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Readability of online COVID-19 health information and advice

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ABSTRACT

Readability is a systematic measure of ease, with which written information can be read and understood. It can affect the reader's ability to access, comprehend, and utilize health information. This study assessed the readability of online COVID-19 information readily available to the public to engage with. At a time when organisations and institutions were rapidly providing advice and reacting to a developing pandemic, it was hypothesised that some of that haste would be associated with a lack of clarity, as measured by readability indices. N = 65 website sources containing information relating to COVID-19 were accessed and assessed for inclusion in the study. Eight readability indices, including Flesch Reading Ease and Flesch-Kincaid Grade Level, were calculated to determine readability scores for each source of information. Readability scores varied greatly between individual sources of COVID-19 information. Despite the recommendation that information be presented to the general public at a sixth-grade reading level, most websites we assessed addressing COVID-19 information and advice presented content at greater than the recommended reading level. Based on these results, a significant amount of information available on the Internet about COVID-19 will not be easily readable for many individuals attempting to use the Internet to help inform their decisions about their health and behavior.

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Readability; COVID-19; coronavirus; online health information

Introduction

Health information is only effective if it is understood by its audience. Readability is a systematic measure of ease with which written information can be read and understood, described by Storino et al. (2016) as a 'surrogate for reading level'. A standardised calculated readability score can indicate what level of education someone will need to be able to easily read a piece of text. Readability can affect the reader's ability to access, comprehend, and utilize health information if it is not written at an appropriate reading level (Blanck and Marshall 2011; Mcinnes and Haglund 2011). However, readability is a frequently overlooked aspect of health information quality and accessibility (Boulos 2005). If health information is not clearly understood, it can have an impact on health-care treatment, for example, by affecting the decision-making process when it comes to treatment planning (Weih et al. 2008).

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The internet has become an increasingly popular source of health information for the public to learn about health, disease and treatment options and, for many, is the first source of health information before healthcare professionals (Tonsaker, Bartlett, and Trpkov 2014). Two previous reviews reported that health information and patient education handouts are commonly written at a level of readability that is too high for their anticipated audience (Daraz et al. 2018). Further, studies have found that the readability of online health information is beyond the average reading ability of the general population (Cheng and Dunn 2015; Mcinnes and Haglund 2011). Therefore, the information is at risk of being misunderstood. Such incompletely processed information may be ineffective in encouraging protective health behaviours if the information is not fully understood. Accordingly, it is important for written health information to be readable and able to be processed fluently.

The topic of readability has been researched increasingly over recent years given the rise in patients turning to the internet for online health information, but it varies widely in terms of quality (Eysenbach et al. 2002). A pertinent area of readability research can be found in the cancer literature (Fefer et al. 2020; Storino et al. 2016; Sha et al. 2020). Overall, this research suggests that online cancer information providers overestimate the reading ability of the audience (Storino et al. 2016), and generally websites require reading levels much higher than is recommended (Sha et al. 2020) potentially leaving patients poorly informed.

The importance of written health information to be readable and processed fluently is no less important when the online information pertains to public health crises, such as the COVID-19 pandemic. COVID-19 is a fast-spreading communicable infection, its severity varying from mild self-limiting influenza-like symptoms to severe pneumonia, respiratory failure, and death (Hill, Mantzoros, and Sowers 2020).

Readability is found to be associated with engagement. Research discussed above demonstrates that while some studies have explored the relationship between readability and engagement in the health literature, studies from other fields suggest that online messages that have lower readability levels are more likely to engage their audience (Li et al. 2017). Therefore, it is essential that online health information relating to COVID-19 be assessed for readability too.

The purpose of public health messaging is to reach the public, be understood and subsequently actioned. Readability is, essentially, the first link in that chain. Therefore, this study was conducted to assess the readability of available online COVID-19 information readily available to the public to engage with. At a time when organisations and institutions were rapidly providing advice and reacting to a developing pandemic, it was hypothesised that some of that haste would be associated with a lack of clarity, as measured by readability indices.

Methods

Using a cleared Internet browser (clear of cache, cookies, and history), a search was conducted for 'COVID-19' using Microsoft Edge internet browser (subsequently verified through the Google Chrome browser) due to these being the internet browsers used by the researchers and commonly throughout the world, mirroring the likely tools that the public would employ when searching for information online.

Websites containing information relating to COVID-19 were accessed and assessed for inclusion in the study. Before beginning the search, the authors decided that the purpose of the research was to survey a *selection* of information, on advice and guidance on COVID-19, that was intended for the public and was freely accessible and was verifiable and produced from a credible source, rather than a full systematic search of every single site that came up in the search. Credible sources included charity websites, the UK government, and the NHS, thus these sources were included. Research has suggested that patients are likely to only access the first page of results when searching the internet for online health information (Morahan-Martin 2004), and so, we did not search beyond this.

If the website contained health information surrounding Covid-19 such as advice on how to avoid contracting the virus, then the source was included. The focus of this study was to include official sources from governmental websites, formal advice from health-related charities which are well established, avoiding lay or 'amateur' web pages and those not freely available. Therefore, if websites required users to log in or sign up to view information or were not registered charities or official government or NHS sites, they were excluded. In order to try to conduct a thorough search and avoid missing relevant websites, manual searches of websites were also conducted to find information. Most of the charity websites included were hyperlinked from the UK NHS website pages on COVID-19, concluding that these websites were the most likely to be viewed by patients given they were signposted to by the NHS.

