Readability following cultural and linguistic adaptations of an Internet-based Intervention for Tinnitus for use in the United States

Eldré W. Beukes,[1,2] Marc Fagelson,[3,4] Elizabeth Parks Aronson[5] Maria F. Munoz,[1] Gerhard Andersson[6,7] & Vinaya Manchaiah[1,8,9]

1. Department of Speech and Hearing Sciences, Lamar University, Beaumont, Texas, USA
2. Department of Vision and Hearing Sciences, Anglia Ruskin University, Beaumont, Texas, USA
3. Department of Audiology and Speech-Language Pathology, East Tennessee State University, Johnson City, Tennessee, USA
4. Audiological Rehabilitation Laboratory, Auditory Vestibular Research Enhancement Award Program, Veterans Affairs Medical Center, Mountain Home, Tennessee, USA
5. Department of Psychology, Lamar University, Beaumont, Texas, USA
6. Department of Behavioral Sciences and Learning, Linköping University, Linköping, Sweden
7. Department of Clinical Neuroscience, Division of Psychiatry, Karolinska Institute, Stockholm, Sweden
8. Department of Speech and Hearing, School of Allied Health Sciences, Manipal University, Manipal, Karnataka, India
9. Audiology India, Mysore, Karnataka, India

Address for Correspondence

Eldré Beukes, PhD

Department of Speech and Hearing Sciences,

P.O. Box: 10076, Lamar University,

Beaumont, Texas 77710, USA

E-Mail: ebeukes@lamar.edu

Tel: +1 (409) 880 8977

Fax: +1 (409) 880 2265

Abstract

Purpose:

An Internet-based tinnitus intervention for use in the United States could improve the provision of tinnitus-related services. Although such interventions have undergone clinical trials in Europe, the UK, and Australia, their suitability for adults with tinnitus in the US has not been established. The aim of this study was to improve the cultural and linguistic suitability, and lower the readability level, of an existing program for tinnitus to ensure its suitability for US English- and Spanish-speaking populations.

Method:

Guidelines for cultural adaptation were followed and involved four phases: (i) cultural adaptations, as interventions targeted at specific cultures have been shown to improve outcomes; (ii) creating Spanish materials to improve access of the materials to the large

Spanish-speaking population in the US; (iii) professional review of the materials for acceptability as an intervention tool for a US population; and (iv) literacy level adjustments to make the content accessible to those with lower levels of health literacy skills.

Results:

Cultural adaptations were made by using word substitutions, changing examples and modifying the spelling of certain words. The materials were then translated into Spanish and cross-checked. Professional review ensured suitability of the chapters. Literacy level adjustments ensured all chapters were within the guidelines for readability grade levels below the 6th-grade level.

Conclusions:

The previously developed tinnitus materials were revised to adhere to best practice guidelines and ensure cultural suitability for adults with tinnitus in the US. As it is also available in Spanish, members of the large Hispanic community also have access to the intervention in their first language. Further studies should determine whether these changes improve patients' self-efficacy, engagement, and motivation to complete the intervention.

Key Words

Internet intervention, Cultural adaptation, Linguistic adaptation, Readability, Translation, Tinnitus, Health literacy

Conflict of Interest

There are no relevant conflicts of interests.

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Abbreviations

CBT: Cognitive behavioral therapy

F-K RGL: Flesch-Kincaid Reading Grade Level

FRE: Flesch Reading Ease

ICBT: Internet-based cognitive behavioral therapy intervention

RGL: Reading Grade Level

RRE: Raygor Readability Estimate

SMOG: Simple Measure of Gobbledygook

WHO: World Health Organization

Introduction

In view of improving outcomes and promoting patient-centered care, engaging patients in their own health care has become a priority for health care providers (Carman, et al., 2013; Hibbard, Mahoney, Stock, & Tusler, 2007). Such engagement can increase a patient's awareness, knowledge, and confidence, thereby empowering individuals to manage their own health (European Health Literacy Consortium, 2012). Mobile technologies delivered via smartphones, apps and the Internet, have created opportunities for individuals to be directly involved in

