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses based search strategy.

limited to the first three pages as studies suggest that users do not engage with websites beyond the third page of results (Voodoo Marketing, 2012).

Websites that were duplicates, not in English, aimed at clinicians or behind a paywall were excluded from this study. If the search result was a website home page, all relevant information pages were analysed, and an average score was calculated. Linked pages were, however, not included. Inclusion and exclusion criteria are detailed in **Figure 1**. Eight pages were excluded due to being duplicates, with a further 15 removed due to being aimed at clinicians.

Five validated tests were used for analysis: Flesch-Kincaid Grade Level (FKGL), Flesch Reading Ease (FRE), Gunning Fog Index (GFI), Coleman-Liau Index (CLI) and Simple Measure of Gobbledygook (SMOG). The five readability tests chosen have been widely discussed in a variety of previous studies and have been validated in numerous studies (Friedman and Hoffman-Goetz, 2006). Each test uses a different formula to find the readability of a piece of text (**Table 1**), with a combination of scores used to ensure different measures of readability were included. Flesch-Kincaid Grade Level and FRE are the most commonly used readability formulae in practice (57% and 22% respectively), with SMOG (26%) and Gunning Fog (10%) following. **Table 2** details the relationship between the Flesch Reading Ease Score and subsequent grade, as well as style, syllables per word and average sentence length. There is currently no consensus as to which readability formula is best suited for assessing patient education materials, it is widely agreed to use more than one readability method to improve the reliability of the results (Wang et al, 2013). An online readability tool, Readable, was used to calculate each readability metric for each website included (Readable, 2019).

Table 1. A table detailing the different readability metrics and associated algorithms

Readability Metric	Algorithm
Flesch Reading Ease	206.835–1.015(words sentences)–84.6(syllables words)
Flesch-Kincaid Grade Level	0.39(words sentences)+11.8(syllable words)–15.59
Coleman-Liau Index	0.0588(letters100words)–0.396(sentences100words)–15.8
Gunning-Fog Index	0.4[(words sentences)+100(complex words words)]
SMOG Grade Level	1.0430complex words×30sentences+3.1291

Complex words are defined as words with 3 or more syllables. SMOG, Simple Measure of Gobbledygook.

Table 2. A table detailing the correlation between Flesch Reading Ease score and subsequent grade, style, syllables per word and average sentence length

Reading Ease	Grade	Description of Style	Syllables Per 100 Words	Average Sentence Length
90–100	5	Very Easy	123	8
80–90	6	Easy	131	11
70–80	7	Fairly Easy	139	14
60–70	8–9	Standard	147	17
50–60	10–12	Fairly Difficult	155	21
30–50	College	Difficult	167	25
0–30	College Graduate	Very Difficult	192	29

There is a varied literacy level across the devolved nations in the UK, ranging from 12.5–25% of adults with a very poor literacy level. To ensure information is accessible, the *NHS Health Literacy Toolkit* advises the reading age needs to be age 11 or below (i.e. 6th grade level or Year 7 level) (NHS, 2023). Based on this recommendation, this study set a suitable score for FRE as 80–90.

Results

This systematic review of the literature identified 37 relevant websites for further analysis. Statistical analysis was undertaken using SPSS (IBM SPSS Statistics for MacOS, version 29.0.1, Chicago, IL, USA). The mean grade score combined was 8.78 ± 4.1 for each test (FKGR, GFI, CLI, SMOG) across all websites. Mean FRE was 53.85 ± 21.9 correlating to a reading age of 15–17 (10th–12th grade level or year 11–13). Only 8.1% of articles were at the recommended reading age of 11–12 years old. Mean scores, standard deviation, median and range for each readability test are presented in Table 3.

8 out of 37 included webpages were NHS websites. The mean grade score for all NHS websites across all readability formulae combined (FRE, FKGR, GFI, CLI, SMOG) was 6.1 ± 3.58 compared to 9.54 ± 4.0 for all non-NHS websites. The mean FRE for all NHS websites was 70.3 ± 17.7 versus 49.1 (49.09) ± 21.1 for all non-NHS websites. This is shown in Figure 2. The maximum FRE score was 97.7 (range of 53.1) for NHS websites compared to 69.8 (range of 101) for non-NHS websites.