Given the COVID-19 specific information under investigation, whole URLs were not assessed for readability. Only those links and website pages pertaining specifically to COVID-19 were assessed. The primary researcher searched websites for relevant COVID-19 information which was entered into the Readable.com service. The sources and text selected were checked by the secondary researcher to verify resultant readability scores and eliminate random errors.

The readability scores for each section of information were determined using Readable.com, a Medline-recommended service, chosen due to it being able to calculate several recommended, standardised readability tests and formulae such as Flesch-Kincaid Grade Level (FKGL) and Gunning Fog Index (GFI) within one service.

The following standardised readability tests and formulae were calculated to assess the readability of the online health information sources, through inputting the content of each information source into the Readable.com service.

Flesch-Kincaid Grade Level

Scores are calculated by inputting sentence length as judged by the average number of words in a sentence and word length, assessed by the average number of syllables in a word. The score generated is equivalent to the US grade level of education that the reader would require to be able to understand that piece of text. Text intended for readership by the public should aim for a grade level of around 8, schooling age 13–14.

Gunning Fog Index

This formula generates a grade level, typically between 0 and 20. The formula estimates the years of formal education the reader requires to understand the text on first reading. If a piece of text has a grade-level readability score of 6, then this should be easily readable by those educated to sixth grade in the US schooling system, i.e. 11–12-year olds. The ideal score for readability with the Fog index is 7–8. Anything above 12 is too hard for most people to read.

Coleman–Liau Index

The CLI formula is calculated by inputting the average number of letters and sentences per 100 words and estimates the years of education the reader needs to understand the text. An index score of 6, for example, states that your text can be understood by an audience of sixth graders and older using the US schooling system (age 11–12). When writing for the general public, an index score of 8 to 10 is thought to be ideal (age 12–15).

SMOG (Simple Measure of Gobbledygook) grade level

This is formulated by counting 10 sentences near the beginning of the text, 10 in the middle and 10 near the end, totalling 30 sentences, counting every word with three or more syllables, square-rooting the number and rounding it to the nearest 10, then adding three to this figure. The formula estimates the years of education the average person needs to understand any piece of writing.

FORECAST

This tool produces a Grade level by calculating, $20 - (N/10)$, where N = the number of single-syllable words in a 150-word sample.

Rix

This measures readability based on letter counting, rather than using the syllable counting method of other formulas. Rix is formulated by the number of long words divided by the number of sentences.

Fry

Fry is a graph-based formula which uses sentences and syllables as variables to calculate the US grade level required to understand a piece of text.

For text aimed at the public, a readability grade level of 8 or lower is a suitable score to achieve on these readability indices. That is good enough for 85% of the public to be able to easily read the content.

Flesch Reading Ease

This score gives the level of education that is needed to easily read a piece of text by giving the text that is being assessed, a score between 1 and 100, based on word and sentence length. Scoring between 70 and 80 is equivalent to school grade level 8, meaning text should be fairly easy for the average adult to read. The higher the reading score, the easier a piece of text is to read.

If a piece of text has a grade-level readability score of 6, then this should be easily readable by those educated to sixth grade in the US schooling system, i.e. 11–12 year olds. Text intended for readership by the general public should aim for a grade level of around 8, schooling age 13–14.

Readability scores for a given text are generally correlated across indices but are by no means identical, showing that each index has an independent contribution to make; therefore, the use of multiple formulae has been found to improve the reliability and accuracy of readability scores (Mumford 1997).

Results

Readability scores using eight readability indices were calculated for each source ($n = 65$) and scores varied between individual sources of COVID-19 information. Whilst there were 65 sources assessed, in several cases, a number of sources came from the same website (for example, the GOV.UK website), but separate pages or sections of information were assessed individually due to them containing different types of information about COVID-19. We included the lyrics of a popular comedy music track released during the early stages of the pandemic by British comedian, Matt Lucas, which aimed to help promote public health advice in light of coronavirus. The lyrics were included as a source of information for the purposes of comparison to COVID-19 related health information provided by websites likely visited by the public seeking information and advice pertaining to the pandemic.

Table 1 displays the eight readability scores for each source of information. The table demonstrates that readability scores also varied within sources based on the different readability indices.

Table 2 displays descriptive statistics for all eight readability measures. This table demonstrates that whilst some indices such as FKGL on average were pitched appropriately for the general public (a grade level of 8), for others, such as GFI, the readability of the sources on average was above the recommended reading level.

For each readability indices, the sources were ranked in order of readability (where a score of 1 means the source was the most readable). This information can be seen in Table 3.

Table 3 demonstrates that the ranking for each source varied between readability indices. This is due to the different indices measuring different aspects of text complexity, thus showing that each index has an independent contribution to make. Therefore, a league table of the most to least easily readable information source was created based on median rank position across six readability indices. This can be seen in Table 4. Two

Table 1. Readability index scores for each source of COVID-19 information.

