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Nutrition and Food Science

Assessment of quality of information available over the internet about vegan diet

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Assessment of quality of Information available over the Internet about Vegan diet

Abstract

Purpose- To assess the quality of health information available to patients seeking online advice about the Vegan diet.

Design/methodology/approach- A cross-sectional sample of patient-oriented websites was selected by searching for "Vegan diet" in the 3 most popular search engines. The first 50 websites from each search were examined. Quality of information was assessed using the DISCERN instrument, a questionnaire tool designed to judge the quality of written information on treatment choices. Readability was determined with the Flesch Reading Ease score (FRES) and Flesch-Kincaid Grade Level (FKGL). Relevance to health and disease was assessed by counting the appearances of 10 related keywords, generated by searching the query term "Vegan diet" into PubMed and recording the top 10 health-related words.

Findings- Of 150 websites retrieved, 67 (44.7%) met inclusion criteria. Of these, 42 (62.7%) were non-pharmaceutical commercial, 7 (10.4%) institutional, 6 (9.0%) magazines or newspapers, 4 (6.0%) support websites, 4 (6.0%) charitable websites, 2 (3.0%) encyclopedias, and 2 (3.0%) personal blogs. The overall DISCERN rating of the websites was fair (mean 41.6±15.4 on an 80-point scale), but nearly half (31/67) of the websites were assessed as having 'poor' or 'very poor' quality of information. FRES and FKGL readability indices met the recommended standards on average (means 63.3±9.6 and 6.6±1.7, respectively), but did not correlate with high DISCERN ratings. Analysis of variance on DISCERN scores ($F(6,60)=6.536$, $P<0.001$) and FRES ($F(6,60)=2.733$, $p=0.021$) yielded significant variation according to website source type.

Originality/value- Quality standards of health information available on the Internet about the Vegan diet vary greatly. Patients are at risk of exposure to low quality and potentially misleading information over the Internet and should be consulting dietitians or physicians to avoid being misled.

Keywords Vegan diet, Internet, Social media, Quality of information, e-health, Health promotion.

Paper type Research paper

Introduction

The Internet is now a fundamental part of patients' lives. Rapid growth in Internet usage has been paralleled with a growth in consumers seeking health information (Powell and Clarke, 2002). Over 70,000 websites provided health-related information in 2000 (Fleming, 2003) and over 12.5 million health-related Internet searches were conducted globally each day in 2003 (Eysenbach, 2003). Diet and nutrition queries make up 44% of all health-related searches, making it the third most popular subcategory of health (Le and Sabaté, 2014).

The Vegan diet is a plant-based diet that excludes meat, fish, dairy and eggs. The term "Vegan" was coined in 1944 by Donald Watson but, preceding the invention of home-Internet, information access was limited to readers of his "Vegan News" newsletter. Popularity has quadrupled in the past 4 years, with 600,000 Vegans in Great Britain in 2018 (UK Vegan Society, n.d.). Along with environmental and ethical benefits, Veganism is recognized for its health-advantages. The Vegan diet may be protective against diabetes (Tonstad et al., 2013), rheumatoid arthritis (Peltonen et al., 1997) and cardiovascular disease (Jenkins et al., 2014), and may prove useful in treating certain cancers, obesity, hypertension, and total mortality (Le and Sabaté, 2014).

Patients are increasingly using the Internet to gain knowledge about the Vegan diet. Whilst many websites are of high quality, many might provide unregulated, biased or inaccurate information. To protect patients from being misled, it is important that they have access to reliable information. Previous studies have looked into the poor quality of nutrition information on the Internet (Le and Sabaté, 2014), but we could not identify studies specific to the quality of online information available to patients researching the Vegan diet. To address this gap, we performed a cross-sectional survey of English language websites on the Vegan diet and employed validated and established tools (Banasiak and Meadows-Oliver, 2017; Charnock et al., 1999; Daraz et al., 2011; Grewal and Alagaratnam, 2013; Hirasawa et

al., 2012; van der Marel et al., 2009) to assess the quality, readability and relevance of health information provided on these websites.