Table 3. A table showing the overall mean, minimum, maximum, median and standard deviation scores for each readability formula: Flesch-Kincaid Grade Level (FKGL), Coleman-Lindau Index (CLI), Gunning Fog Index (GFI), Simple Measure of Gobbledygook (SMOG) for all websites

Readability Formula	Mean Score	Minimum Score	Maximum Score	Median Score	Standard Deviation
Flesch Reading Ease	53.85	44.6	97.7	57.3	21.9
Flesch-Kincaid Grade Level	7.32	0.3	18	7.05	3.1
Gunning Fog Index	7.80	1.8	13.2	8.5	3.0
Coleman-Liau Index	13.47	7.3	29.2	13.45	4.1
SMOG Grade Level	6.51	2.8	9.9	6.85	1.6
Combined Score (FRE, FKGL, CLI, GFI, SMOG)	17.79	0.3	97.9	8.8	20.91

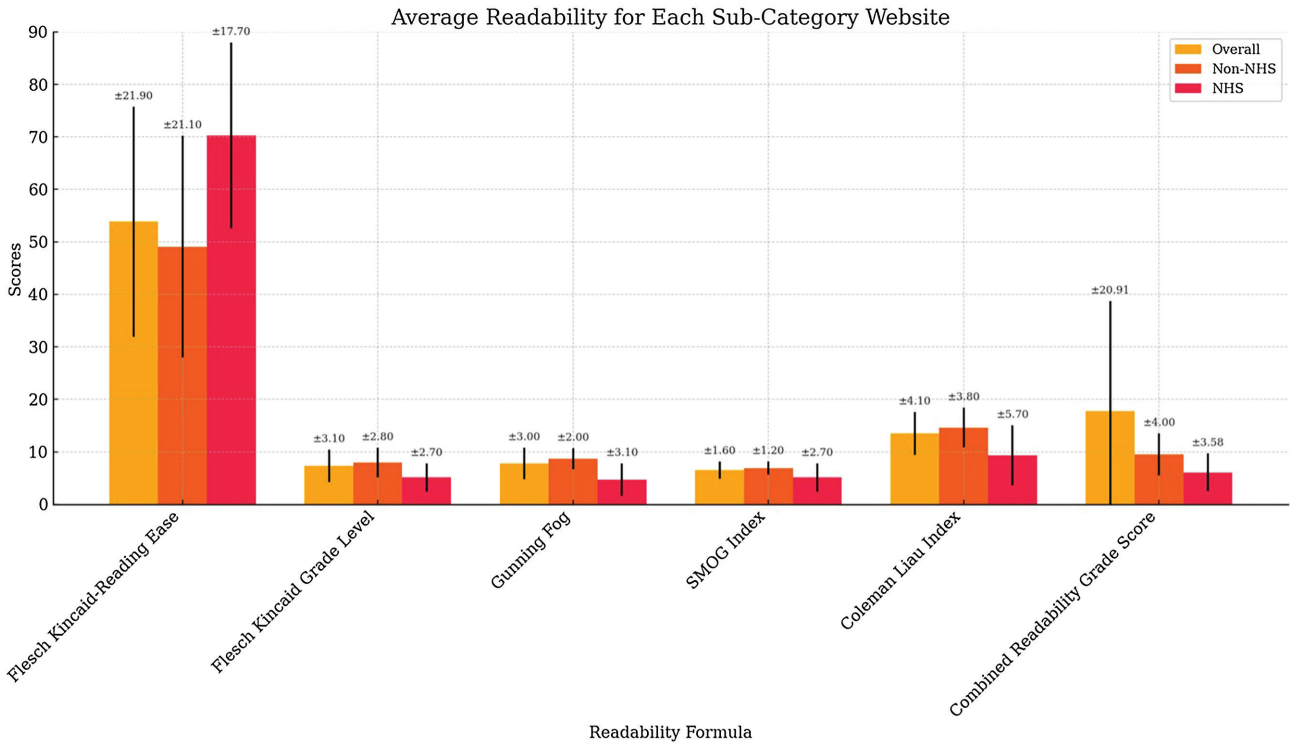

Figure 2. A bar chart demonstrating the mean scores for National Health Service (NHS), non-NHS and all included websites.

Discussion

This study found that the most online information about PSBS is not accessible and is too difficult to read for the general population. Only three websites, all of which were NHS webpages, from the 37 identified were readable at 6th grade level (11–12-year-olds) as recommended by the *NHS Health Literacy Toolkit* (NHS, 2023).

There are no other studies on the readability of online health information pertaining to PSBS for comparison; however, the results from this study are consistent with the

readability of online health information generally (Rowlands et al, 2015). One should keep in mind that the available literature investigating the quality and readability of online health information pertaining to PSBS is currently very limited.