Source no.	Data source	Flesch–Kincaid grade level	Gunning Fog Index	Coleman–Liau	SMOG	Fry	Flesch Reading Ease	FORCAST	Rix
1	Lyrics of ‘Thank You Baked Potato’ 2020 version	2.6	3.1	4.0	7.9	2	86.2	8.5	3
2	GOV.UK Coronavirus (COVID-19): what you need to do	3.3	4.8	4.1	5.5	3	89.9	8.6	3
3	WHO Coronavirus disease (COVID-19) advice for the public	7.9	9.7	10.2	10.4	9	60.5	10.7	7
4	NHS check if you have coronavirus symptoms	6.2	8.4	7.9	9.1	6	70.0	9.2	6
5	NHS What to do if you or someone you live with has symptoms of coronavirus	6.5	9.0	7.6	9.7	6	69.9	9.1	6
6	NHS How to treat coronavirus symptoms at home	8.0	9.8	9.9	10.3	n/a	56.8	10	6
7	NHS Who’s at higher risk from coronavirus	7.5	9.2	9.7	10	n/a	59.8	10.4	6
8	NHS Staying at home and away from other people (social distancing)	7.3	10.3	8.8	10.7	7	64.7	9.8	7
9	NHS How to get medical help from home	6.3	9.2	7.9	9.8	6	68.6	10.0	6
10	NHS If you’re at very high risk from coronavirus (extremely vulnerable)	6.9	9.6	8.7	10.2	7	67.9	9.8	7
11	NHS If you live with someone at very high risk from coronavirus (extremely vulnerable)	7.2	9.8	9.1	10.3	7	66.5	9.9	7
12	GOV.UK Guidance on shielding and protecting people who are clinically extremely vulnerable from COVID-19	9.1	11.9	11.2	11.8	9	56.1	10.7	9
13	RCOG Coronavirus infection and pregnancy	12.1	15.0	11.7	14.1	12	45.3	11.0	11
14	NHS Inform coronavirus (COVID-19): General advice	8.3	10.7	10.6	11.0	9	57.8	10.5	8

(Continued)

Table 1. (Continued).

Source no.	Data source	Flesch–Kincaid grade level	Gunning Fog Index	Coleman–Liau	SMOG	Fry	Flesch Reading Ease	FORCAST	Rix
15	Asthma UK Shielding advice for very high-risk groups	7.8	10.0	9.1	10.8	7	66.4	9.9	8
16	CRUK coronavirus (COVID-19) and cancer	7.6	9.4	10.0	9.9	8	61.9	10.6	7
17	CRUK coronavirus (COVID-19) and cancer treatment	7.8	10.2	10.6	10.7	8	61.4	10.5	8
18	CRUK I have symptoms of cancer what should I do during the coronavirus outbreak?	5.8	8.7	7.1	9.6	6	76.6	9.0	6
19	Stroke Association Information on coronavirus for stroke survivors	7.3	9.4	9.3	10.2	7	64.1	10.2	7
20	Terrence Higgins Trust Coronavirus COVID-19	8.6	10.8	8.9	11.0	8	63.4	9.8	8
21	British Lung Foundation Coronavirus and COVID-19	8.5	11.1	9.8	11.3	9	60.2	10.1	8
22	Dementia UK Coronavirus: questions and answers	9.4	12.4	9.8	12.5	9	58.8	10.1	9
23	BDA COVID-19/ Coronavirus – Advice for the General Public	9.7	12.1	11.2	12.6	10	54.2	10.7	9
24	Mind Coronavirus and your wellbeing	7.8	10.1	9.6	10.6	7	64.5	10.1	8
25	RCN COVID-19 (coronavirus) FAQs	13.2	14.9	13.2	14.3	n/a	28.8	12.5	11
26	RCM Advice for pregnant women	10.7	13.5	10.9	13.0	10	51.8	10.6	10
27	Royal College of Paediatrics and Child Health Advice for parents during coronavirus	8.1	10.3	10.0	10.9	9	59.1	10.5	8
28	Versus Arthritis What is coronavirus (COVID-19)?	8.1	10.3	10.0	10.9	9	59.1	10.5	8
29	Versus Arthritis Arthritis and COVID-19 – your questions answered	9.0	10.7	11.2	11.4	10	54.6	10.8	8

(Continued)

Table 1. (Continued).

Source no.	Data source	Flesch–Kincaid grade level	Gunning Fog Index	Coleman–Liau	SMOG	Fry	Flesch Reading Ease	FORCAST	Rix
30	Versus Arthritis Staying at home and arthritis	7.4	9.4	9.7	10.0	7	66.4	10.0	7
31	GOV.UK Guidance Staying alert and safe (social distancing)	11.3	14.3	11.6	13.6	11	49.9	10.8	11
32	NHS Coronavirus in children	5.2	7.7	6.3	8.8	5	76.5	8.6	5
33	Cystic Fibrosis Trust Coronavirus, staying home and shielding	9.5	12.2	10	12.3	9	58.4	10.3	9
34	Cystic Fibrosis Trust The impact of coronavirus on your CF care	10.8	14.2	10.7	13.7	10	51.6	10.4	10
35	Kidney Care UK Coronavirus (COVID-19) guidance for patients with kidney disease	10.9	13.1	11.5	13.0	11	50.5	10.9	10
36	Sickle Cell Society Coronavirus (COVID-19) & Sickle Cell Disorder General Information and Guidance	8.7	11.4	10.2	11.5	9	60.2	10.4	8
37	MND Association Coronavirus Information	8.9	11.1	10.5	11.5	9	56.9	10.7	8
38	Alzheimer's Society Coronavirus: Information for people affected by dementia	8.5	10.5	10.6	10.8	9	57.9	11.0	7
39	Alzheimer's Society Coronavirus: Supporting a person with dementia at home	8.0	10.8	9.0	11.3	8	63.9	9.9	7
40	Alzheimer's Society Coronavirus: Support for a person with dementia living alone	11.2	14.4	9.9	13.5	9	54.3	10.2	9
41	Alzheimer's Society Coronavirus: Supporting a person with dementia from a distance	7.4	9.9	8.2	10.3	6	70.6	9.3	8
42	Alzheimer's Society Coronavirus: Supporting a person with dementia who falls ill	9.2	11.8	9.1	11.5	8	60.9	9.9	8