Methods

Website selection and data collection

In July 2018, we entered the keyword "Vegan diet" into the three most popular search engines: Google.com, Bing.com and Yahoo.com. The first fifty results from each search engine were taken for initial examination, as research shows 90% of users click on a result within the first three pages of search results (Edmunds et al., 2013). Duplicate websites were excluded and the remaining URLs were reviewed for relevance. Further exclusions occurred for URLs and websites that were non-evaluable for the purposes of this study, such as weblinks to videos, invalid addresses, restricted-access sites, open chat rooms or forums, or pages with no relevance to the Vegan diet. Retrieved websites were divided into the seven following categories: non-pharmaceutical commercial, institutional, online magazine or newspaper, online encyclopedia, personal blog, charitable, and support. Two of the investigators completed data extraction within 2 weeks and website evaluation within 6 weeks of the study start-date. Each website was independently examined. Extracted data and ratings were compared and discrepancies between the investigators were resolved by consensus.

Assessment of website quality

The DISCERN instrument was utilized to investigate the quality of the selected websites. DISCERN is a reliable and validated tool for assessing the quality of written and online consumer health information for treatment choices (Charnock et al., 1999; Charnock and Shepperd, 2004). The tool is based on 16 questions addressing quality criteria, such as

clarity, documentation of sources, lack of bias, and description of risks and benefits of treatment options (see **Table 1**). Each question is rated from 1 to 5 (1 for 'no', 2-4 for varying degrees of 'partially', and 5 for 'yes') yielding an overall DISCERN score ranging from 16 to 80. Overall numeric scores were categorized as excellent (63-80), good (51-62), fair (39-50), poor (27-38), and very poor (16-26).

Assessment of website readability

Readability was determined using the Flesch Reading Ease Score (FRES) and the Flesch-Kincaid Grade Level scale (WedFX, n.d.). FRES is calculated as 206.835 – 1.015 x (words/sentences) – 84.6 x (syllables/words) and can range from 0 to 100. A high FRES score indicates that material is easier to understand, whereas a lower score indicates that text is more difficult to read. A text scoring between 60 and 70 is considered 'plain English' and 'easily understood by 13- to 15- year-olds' (Jindal and MacDermid, 2017). The Flesch-Kincaid Grade Level is calculated as 0.39 x (words/sentences) + 11.8 x (syllables/words) – 15.59 and the produced index corresponds with the grade level of the educational system in the USA (Jindal and MacDermid, 2017). For example, Flesch-Kincaid Grade Level of 7 indicates that a seventh-grader should easily understand the text. To calculate the readability scores, we pasted URL of each website into the online software provided Webpage FX (WedFX, n.d.). In accordance to the recommendations by the Institute of Medicine and others (Edmunds et al., 2013; Institute of Medicine, 2009), typical readability standards considered in this study were 65 or higher for FRES and 6-8 or below for Flesch-Kincaid Grade Level.

Relevance of websites to health and disease

To assess whether websites linked the Vegan diet to health and disease, the frequency of appearance of 10 related keywords was recorded. A list of 10 relevant keywords was generated for this purpose by searching the query term "Vegan diet" into PubMed in July

2018. The 10 words extracted were 'gut', 'oral', 'nutrition', 'weight', 'cardiovascular', 'blood lipid', 'diabetes', 'hypothyroidism', 'arthritis' and 'anxiety'. Frequency of appearance of each keyword was recorded for each website page.

Statistical analysis

Numerical data were summarized using mean values, standard deviations (SD) and ranges. Categorical data were presented using counts and percentages. One-way analysis of variance was used to examine the statistical significance of an overall difference in mean DISCERN scores, FRES scores and Flesch-Kincaid grade levels across website source categories. Post-hoc significance tests were conducted to evaluate pairwise mean differences among website categories using the Tukey-Kramer method to control for Type I error across tests. The correlation between quality and readability scores was determined using Pearson's correlation coefficient. $P<0.05$ was considered as statistically significant.

Results

Of the 150 websites retrieved, 67 (44.7%) met the inclusion criteria (**Figure 1**). Of these, 42 (62.7%) were non-pharmaceutical commercial, 7 (10.4%) institutional, 6 (9.0%) online magazines or newspapers, 4 (6.0%) support websites, 4 (6.0%) charitable websites, 2 (3.0%) online encyclopedias, and 2 (3.0%) personal blogs.

