The Trustworthiness, Readability, and Suitability of Web-based Information for Stroke Prevention and Self-Management

Abstract

**Background:** The websites are common resources of health-information to stroke survivors and caregivers to obtain information and resources for continual management of stroke and the long-term sequels. Korean Americans (KAs) are frequent users of the web-based health information related to stroke management. The high stroke risk factors and mortality in KAs and lack of insurance, thus limited access to long-term care explains KAs' reliance on the web-based information. Quality of information on the websites is often questioned.

**Objective:** This study aimed to provide a systematic evaluation of stroke-related websites regarding (1) trustworthiness (2) readability, and (3) the suitability for stroke prevention and self-management in KAs.

**Methods:** The search terms 'stroke,' 'CVA,' '중풍 [jungpung],' and '뇌졸증 [noejoljung]' were used to find stroke-related websites on Google and Yahoo. A total of 156 websites appeared on the 1st and 2nd pages. After eliminating duplicates and irrelevant websites (n=116), a total of 42 websites (15 in English and 27 in Korean) were evaluated using the National Library of Medicine’s health websites evaluation tool for trustworthiness; SMOG for readability; and Suitability Assessment of Materials (SAM) for suitability. All three instruments used the 3-point Likert scale: superior (=2), adequate (=1), or not suitable (=0).

**Results:** Overall, 26 (61.9%) websites received a rating of “adequate” or above for trustworthiness; however, in currency/timeline, the information on 47.6% hasn’t been updated more than a year. In terms of authority, 33% failed to provide the publisher and contact information. Regarding accuracy, 50% of the websites didn’t cite sources of health information. The overall readability was not suitable; only two (4.8%) websites were rated 5th grade or lower reading level. In the suitability evaluation, only one website was rated as “superior,” 25 (59.5%) websites were “adequate,” and 16 (38.1%) websites were “not suitable.” Among the suitability subcategory criteria, many websites were limited in graphical directions, interactive motivations for desired healthy behaviors, and multiple-language translations.

**Conclusion:** The existing stroke-related websites in either English or Korean are trustworthy and suitable, yet precise citation of evidence-based information will improve trustworthiness. The high reading level of the information may set a barrier to utilization of web-based health information to KAs with a lower level of education. With the consideration of culturally relevant information in multiple languages, graphical examples, multimedia, and interaction features are the areas for improvement in suitability. The improved features can reduce the reading burden of stroke patients/caregivers and build more confidence or self-efficacy when applying the information for condition management and rehabilitation in daily living. These strategies are especially crucial to KAs, who inevitably seek web-based information to fill the gap between their demand and access to healthcare for a long-term self-management after a stroke.

**Keywords:** Stroke, Website Evaluation, Trustworthiness, Readability, Suitability
**Introduction**

With advancements in the Internet services and communication technologies, both release and seeking of health information through the web have been exponentially growing. In the U.S., 89% of adults use the Internet, and among them, 72% lookup online for health information [1, 2]. By using smartphones, the access to health information became ubiquitous. Recent surveys reported that 77% of U.S. adults own a smartphone, and among them, 62% have used their phone to get information about a health condition [3, 4].

Use of web-based health information is common among KAs [5-8]. KAs are about 1.8 million and the fifth largest Asian American population in the U.S. [9]. One possible reason for KA’s using websites as an important resource for health information may be the limited access to health care professionals due to lack of health insurance [10]. KAs record one of the lowest rates of health insurance coverage among all racial and ethnic groups living in the U.S. [11-13]. The limited English proficiency (LEP), which is in predominantly first-generation (75.5%) and monolingual immigrants (37%), have also contributed to limited health care access among KAs [14, 15]. Limited health care access increases KAs’ sense of self-responsibility and may lead individuals to be more active in seeking health information through available sources, such as web-based information [10].