(Continued)

Table 1. (Continued).

Source no.	Data source	Flesch–Kincaid grade level	Gunning Fog Index	Coleman–Liau	SMOG	Fry	Flesch Reading Ease	FORCAST	Rix
43	Alzheimer's Society Coronavirus: Supporting a person with dementia in hospital	9.5	12.5	9.8	12.1	9	59.5	10.0	9
44	Alzheimer's Society Coronavirus: Supporting a person with dementia in a care home	7.6	10.3	7.7	10.2	7	69.9	9.3	7
45	Alzheimer's Society Coronavirus: If a person with dementia in a care home falls ill	9.3	12.1	9.7	11.7	9	59.8	10.1	9
46	Alzheimer's Society Coronavirus: Frequently asked questions and useful organisations	9.1	11.9	10.1	11.8	9	59.4	10.1	9
47	Asthma UK What should people with asthma do now?	7.0	9.9	8.5	10.4	7	68.2	9.8	7
48	Asthma UK Shielding advice for very high-risk groups	8.8	11.4	9.7	11.5	8	62.3	10.0	9
49	Asthma UK If you get COVID-19 and have asthma	7.6	9.9	7.9	9.8	7	70.0	9.5	7
50	Macmillan Cancer Support Coronavirus (COVID- 19) guidance for people with cancer	8.9	10.3	11.0	10.7	n/a	53.1	11.1	7
51	British Heart Foundation Coronavirus: what it means for you if you have heart or circulatory disease	10.1	12.5	10.6	12.0	9	56.5	10.0	9
52	British Heart Foundation What does coronavirus do to your body?	8.8	10.8	9.6	10.6	8	61.7	10.2	7
53	British Heart Foundation Coronavirus: your questions answered	8.5	11.3	9.4	11.6	8	62.4	9.7	8

(Continued)

Table 1. (Continued).

Source no.	Data source	Flesch–Kincaid grade level	Gunning Fog Index	Coleman–Liau	SMOG	Fry	Flesch Reading Ease	FORCAST	Rix
54	British Liver Trust Coronavirus (COVID-19) – health advice for people with liver disease and liver transplant patients	10.3	12.6	11.1	12.4	10	53.4	10.8	9
55	British Liver Trust Social distancing, self-isolating and shielding: what are they and how do they differ?	9.6	11.9	10.2	11.4	9	59.6	10.6	9
56	Diabetes UK Coronavirus (Covid-19) and diabetes updates	9.2	12.1	10.0	12.0	9	59.6	10.0	9
57	Diabetes UK coronavirus and blood sugar levels	10.8	13.2	11.3	12.6	10	53.1	10.7	10
58	Diabetes UK Coronavirus – what we’re doing	11.4	14.3	11.8	13.5	11	49.4	10.5	10
59	Diabetes UK Staying at home and managing diabetes	7.1	9.9	8.1	10.2	6	72.3	9.2	7
60	NHS Social distancing: what you need to do	6.8	9.7	8.4	10.2	6	68.5	9.5	6
61	NHS How to get medical help from home	6.3	9.2	7.9	9.8	6	68.6	10.0	6
62	GOV.UK Coronavirus action plan: a guide to what you can expect across the UK	12.8	15.2	13.3	14.7	n/a	38.2	11.9	12
63	GOV.UK Guidance Coronavirus (COVID-19): getting tested	10.2	13.3	13.3	12.6	n/a	44.7	11.6	9
64	GOV.UK Apply for a coronavirus test	6.5	8.2	7.3	9.2	6	68.7	9.5	6
65	GOV.UK Guidance Coronavirus outbreak FAQs: what you can and can’t do	9.3	12.3	10.5	12.1	9	58.5	10.4	9

RCN: Royal College of Nursing; RCM: Royal College of Midwives; RCPCH: Royal College of Paediatrics and Child Health; RCOG: Royal College of Obstetricians and Gynaecologists; BDA: British Dietetic Association; MND: Motor Neurone Disease; CRUK: Cancer Research UK.

Table 2. Descriptive statistics for the readability indices of all sources ($n = 65$).