Quality

Mean DISCERN quality ratings varied by question across the 67 websites (**Table 1**). Five questions had an average rating exceeding 3 on the 5-point scale, but no question achieved a mean score of 4 or more. The seven quality criteria that were least well addressed across the websites (rated below 2.5 on the 5-point scale) concerned the following: describing what

would happen if there were no treatment, showing clearly when information used was produced, having clear sources of information, supporting shared decision-making, describing how treatment choices affect the quality of life, describing risks of each treatment, and describing how each treatment works.

The overall quality rating of the 67 websites was fair (mean 41.6±15.4 on an 80-point scale); ratings ranged from 17 to 80 (poor to excellent). Nine (13.4%) websites rated as excellent, 6 (9.0%) good, 21 (31.3%) fair, 22 (32.8%) poor, and 9 (13.4%) websites as very poor (15-26).

Quality of information was also analyzed by website source category. On average, personal blogs rated as "very poor" (mean DISCERN score, 26.0). Online magazines or newspapers (mean 28.3) and charitable sites (mean 36.0) rated as "poor" (mean scores 28.3 and 36.0, respectively). Non-pharmaceutical commercial sites and support sites rated as "fair" (mean scores 39.7 and 47.3, respectively). Institutional sites rated as "good" (mean 60.71) and online encyclopedias rated as "excellent" (mean 70.5) on the DISCERN scale. Analysis of variance on these scores yielded significant variation among website categories ($F(6,60)=6.536$, $P<0.001$). Post hoc Tukey tests showed that mean DISCERN scores for online encyclopedias and institutional websites had no statistically significant difference between them, but were both significantly higher than mean DISCERN scores achieved in all other website categories (**Table 2**).

Readability

Readability assessments are shown in **Table 3**. Websites scored, on average, close to the recommended readability standards. The mean FRES was 63.3±9.6 (range 37.1 – 96.4) and the mean Flesch-Kincaid Grade Level was 6.6±1.7 (range 1.1 - 11.3). However, 38 of the 67 websites (56.7%) failed to meet the recommended FRES of 65 or higher, while 9 websites (13.4%) had a grade reading level exceeding 8.

Analysis of variance indicated significant variability of FRES across website source categories ($F(6,60)=2.733$, $p=0.021$). The highest FRES scores were observed for online magazines or newspapers and non-pharmaceutical commercial websites (mean 67.2 and 65.6, respectively), of which 5 (83.3%) and 19 (45.2%) sites achieved the recommended typical standard for FRES, respectively. By contrast, online encyclopedias and support websites were the most difficult to read (mean FRES 46.9 and 57.0, respectively); none of the latter achieved the recommended FRES of 65 or higher. Less variability was observed in Flesch-Kincaid Grade Levels across the different website categories ($F(6, 60)=1.922$, $p=0.092$). Online encyclopedias and personal blogs exceeded the 8th grade level (mean levels 9.3 and 8.6, respectively), while all other types of websites presented mean grade levels between 6-8 (**Table 3**).

As expected, the FRES and Flesch-Kincaid Grade Level scores presented a strong negative correlation ($r= - 0.87$, $p<0.001$). However, readability ratings did not appear to be strongly related to quality ratings. DISCERN scores presented non-significant correlation with Flesch-Kincaid Grade Levels and weak negative correlation with FRES ($r= -0.25$, $p=0.045$).

Relevance

Assessed websites contained, on average, 2.6 (range 1-7) relevant keywords. The cumulative frequencies of appearance for each keyword across all websites were: blood lipid (*n*=2), anxiety (*n*=3), hypothyroidism (*n*=3), oral (*n*=9), arthritis (*n*=22), gut (*n*=39), cardiovascular (*n*=52), diabetes (*n*=152), weight (*n*=347), nutrition (*n*=385). The highest keyword counts were noted in online encyclopedias and institutional websites (mean 5.0 and 3.0 keywords, respectively), while charity websites had the lowest keyword count (mean 1.0 keyword). Six websites contained none of the keywords, of which three were in the non-pharmaceutical category, two were charitable and one was institutional. Analysis of variance on keyword

counts did not indicate a statistically significant variation in mean keyword frequencies across the different website categories.

Discussion

This study shows that quality standards of health information on the Internet about the Vegan diet vary greatly. Using the DISCERN tool, our overall quality assessment of 67 patient-oriented websites on the Vegan diet, which appeared as first 'hits' in three popular search engines, was 'fair'. However, nearly half (31/67) of these websites were assessed as having 'poor' or 'very poor' quality of information. Patients seeking advice about the Vegan diet are therefore at a substantial risk of exposure to low quality and potentially misleading information over the Internet.