Universally, individuals with chronic or stigmatized diseases such as stroke are more likely to search for health information on the Internet than those without the health conditions do [16-19]. Stroke is the foremost cause of serious long-term disability with high health care cost [20] and puts an increasing economic burden on health care resources [21]. The varying degrees of long-standing disability, as a result of stroke, let patients and their caregivers live with daunting long-term management. With this burden, stroke survivors and caregivers often use websites as resources of information that they need [22].

Stroke is the third-leading cause of death among KAs [23]. The proportionate mortality ratios of stroke, especially hemorrhagic stroke, were higher in KA women (2.07) and men (1.89), compared to non-Hispanic white women (1.06) and men (0.94) [24]. Elderly KAs have a higher prevalence of stroke risk factors such as hypertension, dyslipidemia, etc. than Caucasians and lacks knowledge about stroke [25]. Thus, prevention and appropriate long-term management of stroke and the sequels with quality information is critical in KAs.

Obtaining web-based health information can be beneficial for or harmful to people. The explosion and proliferation of health information available online is on the promise that these online resources can confirm or broaden patients/families’ understanding of diseases and treatment opinions that influence health-care decisions, and empower them to effectively self-manage health conditions [26, 27]. However, the quality of the web-based health information, generally in trustworthiness, readability, and suitability aspects, is often questioned. Online health information seekers could be at risk of finding unreliable or inappropriate information from the websites. Incorrect or inappropriate health information can be used in an improper way and cause detrimental outcomes by negatively influence healthcare-related decisions [28, 29]. As patients have a wide range of health information literacy, some patients are unable to assess critically or might misinterpret health
Considering the high demand of web-based health information in native and/or English language among KAs, who have LEP, it is critical for the websites to be trustworthy with up-to-date, reliable and accurate information, readable and suitable for this specific population. Thus, it is important to examine trustworthiness, readability, and suitability of health information in native and English language on websites. The study finding will facilitate devising strategies to better design and implementation of stroke-related websites.

Research Question
The purpose of this study was to address the following question: Is the web-based stroke information adequate for KAs to read, understand, and engage in stroke care? Specifically, the study aimed to evaluate stroke-related websites in terms of (1) trustworthiness, (2) readability, and (3) suitability for stroke prevention and self-management in KAs.

Methods
Selection of the websites for stroke
Initially, we considered a question that how KAs would seek stroke information on the Internet. One of the common behaviors of KAs performed was bilingual searches in their health information seeking as a technique for coping with LEP [30]. In general, people selected health websites within only the first one or two pages of searching results (10 results per page) when searching the Internet; about half of the Internet users entered a single query [30, 31]. In van Deursen and van Dijk’s [31] study, nobody used advanced search features (e.g., Boolean operators like AND, OR, and NOT). Google and Yahoo have been the most popular search engines for Koreans and Americans [2, 30].

Based on a review of these studies about online health information seeking behaviors of KAs, we searched stroke-related websites in Google and Yahoo searching engines, using the following terms: ‘Stroke,’ ‘CVA,’ ‘중풍[jungpung],’ and ‘뇌졸증[noejoljung].’ The term, ‘Stroke’ is healthcare consumer’s preferred term listed in the Consumer Health Vocabulary Initiative [32]. The term, ‘CVA’ is another representative term for a stroke. ‘중풍,’ and ‘뇌졸증’ are most commonly used Korean terms to indicate ‘stroke.’ We retrieved a total of 156 stroke-related websites appeared on the 1st and 2nd pages only after searching. With the use of ‘Stroke’ and ‘CVA’ terms, Google produced 45 sites while Yahoo produced 35 sites. Searching with the use of ‘중풍,’ and ‘뇌졸증’ terms resulted in 36 sites from Google and 40 sites from Yahoo. After duplicates and irrelevant sites (n=116) were eliminated, a total of 42 websites (15 in English and 27 in Korean), including the ones of the non-for-profit organization, clinics, magazines, and blogs, were selected.