monitoring, participating in, and directing their own health care needs (Riucciardi, Mostashari, Murphy, Daniel, & Siminerio, 2013). As medical advice and instructions can be reviewed, such technologies can aid in improving patient recall and compliance (Discoll, 2011). Although these technological advances have the potential to enable patient participation, other factors still hamper accessibility of the health care information provided. Of great importance, patients must be able to read and comprehend the information presented in written form. Health literacy skills are required to access, understand, appraise and apply health-related information to make decisions concerning health management (McGee, 2010; Sørensen, et al., 2012). Higher health literacy competencies were associated with improved health and well-being and shown to reduce health inequalities (D'Eath , Barry , & Sixsmith, 2012; Kickbusch, Pelikan, Apfel, & Tsouros, 2013). On the other hand, lower health literacy skills resulted in fewer preventative measures, unhealthier choices, poorer health, increased hospitalization and substantial drain on health system resources (Berkman, et al., 2011; Dewalt, Berkman, Sheridan, Lohr, & Pignone, 2004; Kickbusch, Pelikan, Apfel, & Tsouros, 2013; Parker, 2009). Moreover, the health literacy report by the World Health Organization (WHO) indicated that literacy competency was one of the strongest predictors of health status (Kickbusch, Pelikan, Apfel, & Tsouros, 2013).

Despite the importance of health literacy, the European Health Literacy Survey showed that nearly half the Europeans surveyed have inadequate health literacy competence (Sørensen, et al., 2015). The situation is similar in the US. Findings from the National Assessment of Adult Literacy indicate that the average American adult Reading Grade Level (RGL) is that of about seven years of education (Statistics, 2003), although an even lower RGL was previously suggested for total comprehension (Kirsch, Jungeblut, Jenkins, & Kolstad, 1993). These low

literacy skills pertained to more than half of the US adult population. The resulting estimated cost was more than US$ 8 billion and an estimated 3–5% of the total health care budget in Canada (Kickbusch, Pelikan, Apfel, & Tsouros, 2013). Those with limited health literacy competence are among the most vulnerable, due to lower social status, worse overall health, lower levels of education, older age and/or migrant status (Kickbusch, Pelikan, Apfel, & Tsouros, 2013). Limited health literacy is, however, not only a problem in vulnerable or minority populations. Health literacy competence depends on individual and system factors, as even highly educated individuals may find health care systems complicated, especially when influenced by the demands of a health condition. Capacity and competence related to health literacy vary according to context, culture and setting. Factors influencing these include communication skills, culture, knowledge and the specific characteristics of health care (Kickbusch, Pelikan, Apfel, & Tsouros, 2013). Research suggests that patient engagement levels also differ by race and ethnicity, with African-Americans and Hispanics demonstrating lower engagement levels when compared to Caucasians (Cunningham, Hibbard, & Gibbons, 2011; Hibbard, et al., 2008). Those with limited English proficiency may find accessing health care information particularly difficult due to language barriers, cultural differences and less health-related leaflets written in non-English languages (Schyve, 2007). Adapting health-related information to address cultural sensitivity has been shown to improve self-efficacy (Lee, Hwang, Hawkins, & Pingree, 2008). These adaptions have been successfully made by providers working with non-audiology related conditions such as HIV/AIDS (e.g. Dévieux, Malow, Rosenberg, & Dyer, 2004). The audiologic literature has to date not focused on such cultural adaptations.

Health information is often written in a manner that makes it inaccessible due to literacy demands that exceed the literacy skills of the majority of adults. Many peer-reviewed studies indicate that the readability level of many health materials across a wide range of content is high (Daraz, et al., 2018; Kim & Xie, 2017), including those related to hearing impairment (Laplante-Lévesque & Thorén, 2015) and tinnitus (Manchaiah, et al., 2018). Improving health literacy by minimizing literacy-related barriers is a priority in many countries (Rootman, 2012), and has been emphasized in the UK since the late 1970's (Brach, et al., 2012). The European Commission launched a Clear Writing campaign in 2010 to make all types of documents, in all languages, shorter and simpler (Plain Language Association International, 2013). The responsibility to remove literacy-related barriers should be a priority, and lies with everyone providing health-related information, including health professionals and media sources (Hudson, Rikard, & Staiculescu, 2018). This is particularly important as health literacy is a strong predictor of health status (Kickbusch, Pelikan, Apfel, & Tsouros, 2013); when the reading levels of health interventions are lowered, health inequalities are minimized (D'Eath , Barry , & Sixsmith, 2012; Kickbusch, Pelikan, Apfel, & Tsouros, 2013).