Readability measure	Min	Max	Mean	SD	Recommended readability score for each measure
FKGL	2.60	13.30	8.48	1.94	8
GFI	3.10	15.20	10.92	2.18	7–8
CLI	4.00	13.30	9.64	1.75	8–10
SMOG	5.50	14.70	11.16	1.57	≤8
Fry	2.00	12.00	8.03	1.87	≤8
FRE	28.80	89.90	60.93	9.71	70–80
FORCAST	8.50	12.50	10.17	.72	≤8
Rix	3.00	12.00	7.88	1.71	≤8

FKGL: Flesch–Kincaid Grade Level; GFI: Gunning Fog Index; CLI: Coleman–Liau Index; SMOG: Simple Measure of Gobbledygook; FRE: Flesch–Kincaid Reading Ease.

Table 3. Ranking of each source of COVID-19 information for each readability index.

Source number	Source name and detail	FKRG ranking position	GFI ranking position	CLI ranking position	SMOG ranking position	FRE ranking position	FORECAST ranking position	Median rank position
1	Lyrics of 'Thank You Baked Potato' 2020 version	1	1	1	2	2	1	1
2	GOV.UK Coronavirus (COVID-19): what you need to do	2	2	2	1	1	2	2
3	WHO Coronavirus disease (COVID-19) advice for the public	26	15	42	22	31	51	28.5
4	NHS check if you have coronavirus symptoms	5	5	8	4	7	6	5.5
5	NHS What to do if you or someone you live with has symptoms of coronavirus	8	7	6	7	9	5	7
6	NHS How to treat coronavirus symptoms at home	27	17	34	19	48	22	24.5
7	NHS Who's at higher risk from coronavirus	19	8	27	12	34	39	23
8	NHS Staying at home and away from other people (social distancing)	15	26	17	26	20	14	18.5
9	NHS How to get medical help from home	6	9	9	8	12	23	9
10	NHS If you're at very high risk from coronavirus (extremely vulnerable)	10	14	16	14	16	15	14.5
11	NHS If you live with someone at very high risk from coronavirus (extremely vulnerable)	14	18	20	20	17	18	18
12	GOV.UK Guidance Guidance on shielding and protecting people who are clinically extremely vulnerable from COVID-19	42	43	55	45	50	52	47.5
13	RCOG Coronavirus infection and pregnancy	63	64	61	63	62	60	62.5
14	NHS Inform Coronavirus (COVID-19): General advice	31	32	47	33	46	43	38

(Continued)

Table 3. (Continued).

Source number	Source name and detail	FKRG ranking position	GFI ranking position	CLI ranking position	SMOG ranking position	FRE ranking position	FORECAST ranking position	Median rank position
15	Asthma UK Shielding advice for very high-risk groups	23	23	21	29	18	19	22
16	CRUK Coronavirus (COVID-19) and cancer	20	11	36	11	27	48	23.5
17	CRUK Coronavirus (COVID-19) and cancer treatment	24	25	48	27	29	44	28
18	CRUK I have symptoms of cancer what should I do during the coronavirus outbreak?	4	6	4	6	3	4	4
19	Stroke Association Information on coronavirus for stroke survivors	16	12	23	15	22	35	19
20	Terrence Higgins Trust Coronavirus Covid-19	35	34	18	34	24	16	29
21	British Lung Foundation Coronavirus and COVID-19	32	37	31	35	32	30	32
22	Dementia UK Coronavirus: questions and answers	48	51	32	53	42	31	45
23	BDA COVID-19/Coronavirus – Advice for the General Public	52	46	56	54	53	53	53
24	Mind Coronavirus and your wellbeing	25	24	25	24	21	32	24.5
25	RCN COVID-19 (coronavirus) FAQs	65	63	63	64	65	65	64.5
26	RCM Advice for pregnant women	56	58	52	57	57	49	56.5
27	Royal College of Paediatrics and Child Health Advice for parents during coronavirus	29	27	37	31	40	45	34
28	Versus Arthritis What is coronavirus (COVID-19)?	30	28	38	32	41	46	35
29	Versus Arthritis Arthritis and COVID-19 – your questions answered	41	33	57	37	51	56	46
30	Versus Arthritis Staying at home and arthritis	17	13	28	13	19	24	18
31	GOV.UK Guidance Staying alert and safe (social distancing)	61	60	60	61	60	57	60
32	NHS Coronavirus in children	3	3	3	3	4	3	3
33	Cystic Fibrosis Trust Coronavirus, staying home and shielding	49	49	39	51	44	38	46.5
34	Cystic Fibrosis Trust The impact of coronavirus on your CF care	57	59	51	62	58	40	57.5
35	Kidney Care UK Coronavirus (COVID-19) guidance for patients with kidney disease	59	55	59	58	59	59	59
36	Sickle Cell Society Coronavirus (COVID-19) & Sickle Cell Disorder General Information and Guidance	36	40	43	39	33	41	39.5
37	MND Association Coronavirus Information	39	38	45	40	47	54	42.5

(Continued)

Table 3. (Continued).