Evaluation Tools
Trustworthiness
Each website was initially evaluated for its trustworthiness, using three criteria for health websites evaluation endorsed by the National Library of Medicine (NLM) [33]: 1) Currency/Timeliness (When was the page last updated?), 2) Authority (Who published the
page?), and 3) Accuracy (Are the sources cited reliable?). Each criterion was rated on a 3-point Likert scale, where 0 = not suitable, 1 = adequate, and 2 = superior. The descriptions for each point are presented in Table 1. Thus, the possible total score per site range from 0 to 6, with higher scores indicating better trustworthiness.

**Readability**
The readability of the information on the selected websites was evaluated using the Simple Measure of Gobbledygook (SMOG) Readability Test and the Reading Grade level of the Suitability Assessment of Materials (SAM) instrument. The SMOG has been the preferred measure of readability when evaluating consumer-oriented healthcare materials in many studies. We used the English version of the measure for evaluating the websites published in English [34] and the Korean version [35] for the websites in Korean. The formula asks to count off ten consecutive sentences at the beginning, middle, and end of website pages (30 total sentences). Second, it asks counting the number of words with three or more syllables in the 30-sentence sample. Then, with the total number of polysyllabic words counted, the grade level was determined using the SMOG Conversion table. The grade levels were converted to the SAM's 3-point scale, where 0 = not suitable (9th-grade level and above), 1 = adequate (6th-, 7th-, or 8th-grade level), and 2 = superior (5th-grade level or lower).

**Suitability**
Each website was evaluated by the Suitability Assessment of Materials (SAM) instrument [36]. The SAM consists of 22 items grouped under six factors, namely 1) Content, 2) Literacy Demands, 3) Graphics, 4) Layout and Typography, 5) Learning Stimulation and Motivation, and 6) Cultural Appropriateness. We added one item to the list, which was ‘multiple language translations’ under the factor of Cultural Appropriateness. Each of the 23 items was rated on an ordinal scale, where 0 = not suitable, 1 = adequate, and 2 = superior. Raw scores were summed to yield an overall score. This overall score was then converted to a percentage of the possible total score (46 = 23 items X 2 maximum score per item) for each website, with 70%–100% being a superior website, 40%–69% adequate, and 0%–39% not suitable website. This process was also completed to examine which criterion has been suitably met across the websites.

**Evaluation and Analyses**
Three raters evaluated the websites independently at the first round, and the ratings were collected. At the second round, three raters reviewed the websites together. The frequencies and intraclass correlation coefficients (ICC) per the evaluation criteria were obtained using SPSS 24. The final inter-rater agreement levels among the three evaluation criteria were NLM (ICC = .969-.987), SMOG (ICC = .810), and SAM (ICC = .626-.994).

**Results**

**General Characteristics**
Out of the 42 appraised websites, 15 stroke websites were in English, and 27 websites were in Korean. 12 websites were ones of the not-for-profit organization; seven were blogs of stroke; five were published by clinics or hospitals; five were Wikipedia; four were medical magazine sites; three were general magazine sites; two were postings on broadcasting websites, one was on a pharmacological company website; one was from an insurance
company website; one was on a general online forum site, and one was a medical information website.

**Trustworthiness**
26 (61.9%) websites received a rating of 3.0 or above, which presents ‘adequate’ level. In currency/timeline, the majority of the selected websites (n = 33, 78.6%) indicated published date of the information on their websites, whereas 9 (21.4%) didn’t indicate a published date of the information. The updated dates of the information on 13 websites (31%) were less than one year; while 20 websites (47.6%) was older than one year. In terms of authority, 9 websites (21.4%) didn’t present the information of either publisher or contact information. Regarding accuracy, 14 websites (33.3%) posted health information based on medical research evidence along with citations, whereas half of the websites (n = 21) did not cite any source of information on their websites (Table 1).