Websites were most deficient in describing what would happen if no treatment was used, that is, the consequences from not following the Vegan diet. This may be a result of website bias and preference to discuss potential outcomes if the Vegan diet *is* followed, or simply because such consequences are likely hard to predict. Literature states similar flaws in treatment information (Ma et al., 2017; Maloney et al., 2005).

Our results reveal significant variation in quality of information according to the type of website, suggesting that the organization providing health-information may have considerable influence on the quality of that information. Institutional websites and online encyclopedias scored highest on the DISCERN scale, whereas personal blogs and online magazines or newspapers were consistently of poorer quality ratings in this study. The distribution of website types appearing as first hits in popular search engines was unfavorable in this regard; only 10% of the websites were institutional and 3% online encyclopedias. Thus, consumers are less likely to access high quality sites simply because they are over shadowed in numbers by sites of poorer quality.

No significant correlation was found between the DISCERN quality ratings and both the FRES and Flesch-Kincaid Grade Level readability indices. This means that good-quality websites are not necessarily well readable and vice-versa. High-quality websites that are difficult to read may pose no problem for highly educated patients, but may be especially problematic for semiliterate patients. Such disparities between quality and readability of health information have been previously reported in literature (Grohol et al., 2014; Ma et al., 2017; Priyanka et al., 2018).

The frequency of appearance of relevant keywords is indicative to the nature of websites and the interests of the public. “Weight” and “nutrition” appeared most frequently, with cumulative counts of 347 and 385 across all websites, respectively. Despite research suggesting that the Vegan diet confers protection against diseases such as obesity, hypertension and cardiovascular disease (Fraser et al., 2014; Jaceldo-Siegl et al., 2019; Le and Sabaté, 2014; Matsumoto et al., 2019; Orlich et al., 2013), “blood lipid” appeared only twice throughout the 67 websites. It must be noted that our search was limited to the query term “Vegan diet”. Patients wanting to access more specific information on the Vegan diet’s link to health and disease are likely to use a more extensive search-query.

Social media sites are increasingly becoming popular platforms on which to consume and exchange health information (Thackeray et al., 2013). The rise in Veganism may be attributed to this, with networks such as Instagram and YouTube being accessible and appealing methods of reaching audience. In 2013, Thackeray et al found that 30-40% of study participants used social-networking sites to consume health information (Thackeray et al., 2013). We therefore should no longer single-out Internet search-engines when investigating patients’ online health-seeking behavior. Further research is needed to assess the quality of Vegan diet information across social media platforms.

Limitations of our study should be considered. First, our assessment of sites was not exhaustive. While a search-engine query pulls up millions of results, we selected only the

first 50 sites for assessment in the hope to replicate the true experience of an Internet user. Next, our study has temporal limitations due to the rapidly changing nature of Internet information – our results are likely to become outdated and no longer truly valid in the near future. Finally, we only assessed English-language websites. Other language websites may provide information of varying standards.

In summary, this examination of top results in popular search engines revealed significant variation in the quality of health information that is readily available to consumers seeking online advice about the Vegan diet. Moreover, high-quality websites are not necessarily easily readable and might provide material that is mostly unclear or difficult for the patients to understand. Patients should be cautious about searching the Internet for health information related to the Vegan diet and should consult dietitians or physicians to avoid being misled.

References

Banasiak NC and Meadows-Oliver M (2017) Evaluating asthma websites using the Brief DISCERN instrument. *Journal of asthma and allergy* 10: 191–196. DOI: 10.2147/JAA.S133536.

Charnock D and Shepperd S (2004) Learning to DISCERN online: applying an appraisal tool to health websites in a workshop setting. *Health education research* 19(4): 440–6. DOI: 10.1093/her/cyg046.

Charnock D, Shepperd S, Needham G, et al. (1999) DISCERN: an instrument for judging the quality of written consumer health information on treatment choices. *Journal of epidemiology and community health* 53(2): 105–11. Available at: http://www.ncbi.nlm.nih.gov/pubmed/10396471 (accessed 1 February 2019).

Daraz L, Macdermid JC, Wilkins S, et al. (2011) The quality of websites addressing fibromyalgia: an assessment of quality and readability using standardised tools. *BMJ*

open 1(1): e000152. DOI: 10.1136/bmjopen-2011-000152.