Source number	Source name and detail	FKRG ranking position	GFI ranking position	CLI ranking position	SMOG ranking position	FRE ranking position	FORECAST ranking position	Median rank position
38	Alzheimer's Society Coronavirus: Information for people affected by dementia	33	31	49	30	45	61	39
39	Alzheimer's Society Coronavirus: Supporting a person with dementia at home	28	35	19	36	23	20	25.5
40	Alzheimer's Society Coronavirus: Support for a person with dementia living alone	60	62	35	59	52	36	55.5
41	Alzheimer's Society Coronavirus: Supporting a person with dementia from a distance	18	19	13	21	6	8	15.5
42	Alzheimer's Society Coronavirus: Supporting a person with dementia who falls ill	44	42	22	41	30	21	35.5
43	Alzheimer's Society Coronavirus: Supporting a person with dementia in hospital	50	52	33	49	38	25	43.5
44	Alzheimer's Society Coronavirus: Supporting a person with dementia in a care home	21	29	7	16	10	9	13
45	Alzheimer's Society Coronavirus: If a person with dementia in a care home falls ill	46	47	29	44	35	33	39.5
46	Alzheimer's Society Coronavirus: Frequently asked questions and useful organisations	43	44	41	46	39	34	42
47	Asthma UK What should people with asthma do now?	12	20	15	23	15	17	16
48	Asthma UK Shielding advice for very high-risk groups	37	41	30	42	26	26	33.5
49	Asthma UK If you get COVID-19 and have asthma	22	21	10	9	8	10	10
50	Macmillan Cancer Support Coronavirus (COVID-19) guidance for people with cancer	40	30	53	28	55	62	46.5
51	British Heart Foundation Coronavirus: what it means for you if you have heart or circulatory disease	53	53	50	47	49	27	49.5
52	British Heart Foundation What does coronavirus do to your body?	38	36	26	25	28	37	32
53	British Heart Foundation Coronavirus: your questions answered	34	39	24	43	25	13	29.5
54	British Liver Trust Coronavirus (COVID-19) – health advice for people with liver disease and liver transplant patients	55	54	54	52	54	58	54

(Continued)

Table 3. (Continued).

Source number	Source name and detail	FKRG ranking position	GFI ranking position	CLI ranking position	SMOG ranking position	FRE ranking position	FORECAST ranking position	Median rank position
55	British Liver Trust Social distancing, self-isolating and shielding: what are they and how do they differ?	51	45	44	38	36	50	44.5
56	Diabetes UK Coronavirus (Covid-19) and diabetes updates	45	48	40	48	37	28	42.5
57	Diabetes UK coronavirus and blood sugar levels	58	56	58	55	56	55	56
58	Diabetes UK Coronavirus – what we’re doing	62	61	62	60	61	47	61
59	Diabetes UK Staying at home and managing diabetes	13	22	12	17	5	7	12.5
60	NHS Social distancing: what you need to do	10	16	14	18	14	11	14
61	NHS How to get medical help from home	7	10	11	10	13	29	10.5
62	GOV.UK Coronavirus action plan: a guide to what you can expect across the UK	64	65	64	65	64	64	64
63	GOV.UK Guidance Coronavirus (COVID-19): getting tested	54	57	65	56	63	63	60
64	GOV.UK Apply for a coronavirus test	9	4	5	5	11	12	7
65	GOV.UK Guidance Coronavirus outbreak FAQs: what you can and can’t do	47	50	46	50	43	42	46.5

FKGL: Flesch–Kincaid Grade Level; GFI:= Gunning Fog Index; CLI: Coleman–Liau Index; SMOG: Simple Measure of Gobbledygook; FRE: Flesch–Kincaid Reading Ease.

RCN: Royal College of Nursing; RCM: Royal College of Midwives; RCPCH: Royal College of Paediatrics and Child Health; RCOG: Royal College of Obstetricians and Gynaecologists; BDA: British Dietetic Association; MND: Motor Neurone Disease; CRUK: Cancer Research UK.

of the initial eight readability indices were dropped at this point due to several sources not being given a score on those indices (FRY and Rix). The median was seen as the most appropriate measure of central tendency since it accommodates the range effectively.

Table 4 indicates that the lyrics of the popular comedy music track released during the early stages of the pandemic to help promote public health advice relating to coronavirus were ranked as most readable, meaning that they are likely understood by most adults.

The UK Government sources of information feature across the league table; some sources of information were more readable, i.e. ‘Coronavirus: what you need to do’ than others, i.e. ‘Coronavirus action plan: a guide to what you can expect across the UK’ which was ranked 64th in the table.

Table 4. League table of the most to least readable COVID-19 source of information.