### Table 1 Trustworthiness of Stroke Websites by the NLM Criteria

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>Frequency (%)</th>
<th>ICC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Currency/Timeliness:</strong> When was the page last updated?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Superior = 2</td>
<td>13 (31.0)</td>
<td>.969</td>
</tr>
<tr>
<td>The published date of the information is indicated and is less than a year (last year).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adequate = 1</td>
<td>20 (47.6)</td>
<td></td>
</tr>
<tr>
<td>There is a published date of the information on the page, but older than a year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not suitable = 0</td>
<td>9 (21.4)</td>
<td></td>
</tr>
<tr>
<td>no indication</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Authority: Who published the page?</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Superior = 2</td>
<td>28 (66.7)</td>
<td>.980</td>
</tr>
<tr>
<td>The information of publisher (individuals or organizations) and contact information can be easily found.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adequate = 1</td>
<td>5 (11.9)</td>
<td></td>
</tr>
<tr>
<td>The information of publisher (individuals or organizations) can be found. But there is no contact information.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not suitable = 0</td>
<td>9 (21.4)</td>
<td></td>
</tr>
<tr>
<td>no indication</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Accuracy: Are the sources cited reliable?</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Superior = 2</td>
<td>14 (33.3)</td>
<td>.987</td>
</tr>
<tr>
<td>The information is drawn based on sound medical research, and the information sources are noted.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adequate = 1</td>
<td>7 (16.7)</td>
<td></td>
</tr>
<tr>
<td>The information sources are noted.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not suitable = 0</td>
<td>21 (50.0)</td>
<td></td>
</tr>
<tr>
<td>no indication</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ICC= Intraclass Correlation Coefficients

### Readability
A total of 19 out of 42 websites were presented at the 9th-grade level or above. Only two websites (4.8%) were presented at the 5th grade or lower level (Table 2).

### Table 2 Reading Grade Level

<table>
<thead>
<tr>
<th>Reading Level</th>
<th>Frequency: N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 (&gt; 9th grade )</td>
<td>19 (45.2)</td>
</tr>
<tr>
<td>1 (6th – 8 grade)</td>
<td>21 (50.0)</td>
</tr>
<tr>
<td>2 (&lt; 5th grade)</td>
<td>2 (4.8)</td>
</tr>
<tr>
<td>Total</td>
<td>42 (100)</td>
</tr>
</tbody>
</table>
Suitability

Table 3 presents the frequencies per rating score, ICC of the three raters per the SAM criterion, and converted suitability percent score. The overall converted suitability percent score of all 42 websites was 55.7%, which represents “adequate” suitability. Out of 42 websites, only one website of American Stroke Association was rated as “superior,” 25 (59.5%) websites were “adequate,” and 16 (38.1%) websites were “not suitable.” The websites were superior in quality of layout and typography (85.3%). The websites were at adequate level regarding content (65.5%), literacy demand (68.6%), graphic illustration, lists, tables, and charts (42.4%), and learning stimulation and motivation (47.2%), even though there were some individual items with inadequate suitability. However, cultural appropriateness was not suitable (22%).

Under the Content category, the quality of purpose and scope was superior, with scores of 90.5% and 79.8%, respectively. Regarding the extent of the content topics, 11 (26.2%) websites aimed at desirable behavior rather than non-behavior facts. 25 (59.5%) websites showed less than 40% of the content topics focusing on desirable behaviors or actions. Six websites did not present such contents. Many of the appraised websites (n = 23, 54.8%) did not well present summaries or reviews to tell key messages.

Regarding the Literacy Demand, the selected websites were suitable in writing style (81.0%), sentence construction (77.4%), vocabulary use (72.6%), and organization using road signs (82.1%). However, the reading grade level was not suitable across websites (29.8%) as the detailed information is presented in Table 2.

The overall suitability of the Graphic Illustration, Lists, Tables, and Charts category was rated as “adequate” (42.4%). In this category, type of illustrations (48.8%), relevance of illustrations (51.2%), and captions (46.4%) were “adequate” at the lower levels, but cover graphic (36.9%), and graphics (28.6%) were “not suitable.” In more detail, 47.6% of the websites didn’t present cover graphic to attract attention and clearly portray the purpose of the websites. 59.5% of the websites presented graphics without explanation, and 23.8% showed too brief “how to” directions with graphics for readers; only seven (16.7%) websites provided step-by-step directions with an example that will build self-efficacy (confidence). The layouts and typography were superiorly presented in most appraised websites, with the converted suitability scores of 83.3% through 86.9%.