Various Internet interventions have been developed to increase patient access to care as well as activation and empowerment in relation to their health conditions. Such interventions aim to improve self-efficacy, defined as an individual's confidence in their ability to successfully undertake behaviors to achieve specific goals. Attention to literacy in Internet applications is particularly important due to the lower level of face-to-face patient interaction with the professionals responsible for gauging comprehension during the interventions' delivery. One such Internet-based intervention is a guided Internet-based cognitive behavioral therapy

intervention (ICBT) for tinnitus. This intervention was established to increase access to cognitive behavioral therapy (CBT), the approach that currently offers the strongest evidence of efficacy in reducing tinnitus distress (see Hesser, Weise, Westin, & Andersson, 2011 for a systematic review). Despite positive outcomes, there is limited accessibility to CBT for tinnitus, partly due to a shortage of suitably trained clinicians. ICBT intervention for tinnitus was originally developed for a Swedish population (Andersson, Strömgren, Ström, & Lyttkens, 2002). The program was then translated to English (Abbott, et al., 2009) and German (Jasper, et al., 2014) . The English version was later adapted into a more interactive version (Beukes, et al., 2016). An efficacy trial on a UK population indicated statistically and clinically significant reductions in tinnitus distress and comorbidities (i.e., insomnia, depression, hyperacusis, cognitive failures) and an increase in quality of life after undertaking the ICBT intervention (Beukes, Baguley, Allen, Manchaiah, & Andersson, 2018). These results were maintained at 1-year post-intervention (Beukes, Allen, Baguley, Manchaiah, & Andersson, 2018) and participants indicated that they were satisfied with the intervention (Beukes et al., 2018). An effectiveness trial followed indicating that the results were equivalent to that of face-to-face therapy (Beukes, Andersson, Allen, Manchaiah, & Baguley, 2018). A subsequent meta-analysis of tinnitus Internet-interventions undertaken in Europe indicated a medium overall effect size (Beukes, Manchaiah, Allen, Baguley, & Andersson, 2019). Due to the indicated effectiveness of this intervention, its use with wider populations was appropriate. The US population offered a logical opportunity, because ICBT was not previously used for tinnitus in the US. A large-scale epidemiological study showed that physicians rarely discussed CBT as a management option for patients with tinnitus (Bhatt, Lin, & Bhattacharya, 2016). Hence, the use of guided self-help programs such as ICBT may be an option worth considering. However, to improve their

effectiveness, the materials required adaptation prior to their use to address culturally sensitive items relevant to a US population (Barrera, Castro, Strycker, & Toobert, 2013). While the intervention was also adapted to be more interactive than in its previous iteration, there remained a need to improve accessibility, for example by adjusting the readability levels of the intervention.

Readability is the ease with which a person understands written materials (Davison, 1984). The use of readability formulae analyze characteristics of the words or sentences in a passage and quantify the reading difficulty of the materials (Doak, Doak, & Root, 1996; Gemoets, Rosemblat, Tse, & Logan, 2004). For most formulae, the estimate of readability is represented as a RGL, interpreted as the number of years of US education required to understand what is written (Ley & Florio, 1996). Guidelines from the US Health and Human Services and the American Medical Association recommend that health material are written in plain language at or below the 6th RGL (Doak, Doak, & Root, 1996; Weiss, 2003; Weiss & Coyne, 1997). Ensuring these readability recommendations are achieved would thus be an important aspect of ensuring the accessibility of the intervention.