Most readable to least readable	Median rank position	Source
	1	Lyrics of 'Thank You Baked Potato' 2020 version
	2	GOV.UK – Coronavirus (COVID-19): what you need to do
	3	NHS – Coronavirus in children
	4	CRUK – I have symptoms of cancer what should I do during the coronavirus outbreak?
	5.5	NHS – check if you have coronavirus symptoms
	7	NHS – What to do if you or someone you live with has symptoms of coronavirus
	7	GOV.UK – Apply for a coronavirus test
	9	NHS – How to get medical help from home
	10	Asthma UK – If you get COVID-19 and have asthma
	10.5	NHS – How to get medical help from home
	12.5	Diabetes UK – Staying at home and managing diabetes
	13	Alzheimer's Society – Coronavirus: Supporting a person with dementia in a care home
	14	NHS – Social distancing: what you need to do
	14.5	NHS – If you're at very high risk from coronavirus (extremely vulnerable)
	15.5	Alzheimer's Society – Coronavirus: Supporting a person with dementia from a distance
	16	Asthma UK – What should people with asthma do now?
	18	NHS – If you live with someone at very high risk from coronavirus (extremely vulnerable)
	18	Versus Arthritis – Staying at home and arthritis
	18.5	NHS – Staying at home and away from other people (social distancing)
	19	Stroke Association – Information on coronavirus for stroke survivors
	22	Asthma UK – Shielding advice for very high-risk groups
	23.0	NHS – Who's at higher risk from coronavirus
	23.5	CRUK – Coronavirus (COVID-19) and cancer
	24.5	NHS – How to treat coronavirus symptoms at home
	24.5	Mind – Coronavirus and your wellbeing
	25.5	Alzheimer's Society – Coronavirus: Supporting a person with dementia at home
	28.0	CRUK – Coronavirus (COVID-19) and cancer treatment
	28.5	WHO – Coronavirus disease (COVID-19) advice for the public
	29.0	Terrence Higgins Trust – Coronavirus Covid-19
	29.5	British Heart Foundation – Coronavirus: your questions answered
	32.0	British Lung Foundation – Coronavirus and COVID-19
	32.0	British Heart Foundation – What does coronavirus do to your body?
	33.5	Asthma UK – Shielding advice for very high-risk groups
	34.0	RCPCH – Advice for parents during coronavirus
	35.0	Versus Arthritis – What is coronavirus (COVID-19)?
	35.5	Alzheimer's Society – Coronavirus: Supporting a person with dementia who falls ill
	38.0	NHS Inform – Coronavirus (COVID-19): General advice
	39.0	Alzheimer's Society – Coronavirus: Information for people affected by dementia
	39.5	Sickle Cell Society – Coronavirus (COVID-19) & Sickle Cell Disorder: General Information and Guidance
	39.5	Alzheimer's Society – Coronavirus: If a person with dementia in a care home falls ill
	42.0	Alzheimer's Society – Coronavirus: Frequently asked questions and useful organisations

(Continued)

Table 4. (Continued).

42.5	MND Association – Coronavirus Information
42.5	Diabetes UK – Coronavirus (Covid-19) and diabetes updates
43.5	Alzheimer's Society – Coronavirus: Supporting a person with dementia in hospital
44.5	British Liver Trust – Social distancing, self-isolating and shielding: what are they and how do they differ?
45.0	Dementia UK – Coronavirus: questions and answers
46.0	Versus Arthritis – Arthritis and COVID-19 – your questions answered
46.5	Cystic Fibrosis Trust – Coronavirus, staying home and shielding
46.5	Macmillan Cancer Support – Coronavirus (COVID-19) guidance for people with cancer
46.5	GOV.UK Guidance – Coronavirus outbreak FAQs: what you can and can't do
47.5	GOV.UK Guidance – Guidance on shielding and protecting people who are clinically extremely vulnerable from COVID-19
49.5	British Heart Foundation – Coronavirus: what it means for you if you have heart or circulatory disease
53.0	BDA – COVID-19/Coronavirus – Advice for the General Public
54.0	British Liver Trust – Coronavirus (COVID-19) – health advice for people with liver disease and liver transplant patients
55.5	Alzheimer's Society – Coronavirus: Support for a person with dementia living alone
56.0	Diabetes UK – coronavirus and blood sugar levels
56.5	RCM – Advice for pregnant women
57.5	Cystic Fibrosis Trust – The impact of coronavirus on your CF care
59.0	Kidney Care UK – Coronavirus (COVID-19) guidance for patients with kidney disease
60.0	GOV.UK Guidance – Staying alert and safe (social distancing)
60.0	GOV.UK Guidance – Coronavirus (COVID-19): getting tested
61.0	Diabetes UK – Coronavirus – what we're doing
62.5	RCOG – Coronavirus infection and pregnancy
64.0	GOV.UK – Coronavirus action plan: a guide to what you can expect across the UK
64.5	RCN – COVID-19 (coronavirus) FAQs

RCN: Royal College of Nursing; RCM: Royal College of Midwives; RCPCH: Royal College of Paediatrics and Child Health; RCOG: Royal College of Obstetricians and Gynaecologists; BDA: British Dietetic Association; MND: Motor Neurone Disease; CRUK: Cancer Research UK.

The NHS information source on 'coronavirus in children' featured near the top of the league table meaning it was one of the more readable information sources; however, another of the NHS sources of information, 'How to treat coronavirus symptoms at home' can be found further down the league table suggesting it is less understandable based on readability indices.

Several COVID-19 information sources came from Royal colleges such as the Royal College of Midwives. A particularly notable source from the Royal College of Midwives (RCM) provided advice aimed at pregnant women, which was ranked 56.5 out of 64.5 in the league table.

Many of the sources of COVID-19 information came from charity websites relating to chronic conditions, i.e. diabetes; notably, many of which were hyperlinked from the NHS website. The readability of information from charities varied greatly. Even within charity, information varied greatly. For example, Diabetes UK 'Staying at home and managing

diabetes' was ranked 12th in the table, whilst Diabetes UK 'coronavirus and blood sugar levels' was ranked 56th suggesting that different sections of advice from the same information source are more readable than others.

Discussion

To our knowledge, this is the first study to assess the readability of online information related to COVID-19 in the UK.