In terms of Learning Stimulation and Motivation category, the suitability of each criterion was rated as “adequate” even though the suitability percent scores were not high, ranging from 44.0% to 52.4%. In more details, 16 (38.1%) websites did not provide interaction learning or stimulation; 15 (35.7%) website used passive interactions with the Questions & Answer format. Regarding desired behavior patterns presentation, only 16 (38.1%) websites demonstrated instructions for specific behavior and skills by using specific, familiar instances with the rating of “superior.” 12 (28.6%) websites were rated as “adequate” as they provided the information in a mix of technical and common language that the reader may not easily link with daily living activities. In terms of Motivation, only 12 (28.6%) websites reached the “superior” level, which means complex topics are subdivided so that readers may experience small successes in understanding or problem
solving, leading to self-efficacy (confidence). 16 websites (38.1%) did not have features of motivation.

The cultural appropriateness across websites was “not suitable”; the converted suitability percent scores ranged from 14.3% to 33.3%. Regarding Cultural Match, most websites (n = 24, 57.1%) did not present the information in culturally similar to logic, language, and experience of the target population culture. The cultural image and examples were rarely shown in most websites (n = 29, 69%). 85.7% of the websites were presented in only one language and couldn’t be translated in other languages.

### Table 3 The Evaluation of the Stroke Websites based on SAM

<table>
<thead>
<tr>
<th>Categories</th>
<th>Criteria</th>
<th>Frequency: N (%)</th>
<th>ICC</th>
<th>Converted Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0 (0.0)</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Content</td>
<td>Purpose</td>
<td>8 (19.0)</td>
<td>34 (81.0)</td>
<td>.626</td>
</tr>
<tr>
<td></td>
<td>Scope</td>
<td>2 (4.8)</td>
<td>13 (31.0)</td>
<td>27 (64.3)</td>
</tr>
<tr>
<td></td>
<td>Content topics</td>
<td>6 (14.3)</td>
<td>25 (59.5)</td>
<td>11 (26.2)</td>
</tr>
<tr>
<td></td>
<td>Summary &amp; Review</td>
<td>23 (54.8)</td>
<td>8 (19.0)</td>
<td>11 (26.2)</td>
</tr>
<tr>
<td>Subtotal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Literacy Demand</td>
<td>Reading Grade Level</td>
<td>19 (45.2)</td>
<td>21 (50.0)</td>
<td>2 (4.8)</td>
</tr>
<tr>
<td></td>
<td>Writing Style</td>
<td>1 (2.4)</td>
<td>14 (33.3)</td>
<td>27 (64.3)</td>
</tr>
<tr>
<td></td>
<td>Sentence Construction</td>
<td>2 (4.8)</td>
<td>17 (40.5)</td>
<td>24 (57.1)</td>
</tr>
<tr>
<td></td>
<td>Vocabulary</td>
<td>2 (4.8)</td>
<td>19 (45.2)</td>
<td>21 (50.0)</td>
</tr>
<tr>
<td></td>
<td>Learning Enhancement by Advance Organizers</td>
<td>6 (14.3)</td>
<td>3 (7.1)</td>
<td>33 (78.6)</td>
</tr>
<tr>
<td>Subtotal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graphic Illustration, Lists, Tables, and Charts</td>
<td>Cover graphic</td>
<td>20 (47.6)</td>
<td>13 (31.0)</td>
<td>9 (21.4)</td>
</tr>
<tr>
<td></td>
<td>Type of Illustrations</td>
<td>14 (33.3)</td>
<td>15 (35.7)</td>
<td>13 (31.0)</td>
</tr>
<tr>
<td></td>
<td>Relevance of Illustrations</td>
<td>15 (35.7)</td>
<td>11 (26.2)</td>
<td>16 (38.1)</td>
</tr>
<tr>
<td></td>
<td>Graphical Direction: lists, tables, charts, &amp; forms</td>
<td>25 (59.5)</td>
<td>10 (23.8)</td>
<td>7 (16.7)</td>
</tr>
<tr>
<td></td>
<td>Captions are used to announce or explain graphics</td>
<td>14 (33.3)</td>
<td>17 (40.5)</td>
<td>11 (26.2)</td>
</tr>
<tr>
<td>Subtotal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Layout &amp; Typography</td>
<td>Typography</td>
<td>1 (2.4)</td>
<td>9 (21.4)</td>
<td>32 (76.2)</td>
</tr>
<tr>
<td></td>
<td>Layout</td>
<td>1 (2.4)</td>
<td>12 (28.6)</td>
<td>29 (69.0)</td>
</tr>
<tr>
<td></td>
<td>Subheadings and chunking</td>
<td>4 (9.5)</td>
<td>4 (9.5)</td>
<td>34 (81.0)</td>
</tr>
<tr>