Edmunds MR, Barry RJ and Denniston AK (2013) Readability assessment of online ophthalmic patient information. *JAMA ophthalmology* 131(12): 1610–6. DOI: 10.1001/jamaophthalmol.2013.5521.

Eysenbach G (2003) The Impact of the Internet on Cancer Outcomes. *CA: A Cancer Journal for Clinicians* 53(6): 356–371. DOI: 10.3322/canjclin.53.6.356.

Fleming J (2003) Health information on the Internet. *The journal of the Royal Society for the Promotion of Health* 123(1). Sage PublicationsSage CA: Thousand Oaks, CA: 10–1. DOI: 10.1177/146642400312300109.

Fraser, G., Katuli, S., Anousheh, R., Knutsen, S., Herring, P. and Fan, J. (2014). Vegetarian diets and cardiovascular risk factors in black members of the Adventist Health Study-2. *Public Health Nutrition*, 18(03), pp.537-545.

Grewal P and Alagaratnam S (2013) The quality and readability of colorectal cancer information on the internet. *International journal of surgery (London, England)* 11(5): 410–3. DOI: 10.1016/j.ijsu.2013.03.006.

Grohol JM, Slimowicz J and Granda R (2014) The quality of mental health information commonly searched for on the Internet. *Cyberpsychology, behavior and social networking* 17(4): 216–21. DOI: 10.1089/cyber.2013.0258.

Hirasawa R, Saito K, Yachi Y, et al. (2012) Quality of Internet information related to the Mediterranean diet. *Public health nutrition* 15(5): 885–93. DOI: 10.1017/S1368980011002345.

Institute of Medicine (2009) *Health Literacy, EHealth, and Communication*. Washington, D.C.: National Academies Press. DOI: 10.17226/12474.

Jaceldo-Siegl, K., Estevez, D., Fraser, G., Hayes-Bautista, D., Flores, H., Jordan, M. and Singh, P. (2019). Plant-Based Diets in Hispanic/Latino Adult Adventists in the United States

and Their Association With Body Mass Index. *American Journal of Health Promotion*, p.089011711982828.

Jenkins DJA, Wong JMW, Kendall CWC, et al. (2014) Effect of a 6-month vegan low-carbohydrate ('Eco-Atkins') diet on cardiovascular risk factors and body weight in hyperlipidaemic adults: a randomised controlled trial. *BMJ open* 4(2): e003505. DOI: 10.1136/bmjopen-2013-003505.

Jindal P and MacDermid JC (2017) Assessing reading levels of health information: uses and limitations of flesch formula. *Education for health (Abingdon, England)* 30(1): 84–88. DOI: 10.4103/1357-6283.210517.

Le LT and Sabaté J (2014) Beyond meatless, the health effects of vegan diets: findings from the Adventist cohorts. *Nutrients* 6(6): 2131–47. DOI: 10.3390/nu6062131.

Ma Y, Yang AC, Duan Y, et al. (2017) Quality and readability of online information resources on insomnia. *Frontiers of medicine* 11(3): 423–431. DOI: 10.1007/s11684-017-0524-9.

Maloney S, Ilic D and Green S (2005) Accessibility, nature and quality of health information on the Internet: a survey on osteoarthritis. *Rheumatology (Oxford, England)* 44(3): 382–5. DOI: 10.1093/rheumatology/keh498.

Matsumoto, S., Beeson, W., Shavlik, D., Siapco, G., Jaceldo-Siegl, K., Fraser, G. and Knutsen, S. (2019). Association between vegetarian diets and cardiovascular risk factors in non-Hispanic white participants of the Adventist Health Study-2. *Journal of Nutritional Science*, 8.

Orlich, M., Singh, P., Sabaté, J., Jaceldo-Siegl, K., Fan, J., Knutsen, S., Beeson, W. and Fraser, G. (2013). Vegetarian Dietary Patterns and Mortality in Adventist Health Study 2. *JAMA Internal Medicine*, 173(13), p.1230.

Peltonen R, Nenonen M, Helve T, et al. (1997) Faecal microbial flora and disease activity in rheumatoid arthritis during a vegan diet. *British journal of rheumatology* 36(1): 64–8.