The US government has prioritized promoting accessible culturally and linguistically adapted health care as part of the Healthy People initiative (U.S Department of Health and Human Services, 2010). Within the US, there is a large Spanish-speaking population, with Spanish being the largest non-English language spoken according to 2017 census data (US Census Bureau, 2017). It is spoken at home by an estimated 4.5 million (13.3%) residents and this number is projected to rise (Colby & Ortman, 2008). Disparities in the distribution of health care in the US

have been identified (Barrera, Castro, Strycker, & Toobert, 2013), largely attributable to race/ethnicity and socioeconomic status (Livingston, Minushkin, & Cohn, 2008). The disparity is a growing concern, considering projections of an increasing Hispanic population in the US and the impact the changing demographic will exert on current health care practices. Patient engagement among members of the Hispanic population has also been found to be lower in comparison to larger US majority populations (Cunningham, Hibbard, & Gibbons, 2011; Hibbard, et al., 2008). Ensuring that Spanish-speaking populations can comprehend and use health care information such as ICBT for tinnitus will rely upon careful and comprehensive adaptation of the materials to be delivered. Various meta-analyses establish health-behavior interventions that target specific cultural groups are more effective than interventions targeting, at once, a variety of cultures (Griner & Smith, 2006; Hall, Ibaraki, Huang, Marti, & Stice, 2016), and these findings include minimally guided interventions (Shehadeh, Heim, Chowdhary, Maercker, & Albanese, 2016). Culturally-sensitive, personalized interventions are essential to sustain patients' involvement in their treatment and encourage them to take an active role in their own health and health care. Interventions conducted in the participant's native language are twice as effective as those delivered only in English (Griner & Smith, 2006).

The aim of the present study was to ensure the cultural and linguistic suitability of the ICBT for tinnitus intervention for a US population, and by doing so, to overcome the barriers identified in accessing health care due to language and cultural differences. A further aim was to translate the intervention to ensure it was accessible in Spanish, for the large Spanish-speaking population. The final aim was to lower the readability level of the materials to ensure accessibility for the majority of US population. These objectives are consistent with the US government's health

promotion initiative to make health care linguistically and culturally accessible (U.S Department of Health and Human Services, 2010)

Method

Study Design

The study adapted the pre-existing CBT materials culturally and linguistically for a US population. As no human subject data was collected there was no requirement for this study to undergo institutional review board approval.

To address the study's aims, the central question for this study was: what elements of ICBT for tinnitus need to be adapted to enhance their fit and cultural relevance to ensure accessibility for the adult English- and Spanish-speaking US population? Although a few models exist, the guidelines by Bernal, Jimenez, & Domenech, (2009) and Falicov (2009) were most appropriate for the cultural adaptations of the existing ICBT materials. These models were incorporated into the following four adaptation phases:

- Phase 1: Cultural adaptations
- Phase 2: Creating Spanish materials
- Phase 3: Professional review
- Phase 4: Literacy level adjustments

Phase 1: Cultural Adaptations

The ICBT intervention content selected was the self-help program originally developed in Sweden (Andersson, Strömgren, Ström, & Lyttkens, 2002), translated to English for use in

Australia (Abbot et al., 2009), and eventually adapted into an 8-week interactive e-learning version for a UK population (Beukes, et al., 2016). This version was later refined (Beukes, Allen, Manchaiah, Baguley, & Andersson, 2017; Beukes, Manchaiah, Baguley, Allen, & Andersson, 2018) and consisted of 16 recommended modules and 5 optional modules, together with interactive content such as worksheets, quizzes, and videos. Before evaluating the outcomes of ICBT on a US tinnitus population, cultural adaptations of the materials were required. Cultural adaptation was defined as the systematic modification of an evidence-based intervention to consider language, culture, and contexts in a way that it becomes compatible with the patient's cultural patterns, meanings, and values (Bernal, Jiménez-Chafey, & Domenech Rodríguez, 2009). Because health is influenced by culture-linked behaviors, interventions need to be culturally tailored (Barrera, Castro, Strycker, & Toobert, 2013).