<td>Subtotal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learning Stimulation &amp; Motivation</td>
<td>Interaction included in the text and/or graphics</td>
<td>16 (38.1)</td>
<td>15 (35.7)</td>
<td>11 (26.2)</td>
</tr>
<tr>
<td></td>
<td>Desired behavior patterns are modeled</td>
<td>14 (33.3)</td>
<td>12 (28.6)</td>
<td>16 (38.1)</td>
</tr>
<tr>
<td></td>
<td>Motivation</td>
<td>16 (38.1)</td>
<td>14 (33.3)</td>
<td>12 (28.6)</td>
</tr>
<tr>
<td>Subtotal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cultural Appropriateness</td>
<td>Cultural Match: Logic, Language, Experience</td>
<td>24 (57.1)</td>
<td>8 (19.0)</td>
<td>10 (23.8)</td>
</tr>
<tr>
<td></td>
<td>Cultural image and Examples</td>
<td>29 (69.0)</td>
<td>10 (23.8)</td>
<td>3 (7.1)</td>
</tr>
<tr>
<td></td>
<td>Multiple Languages Translation</td>
<td>36 (85.7)</td>
<td>0 (0.0)</td>
<td>6 (14.3)</td>
</tr>
<tr>
<td>Subtotal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
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</tbody>
</table>
Discussion

Our study is the first to provide a systematic evaluation of the stroke-related websites considering KAs. The findings of this study present valuable information about the trustworthiness, readability, and suitability of stroke-related English and Korean websites, which were trustworthy and suitable marginally, but not easily readable. Also, areas that need improvement were identified in each criterion. This information can be utilized by clinicians and researchers in improving or designing stroke websites as well as for people who seek stroke information in their self-assessment of the quality of the information on websites.

Trustworthiness

Patients and caregivers look up the website as they are easy to access, not expensive, and, in general, believed to be timely [30]. Patients are often unsure about which websites to trust and are concerned about accessing potentially misleading or illegitimate health information [37, 38]. The outdated, inaccurate, and unreliable web-based information can mislead the public for their understanding of the stroke and stroke management. In the limited chance of education on which website and its information is trustworthy, KAs consider merely repetition of specific information as a criterion for evaluating the trustworthiness of websites; if the same information appears in several locations on the Internet, KAs are likely to simply believe the information or the website is reliable [30]. The trustworthiness of the website information could be easily checked by the NLM’s [33] three criteria of health website evaluations. These evaluation criteria need to be educated to online health information seekers, including KAs.

In this study, although the majority of the selected websites indicated published date of the information on their websites, the information on 20 websites was older than one year. Nine websites did not indicate a published date of the information. Notably, half of the websites did not cite any source of information on their websites. Agarwal et al. [28] also found in their evaluation of educational resources in three stroke-related websites that users criticized the lack of citations and references for the material and facts provided on all three websites. It is important to present the valid and reliable primary information with the published date and the information sources for health consumers to do right decision-making for their health issues [16, 28]. It is recommended to scrutinize or peer-review before presenting the information on the website. Healthcare providers should be aware of, at least, these three criteria when providing health care information to patients and caregivers via papers or websites. Also, health care providers should provide opportunities to educate patients and caregivers how to check and whether to rely on health care information in any type of web information platform.