Available at: http://www.ncbi.nlm.nih.gov/pubmed/9117178 (accessed 5 February 2019).

Powell J and Clarke A (2002) The WWW of the World Wide Web: Who, What, and Why? *Journal of medical Internet research* 4(1). JMIR Publications Inc.: e4. DOI: 10.2196/jmir.4.1.e4.

Priyanka P, Hadi YB and Reynolds GJ (2018) Analysis of the Patient Information Quality and Readability on Esophagogastroduodenoscopy (EGD) on the Internet. *Canadian journal of gastroenterology & hepatology* 2018: 2849390. DOI: 10.1155/2018/2849390.

Thackeray R, Crookston BT and West JH (2013) Correlates of health-related social media use among adults. *Journal of medical Internet research* 15(1): e21. DOI: 10.2196/jmir.2297.

Tonstad S, Stewart K, Oda K, et al. (2013) Vegetarian diets and incidence of diabetes in the Adventist Health Study-2. *Nutrition, metabolism, and cardiovascular diseases : NMCD* 23(4): 292–9. DOI: 10.1016/j.numecd.2011.07.004.

UK Vegan Society (n.d.) Vegan Society Today. Available at: http://vegansociety.today/ (accessed 1 February 2019).

van der Marel S, Duijvestein M, Hardwick JC, et al. (2009) Quality of web-based information on inflammatory bowel diseases. *Inflammatory bowel diseases* 15(12): 1891–6. DOI: 10.1002/ibd.20976.

WedFX (n.d.) Readable | Free Readability Test Tool. Available at: https://www.webfx.com/tools/read-able/ (accessed 1 February 2019).

Table 1. Mean quality ratings across the 67 included websites using the DISCERN instrument*

DISCERN question	DISCERN rating	
	Mean ± SD	Range
1. Are the aims clear?	3.2 ± 1.3	1 - 5
2. Does it achieve its aims?	3.1 ± 1.2	1 - 5
3. Is it relevant?	3.4 ± 1.0	1 - 5
4. Is it clear what other sources of information were used to compile the publication (other than the author or producer)?	2.0 ± 1.4	1 - 5
5. Is it clear when the information used or reported in the publication was produced?	1.8 ± 1.2	1 - 5
6. Is it balanced and unbiased?	3.1 ± 1.5	1 - 5
7. Does it provide details of additional sources of support and information?	3.1 ± 1.4	1 - 5
8. Does it refer to areas of uncertainty?	2.8 ± 1.5	1 - 5
9. Does it describe how each treatment works?	2.4 ± 1.4	1 - 5
10. Does it describe the benefits of each treatment?	2.5 ± 1.4	1 - 5
11. Does it describe the risks of each treatment?	2.3 ± 1.4	1 - 5
12. Does it describe what would happen if no treatment is used?	1.7 ± 1.0	1 - 5
13. Does it describe how the treatment choices affect overall quality of life?	2.2 ± 1.2	1 - 5
14. Is it clear that there may be more than one possible treatment choice?	2.9 ± 1.2	1 - 5
15. Does it provide support for shared decision-making?	2.2 ± 1.3	1 - 5
16. Overall quality of the publication as a source of information about treatment choices	2.9 ± 1.2	1 - 5

Five questions had an average rating exceeding 3 on the 5-point scale, but no question achieved a mean score of 4 or more. Lower scoring questions were those describing what would happen if there were no treatment, showing clearly when information used was produced, having clear sources of information, supporting shared decision-making,

describing how treatment choices affect the quality of life, describing risks of each treatment, and describing how each treatment works.

Notes. SD: standard deviation

* Each question is rated on a 5-point scale, 1 for 'no', 2-4 for 'partially', and 5 for 'yes'.