Based on our findings, a significant amount of information available on the Internet about COVID-19 will not be easily readable for many individuals attempting to use the Internet to help inform decisions about their health and behaviour. Our results demonstrate that, despite the recommendation that information be presented to the public at a sixth-grade reading level (age 11–12; McKenzie, Neiger, and Thackeray 2016) most of the websites we assessed addressing COVID-19 information and advice presented content that was greater than this recommended reading level based on the readability indices utilised. These findings are consistent with previous findings that suggest reading materials on the internet may be difficult for many individuals to interpret (Kher, Johnson, and Griffith 2017). Similar international research has recently been published and considered the readability of online health information relating to COVID-19 (Szmuda et al. 2020). They found that none of the articles assessed as part of their study met the recommended fifth- to sixth-grade reading level (of an 11–12-year-old).

Our results, however, provide additional novel findings in a UK context; readability of online health information relating to COVID-19 varies not only between but within individual websites, i.e. the GOV.UK and the Diabetes UK websites, making it potentially more difficult for the general public to know which website, and indeed which pages within a website, to navigate to according to their own reading ability or level. Individuals with a chronic condition, or a particular subgroup of the population, for example pregnant women, might visit websites for specific information tailored to their condition or circumstances, which subsequently features information that we calculated as less easily readable than other, general websites.

A further novel finding in this research is that even in a pandemic when the importance of online information be communicated clearly to the population so that their actions can help save their own lives and the lives of others through reducing the risk of transmission and infection, the information available is not easily understood, thus having implications for future behavior which could risk lives.

Considering conclusions from the cancer literature discussed earlier, our findings suggest too that most websites addressing COVID-19 information and advice presented content at higher than the recommended reading level (Sha et al. 2020; Fefer et al. 2020).

However, whilst readability is one crucial metric to consider, it does not guarantee understanding. Even once information is understood, efforts are needed to follow advice and take necessary precautions. Additional research is needed to improve understanding about methods of communicating with the public in ways that increase the likelihood of understanding information that will subsequently increase adherence to advice.

Theoretical implications

Over the past several decades, the internet has played an increasing role in providing the general population with health information, transforming the way in which information is shared and accessed. 92% of UK adults were recent internet users in 2020, up from 91% in 2019 (ONS 2021). Further, it is reported that more than 20% of internet users aged 16 and over sought health-related information online at least weekly in the UK in 2020 (Johnson 2020). Therefore, it is important that research focuses on the topic of eHealth (Eng 2001). Particularly relevant here is the importance of eHealth literacy, the ability to seek out, find and evaluate health information online and then appraise and utilize the information to solve a health query or problem (Norman and Skinner 2006). As research suggests that a significant amount of the general population has difficulty understanding and using health information, then assessing the readability of COVID-19 related health information is just the beginning; future research should consider addressing health literacy, particularly eHealth literacy adequately as the internet inevitably becomes a more reliant source of COVID-19 information. As with survivors of cancer or any other significant health condition or disease, a significant proportion of these individuals endorse ongoing health information needs (Playdon et al. 2016). Among cancer survivors, unmet information needs exist and access to high-quality and relevant health information is associated with improved psychosocial outcomes and overall health-related quality of life (Kent et al. 2012). Therefore, as we move through the COVID-19 pandemic, those living with Post-COVID conditions or 'long Covid' (a wide range of new, returning, or ongoing health problems experienced for four or more weeks after being infected with COVID-19), may also come to rely on new and up-to-date health information to manage their changing health. It is vital that the public have access to reliable, readable health information that avoids harmful, poor-quality information, and/or that which exceeds recommended composite reading levels at the very least, meaning there is a need for interventions to improve eHealth literacy.

Limitations

Readability, does not assess the quality of information that has been produced. Quality can be seen as subjective and therefore vary between viewers of health information. Whilst not the purpose of the current study, future research might consider assessing the quality of health information using various indices such as the relevance, accuracy and the format the information is provided in or using the DISCERN instrument (Charnock et al. 1999).

The study is limited by the impossibility of assessing all search results of all possible search phrases. These sources were examined as part of a survey of information that was intended and freely available to the public from verifiable and credible sources. Whilst we cannot guarantee that all patients with certain health conditions will view health information from the relevant leading charities, these sources were selected as the best options to assess and because they were the main sources hyperlinked from the NHS website. We acknowledge that they might not be accessed by a significant group of the population, but they provided

information that was seen as coming from a credible, freely available source. Additionally, given the fast-moving pace of information available about COVID-19, we acknowledge that information and advice to the public can and has changed over time. However, the purpose of the study was to assess information that the public has access to and guidance that they were advised to follow at that time. Therefore, this study is limited by the constraints of all cross-sectional work because the material available on the internet is constantly changing to reflect current guidance, and the results of our study will only reflect what information was present at a particular point in time.

Practice implications

Our findings have implications for the success of behavioural interventions laid out by UK Government such as rules on mask wearing and previous guidance on shielding. If information is written beyond an individual's reading ability level, then an individual might not understand and follow guidance and advice, having a detrimental impact on the spread of COVID-19 and worryingly, subsequent deaths from COVID-19. Therefore, those providing online health information relating to COVID-19 such as healthcare professionals or Government should routinely check the readability of information before making it available to the general public.

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No potential conflict of interest was reported by the author(s).

Data availability statement

These data were derived from the following resources available in the public domain: <https://readable.com>

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