Readability

Reading level is an essential component of health literacy. Reading level is included as one of the Literacy Demand criteria in the SAM tool. Concerned about health literacy, the Joint Commission [39] has recommended patient education materials to be written at or below the 5th-grade level and has developed an action plan to promote patient literacy. In this
study, 19 out of 42 websites were written at the 9th-grade level or above, which is rated as “not suitable” and categorized as ‘difficult’ in the US readability categories [40]. Only two websites (5%) were written at 5th grade or lower level. This result is consistent with previous studies, which evaluated some stroke-related web pages: The mean readability level of stroke information was found to be 10th grade in Griffin, McKenna, & Worrall’s [41] evaluation of 30 stroke educational websites; these websites are different from the set of websites appraised in our study, except three overlapping websites. Sharma et al. [22] also found that over half of 100 stroke Web pages were produced at the 12th-grade level or above when readability was measured with SMOG. The high reading levels may be due to complex medical terminologies without explanations or translation in layperson’s terms.

The health information is only useful if the consumer can comprehend the information presented. The consequences of not understanding health information can negatively affect both a person’s health and their utilization of healthcare services. The use of consumer health vocabulary may help lowering reading grade level on both English and Korean stroke websites. In the U.S., the Open-Access, Collaborative Consumer Health Vocabulary provides 156,826 consumer-friendly health phrases and synonyms for professional clinical terms [32, 42]. In South Korea, there is research to develop a consumer vocabulary system for health information [43]. Also, the complex medical terms or sentences could be provided with additional understandable explanations so that readers become familiar with it and can use it appropriately [44]. The consideration of KAs’ LEP should be taken as well. LEP was identified as a critical source of health vulnerability; it impacted health perceptions, higher health risk, and negatively influenced healthcare utilization [45-47]. Those with LEP scored lower on all measures of health conditions than their English-proficient counterparts [46]. Considering LEP among KAs, terms and sentence structures of stroke care information on English websites should be used at an appropriate reading level.

Suitability
The overall suitability of all 42 websites was rated as “adequate” (55.7%); however, there are needs for improvements in many areas. Regarding the content, the majority of the websites explicitly showed the purpose of the website and the scope of the content on the websites was well focused on the purposes of the websites. However, they did not well present summaries or reviews to tell key messages. In order to make sure the delivery of important messages and assist the readers’ comprehension, it is necessary to retell key messages in different words or examples and provide summaries of them.

The overall suitability of graphic illustration was marginally adequate (42.4%). Half of the websites didn’t present cover graphic to attract attention, and clearly, portray the purpose of the websites. 59.5% of the websites presented graphics without explanation, and 23.8% showed too brief “how to” directions for readers. This finding is similar to the lack of graphics and other non-textual media covering patient education materials in Agarwal et al. [28]’s evaluation of educational resources in three stroke-related websites. Images and videos combined with the text can act as supplements to difficult topics covered on the site [28] and increase the ability of the user to understand and retain the material [48]. Since the medical information is relatively unfamiliar to laypersons, and the reading level is high, step-by-step directions with graphical examples can reduce reading burden of the stroke
patients and caregivers. The use of strategies to enhance readers’ understanding of the information on websites is especially important to KAs, who inevitably seek online information due to lack of insurance and LEP.