Table 2. Variation of the overall DISCERN rating score by website source category

Website category	No. of websites	DISCERN score*		P-value for pairwise comparison§						
		Mean ± SD	Range	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Online encyclopaedia (1)	2	70.5 ± 0.7	70 - 71	-	0.958+	0.344	0.020	0.036	0.002	0.013
Institutional (2)	7	60.7 ± 14.3	44 – 80	-	-	0.611	0.002	0.039	0.000	0.017
Support (3)	4	47.3 ± 7.8	41 – 57	-	-	-	0.910	0.864	0.245	0.453
Non-pharmaceutical commercial (4)	42	39.7 ± 13.1	19 – 75	-	-	-	-	0.998	0.378	0.738
Charity (5)	4	36.0 ± 12.4	21 – 51	-	-	-	-	-	0.963	0.968
Online magazine or newspaper (6)	6	28.3 ± 9. 0	19 – 39	-	-	-	-	-	-	1.000
Personal blog (7)	2	26.0 ± 12.7	17 – 35	-	-	-	-	-	-	-
Overall	67	41.6 ± 15.4	17 - 80							

The overall quality rating of the 67 websites was fair (mean 41.6±15.4 on an 80-point scale); ratings ranged from 17 to 80 (poor to excellent). Nine (13.4%) websites rated as excellent, 6 (9.0%) good, 21 (31.3%) fair, 22 (32.8%) poor, and 9 (13.4%) websites as very poor (15-26). Quality of information was also analyzed by website source category. On average, personal blogs rated as “very poor” (mean DISCERN score, 26.0). Online magazines or newspapers (mean 28.3) and charitable sites (mean 36.0) rated as “poor” (mean scores 28.3 and 36.0, respectively). Non pharmaceutical commercial sites and support sites rated as “fair” (mean scores 39.7 and 47.3, respectively). Institutional sites rated as “good” (mean 60.71) and online encyclopedias rated as “excellent” (mean 70.5) on the DISCERN scale. Analysis of variance on these scores yielded significant variation among website categories ($F(6,60)=6.536$, $P<0.001$).

Post hoc Tukey tests showed that mean DISCERN scores for online encyclopedias and institutional websites had no statistically significant difference between them (p=0.958), but were both significantly higher than mean DISCERN scores achieved in all other website categories

Notes. SD: standard deviation

* Total score of 16 questions (scale of 1 to 5, higher being better). Total range is 16-80.

§ Post hoc test was performed using the Tukey-Kramer method.

+ Post hoc test was performed using the Tukey-Kramer method, with no significant difference between mean DISCERN scores for online encyclopedias and institutional websites (p=0.958).

Table 3. Readability ratings using the Flesch Reading Ease and Flesch-Kincaid Grade Level scales and frequency of appearance of pre-defined keywords across the 67 included websites

Website source category	No. of websites	Flesch Reading Ease Score*			Flesch-Kincaid Grade Level§			Keyword Count[b]	
		Mean±SD	Range	No. (%) STD[a]	Mean±SD	Range	No. (%) STD[a]	Mean±SD	Range
Online encyclopaedia	2	46.9 ± 4.6	44 - 50	0 (0.0)	9.3 ± 2.3	8 - 11	1 (50.0)	5.0 ± 1.4	4 - 6
Institutional	7	57.9 ± 10.3	37 - 67	3 (42.9)	6.7 ± 1.3	6 - 9	6 (85.7)	3.0 ± 2.3	0 - 7
Support	4	57.0 ± 3.7	52 - 61	0 (0.0)	7.5 ± 1.2	6 - 9	2 (50.0)	2.3 ± 1.0	1 - 3
Non-pharmaceutical commercial	42	65.6 ± 9.5	47 - 96	19 (45.2)	6.2 ± 1.7	1 - 9	38 (90.5)	2.7 ± 1.5	0 - 6
Charity	4	58.9 ± 6.8	54 - 69	1 (25.0)	6.5 ± 1.0	5 - 8	4 (100.0)	1.0 ± 1.2	0 - 2
Online magazine or newspaper	6	67.2 ± 3.1	63 - 72	5 (83.3)	6.5 ± 1.0	5 - 8	6 (100.0)	2.3 ± 1.2	1 - 4
Personal blog	2	60.9 ± 14.3	51 - 71	1 (50.0)	8.6 ± 3.9	6 - 11	1 (50.0)	2.5 ± 2.1	1 - 4
Overall	67	63.3 ± 9.6	37 - 96	29 (43.3)	6.6 ± 1.7	1 - 11	58 (86.6)	2.6 ± 1.6	0 - 7

Websites scored, on average, close to the recommended readability standards. The mean FRES was 63.3±9.6 (range 37.1 – 96.4) and the mean Flesch-Kincaid Grade Level was 6.6±1.7 (range 1.1 - 11.3). However, 38 of the 67 websites (56.7%) failed to meet the recommended FRES of 65 or higher, while 9 websites (13.4%) had a grade reading level exceeding 8.