The existing ICBT modules required modification for a US population. This involved cultural adaptations of the materials to match them with the ethnic cultural and social contexts of this population by the research team (Bernal, Jimenez, & Domenech, 2009; Falicov, 2009). Adaptations included modifying the language and examples used to be compatible with the cultural expectations and meanings. In all instances, the materials were revised to remove any possible discriminatory concepts and were thus free from gender, age-related, race, religious, or belief and ethnic references. For example, videos were added to include expert opinions from both male and female speakers. When vocabulary or contexts differed substantially between distinct cultures, such examples were excluded where possible. There were, thus, no clear pictures of human beings from particular ethnic groups included. Examples of some of the cultural adaptations made are shown in Table 3. An additional chapter on mindfulness was

included to update the intervention to include further evidence-based materials (McKenna, Marks, Hallsworth, & Schaette, 2017; McKenna, Marks, & Vogt, 2018).

[Insert Table 1]

Phase 2: Creating Spanish Materials

Because there is a large Hispanic community in the US, the final versions of the English language materials were translated into Spanish. As the Mexican Spanish dialect is the most common dialect used, it was selected over the South American Spanish dialect. This translation served to make the materials accessible to a broad range of underserved cultures and minority ethnic groups. Translations were performed by a bilingual translator whose first language was Spanish. The decision was made to use only one translator to ensure consistency.

There were many challenges during the translation process. One was deciding whether to use the Spanish translation of the word tinnitus "acúfeno" or the English word. Following discussions, the word tinnitus was used in the Spanish version as this was more commonly used by Spanish speakers in the US. Further challenges included finding simpler words to use in place of medical terms and long words, as these words raised RGL scores. Many of the English words also required finding synonyms that were of acceptable complexity in Spanish. At times this entailed having to replace one word with multiple words, which then increased the sentence length. Thus, finding the right balance between simple language and sentence length that would reduce the readability score without changing a passage's meaning was challenging. When potential cultural differences between American English and American Spanish speakers were identified, the

materials were adjusted in both the English and Spanish versions to overcome these cultural differences.

The videos were recorded by English Speakers. A Spanish speaker voice dubbed the videos and Spanish subtitles were created. All other aspects of the intervention, including the worksheets, quizzes, and diagrams were also translated to Spanish.

For verification purposes, the translated chapters were reviewed by two additional Spanish speakers. One was a Spanish teacher who also had tinnitus, and one was an audiology student. Both had an accurate understanding of tinnitus and were thus suitable candidates to verify the Spanish chapters. No major discrepancies between the English and Spanish materials' content were identified, however, syntactical and grammatical errors were found. These errors mainly consisted of using incorrect word tense and incorrect conjugations. Word order was revised and if there was a shorter way of conveying the same information, that version was used. Translators agreed that all material should be kept uniform for example the formal translation of *you*, "usted" instead of informal "tú". This was also taken into consideration when revising conjugations (e.g. "escucha" instead of "escuchas").

Phase 3: Professional Review of the Materials

An advisory panel reviewed the chapters. The panel consisted of two US tinnitus audiologists and two US psychologists. These professionals identified any aspects of the content, images, or presentation that required cultural or linguistic tailoring to enhance their fit and cultural relevance for an English US population (Bernal, Jimenez, & Domenech, 2009). The aim of the

professional reviewers was to: (i) ensure accessibility of the materials culturally and linguistically; and (ii) check the accuracy of the information and ensure its quality and suitability. The suggestions were incorporated as a further step to adjust the materials to be culturally and linguistically suitable. Professionals subjectively indicated that they thought the intervention was comprehensive and easy to follow. Figures were added and worksheets were modified to make the CBT descriptions and assignments easier to follow. Professional reviewers employed aspects of clinical care for patients with tinnitus with which they were familiar in order to support module accessibility. For example, explaining the putative value of sound therapy benefitted from the professionals' experience of using the technique and related devices in routine clinical practice. Fostering realistic expectations for the patient navigating the ICBT platform would be important for acceptance of sound therapy and hearing aids. Clinical experience informed the professionals' descriptions and recommendations regarding effective use of sound as an element of tinnitus management.