The Learning Stimulation and Motivation category also received the rating of “adequate” but not high (47.2%). No interaction learning or stimulation was provided on 16 (38.1%) websites. Regarding desired behavior patterns presentation, the criterion of the “superior” rating probed if websites demonstrated instructions for specific behavior and skills by using specific, familiar instances; more than half of websites failed to reach this level. Only 12 (28.6%) websites ranked “superior” in the motivation criterion. Mere access to web-based health information does not necessarily empower consumers and patients. Providing actionable health information with accuracy is the top vision in the National Action Plan to Improve Health Literacy published by US Department of Health and Human Services (USDHHS) [49]. Practical guidelines demonstrating specific behavior and skills applicable to daily living will motivate the reader to experience small success in understanding or problem solving, leading to self-efficacy. Multimedia and interactivity features can assist information users to build more confidence by tailoring to individual needs and progress of condition management and rehabilitation. The incorporation of self-assessments of risks or symptom changes and modeling of desirable health behaviors into the website will promote self-efficacy in learning. Miller & Leroy [42] suggested it would be ideal if a consumer would go to a website, answer a few questions, and in a few seconds, a document written specifically for their needs and appropriate to their reading skill would appear in their web browser. The features of dynamic discussions and communication will lead co-learning with each other [26, 50]. Chatting room and emailing services with healthcare providers on websites are other recommendable features to satisfy patients’ information needs.

85.7% of the websites were presented in only one language and couldn’t be translated in other languages. More than half of the websites in English or Korean didn’t present information matched to the Korean culture in texts, images, or examples. The cultural factors influence health information acquisition and access to social support for ethnic minorities [51]. Korean consumers relied heavily on Korean-specific health information, regardless of education levels [30]. KAs have a lower level of knowledge on stroke risk factors and symptoms compared to the level in the general U.S. population [52]. Websites are important sources and channels of health information to KAs. If websites provide more diverse and culturally appropriate information in both Korean and English, the health information can be delivered to a broader population of KAs. Then, it may contribute the increase in knowledge of stroke prevention and self-management in KAs.

Limitations
We evaluated the websites appeared on the 1st and 2nd pages only on Google and Yahoo browsers. Thus, the result cannot be generalizable to reflect the features of the entire stroke-related websites. However, these websites can be the most popular or important ones because studies have found that 73-95% of web users never viewed past the first search engine results page (SERP) and emphasized the value of the first SERP [53-56]. It may also indicate the increasing ability of Web search engines to retrieve relevant web-
based information more effectively [53]. The websites evaluated in this study were stroke specific, which may limit the application of this study results to websites of other specific health conditions.

Conclusions
The quality of health information for patients with stroke is vital to ensure the good recovery and improve quality of life. Easily obtainable, user-friendly, accurate, and reliable online resources could help people make appropriate decisions about how best to maintain or improve their health condition.

This study found that the existing stroke-related websites in either English or Korean are trustworthy and suitable. However, it was notable that the accuracy of information on the websites was low due to lack of citations and reference. Providing accurate, reliable, high-quality and evidence-based information is a critical responsibility of health professionals. Also, the study findings signified the need for diverse features to reduce the high reading level of the information on the websites. Graphical examples, multimedia, and interactive features can reduce reading burden of the stroke patients and caregivers as well as build more confidence or self-efficacy when applying the information for condition management and rehabilitation in daily living. Rather than posting the information in a non-specific way, practical guidelines demonstrating specific behavior and skills applicable to daily living will motivate the reader to experience small success in stroke self-management, leading to self-efficacy.

These strategies to enhance readers’ understanding of the web-based information are especially important to KAs, who inevitably seek online information due to lack of familiarity with the US health care system, inadequate health insurance coverage, and language barriers. Culturally sensitive and relevant to KAs as well as high-quality health information through websites may have great potential to increase knowledge of stroke self-management and make significant contributions to promoting the health of KA stroke survivors.

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Conflicts of Interest
None declared.

Abbreviations
KAs: Korean Americans
NLM: National Library of Medicine
CVA: Cardiovascular accident
SMOG: Simple Measure of Gobbledygook
SAM: Suitability Assessment of Materials
ICC: intraclass correlation coefficients
USDHHS: United States Department of Health and Human Services
LEP: limited English proficiency
SERP: search engine results page
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