Notes. SD: standard deviation; STD: standard;

* Total Flesch Reading Ease range is 0-100, with a higher score indicating that material is easier to understand. Typical readability standards considered in this study were 65 or higher.

§ Flesch-Kincaid Grade Level rating corresponds with USA grade level. Typical readability standards considered in this study were 6-8 or below.

[a] Number and percentage of websites achieving typical standards for readability (score of 65 or higher for the Flesch Reading Ease and 6-8 or below for the Flesch-Kincaid Grade Level).

[b] Frequency of appearance of ten pre-defined keywords (gut, oral, nutrition, weight, cardiovascular, blood lipid, diabetes, hypothyroidism, arthritis, and anxiety).

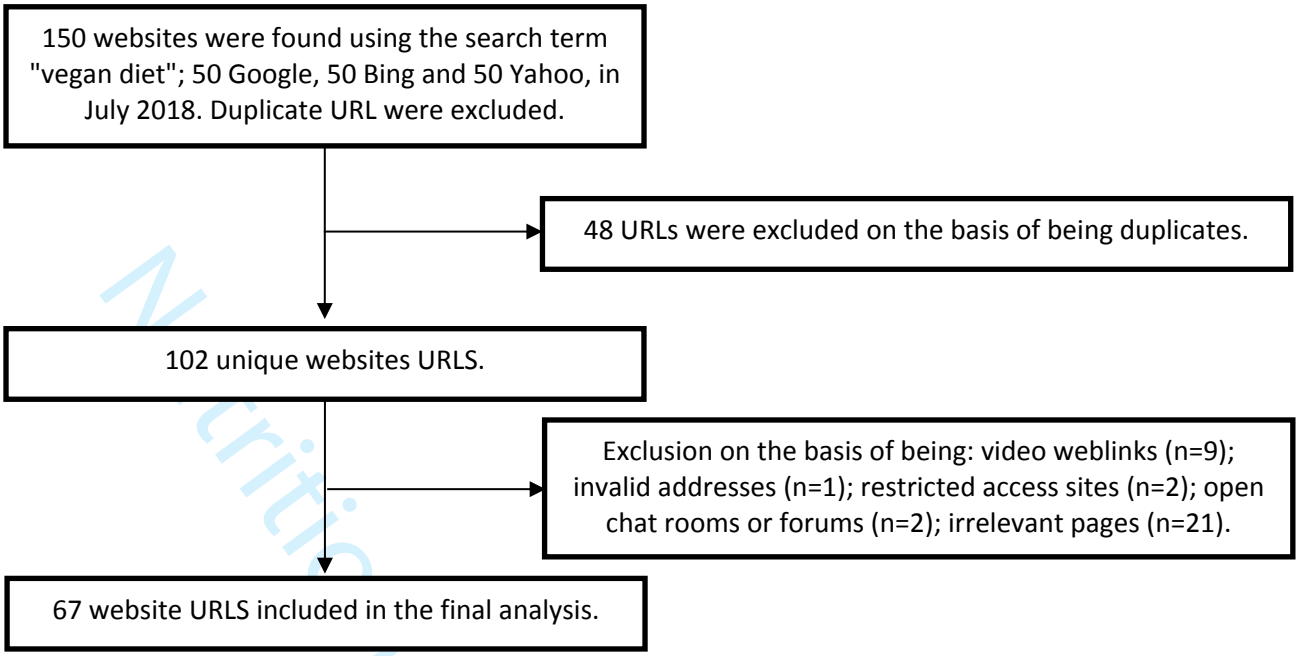

Figure 1. Flow diagram of the search strategy to select websites in the study. In taking the first 50 results from each of the three search engines, a total of 150 websites were included in the initial assessment. Of this 150, 48 (32%) were excluded on the basis of being duplicates URLs, leaving 102 unique website URLs for evaluation. A further 35 (34%) websites were excluded according to criteria listed in the Methods section, leaving 67 website URLs for the final analysis. Of these, 42 (62.7%) were non-pharmaceutical commercial, 7 (10.4%) institutional, 6 (9.0%) online magazines or newspapers, 4 (6.0%) support websites, 4 (6.0%) charitable websites, 2 (3.0%) online encyclopedias, and 2 (3.0%) personal blogs.