Websites written and provided by the NHS were among the easiest to comprehend. Four out of the top five scoring websites, and the only three websites at the recommended 11–12 years reading age, were written by NHS services. With NHSUK being the most visited website for accessing health information (NHS Digital, 2022), it is important that content produced by NHS services is easily understood by the population accessing it. There is an array of guidance in the form of guidelines and toolkits to achieve the reading age of 9–11 years for online information provided by NHS services (Cavallo et al, 2014). Although some websites analysed met this goal, the overall information about PSBS was being delivered at 10–12th grade level (15–17 years old), making it inaccessible to a large proportion of the population.

The general population, however, tend to visit multiple websites to get a broad understanding of a condition and to validate any information discovered (Skierkowski et al, 2019). Government websites are less likely to be visited, with those with lower health literacy levels having less trust in government-owned websites (Bojazar et al, 2020. This results in 'dot com' websites being more likely to be accessed over government ran webpages (Arts et al, 2019; Skierkowski et al, 2019).

Information that is easily readable across a wide variety of online resources improves accessibility for more of the population and ensures engagement in shared and informed decision making. Employing methods such as using plain language, that can be tested with online readability tools as stated in **Table 1** and implementing a logical structure to the content ensures that the information is comprehensible to a wider audience. Using multimedia elements such as visual aids and audible content will further enhance comprehension, regardless of literacy level. Collaborating with key stakeholders early ensures that the content is not only patient-centred but also readable for said patients (Wei et al, 2022). Through implementing these strategies, online information resources can act as catalysts for and enhance shared decision making within healthcare, but this can only be achieved if the content is accessible to patients.

Limitations of the study

There are some limitations of readability formulas. These formulas provide an estimate on readability but should not be used as a measure of comprehensibility. Readability is assessed through the number of syllables per word in a sentence or the average number of words per sentence but does not account for the complexity of medical jargon or a patient's familiarity with commonly used medical terminology (Nash et al, 2023). An example of this is the word 'indigestion' which will increase the readability grade due to its frequency of syllables but is commonly used in layman's terms. This is in comparison to 'gait', which is less likely to be understood by the general population but has less syllables and thus a decreased readability grade. In addition to the above, visual aids, text size, headers and line spacing all influence the readability of a piece of text but cannot be measured within any readability formulas (Nash et al, 2023). In addition, the study itself does have its own limitations. The study primarily focussed on websites accessed through Google search results, which may not be representative of all online health information sources. The search terms used in the study may have limited the spectrum of resources assessed, with the possibility that broader or alternative search terms could yield different results. The focus of the study was on the readability of information sources but did not assess the accuracy or the relevancy of the information provided. This may mean that although the information is readable, it is not accurate and is of no benefit. Due to the dynamic and evolving nature of the internet, the results of the study will only reflect what information was available to the general public at this point in time. This study, however, raises awareness of the problem which may influence medical professionals and organisations to reduce the reading difficulty of online patient information resources.

Conclusion

Online patient education materials regarding PSBS are at a higher-than-recommended reading grade level for the public. Improvement would allow all patients, regardless of literacy level, to access such resources to aid decision-making around undergoing breast surgery. The results of this study highlight the need for health content creators to check their patient information sources using validated mechanisms (e.g. readability assessment formulas and/or *NHS Digital Toolkit* guidance) to enhance accessibility and health outcomes. Healthcare professionals and related institutions at both local and national levels should actively encourage the use of reading age evaluation when both developing and approving patient information resources. These resources should be tailored to the patient's needs and undergo regular review and update to reflect the latest evidence, guidelines and best practices. Clinicians should monitor any feedback or frequently asked questions from patients and adjust materials accordingly to address common questions or misconceptions.

Key points

- There is very limited available research on the quality and readability of online information sources on PSBS.
- PSBS are one of the most common complications of one of the most performed surgeries worldwide. It is therefore pertinent that patients understand the associated risks and impact on quality of life before consenting to this procedure.
- This study demonstrates how patient information sources are consistently above the recommended reading age making them inaccessible to most of the population.

Author details

[1]Department of General Surgery, Queen Elizabeth Hospital, Gateshead NHS Foundation Trust, Gateshead, UK

Availability of data and materials

All the data of this study are included in this article.

Author contributions

AB designed the research project. AB and HR performed the research. AAS and TF contributed to the methodology and data analysis. AB analysed the data. AB drafted the manuscript. All authors contributed to important editorial changes in the manuscript. All authors read and approved the final manuscript. All authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics approval and consent to participate

Not applicable.

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Conflict of interest

The authors declare no conflict of interest.

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