Phase 4: Literacy Level Adjustments

The goal of this phase was to ensure that the readability levels were at or below the 6th RGL for all materials presented. Published guidelines on exactly how to improve readability levels were scarce; as a first step the materials were adapted to ensure plain language was used (see McGee, 2010) by following advice from a range of resources, as presented in Table 2.

[Insert Table 2]

The next step was to reduce the complexity of words and the sentence lengths used as illustrated in Table 3 using the following guide:

- Sentence length was reduced to no more than 22 words per sentence. Long sentences were broken down into two sentences.
- Word complexity was reduced to no more than 3 syllables per word.
- Word familiarity was considered by removing more complex words.
- When appropriate substitutes were available, word length was reduced to 6 characters or fewer.

[Insert Table 3]

Following literacy level adjustments, readability formulae were used as an objective assessment of reading ease of the chapters. RGL scores were calculated using Readability Studio (version 2012.1). Each readability formula uses a different approach to calculate the RGL as explained in Table 4. Various drawbacks exist regarding the use of readability formulae as very few are validated (Diwan & Kelly-Campbell, 2018) and no standard for selecting readability formulae exists. The approach taken was thus to select the three most common formulae generally recommended for health care literature: the Flesch-Kincaid Reading Grade Level (Kincaid, Fishburne, Rogers, & Chissom, 1975), The Fry (Fry, 1968) and Raygor Readability Estimate (Raygor, 1977). As foreign language readability formulae are scarce, those available on the Readability Studio software, namely The Crawford (Crawford, 1984), The Spanish Statistical Measurement of Gobbledygook [SMOG] (Contreras, Garcia-Alonso, Echenique, & Daye-Contreras , 1999) and the Gilliam, Peña, Mountain Fry Graph (Gilliam, Peña, & Mountain, 1980) were used. The average RGL scores from the three formulae were taken as the RGL of each

chapter as recommended by Beaunoyer, Arsenault, Lomanowska, & Guitton (2017). Where these scores were above the recommended 6th RGL (Doak, Doak, & Root, 1996; Weiss, 2003; Weiss & Coyne, 1997) further adjustments were made until the chapters were within the guidelines. Readability levels of the original English versions (i.e., Swedish version translated into English for use in Australia, and UK version) of the program and revised materials (i.e., US English and US Spanish versions) were then compared.

[Insert Table 4]

Data Analysis

Statistical analyses were performed using the Statistical Package for Social Sciences (SPSS) version 24.0. Descriptive statistics were used to calculate the mean and standard deviation of the RGL for each of the three English and three Spanish readability formulae for each of the 22 chapters. The mean and standard deviation of the RGL across the three readability formulae for the Swedish and UK versions were also calculated. The overall mean RGL scores (averaging the scores for chapters 1-22) for each English version (Swedish, UK, US) were then computed. The data were assessed for normality using the Shapiro-Wilk test. The results indicated that the readability data were not normally distributed.

Identifying differences between the versions of the ICBT materials

The Kruskal-Wallis Test was used as a non-parametric alternative to the one-way ANOVA to compare the readability scores (dependent variable) between the three English language versions

(Swedish, UK, and US - independent variable) of the ICBT program. Comparisons were made for each readability measure and for overall average scores. Comparisons were not possible between the Spanish and the English versions as different readability formulae were used. The average scores were, however, compared. When significant main effects were found they were followed up by Bonferroni-corrected Dunn's pairwise tests to identify which versions were significantly different from each other.

Results

The RGL score comparisons between the different language versions (Swedish English, UK English, US English and Spanish) for each chapter can be found in Table 5. Figure 1 summarizes the average readability scores for each language version, indicating that the revised US English and Spanish versions of the ICBT materials were within the recommended 6th RGL . The two previous versions did not meet these guidelines. There were significant differences between all the readability measures for the different versions of the ICBT materials as seen in Table 6. When comparing the overall averages, pairwise comparisons indicated significant differences between all the pairs of versions except for the US vs. Spanish versions and the UK vs. English Swedish version.

[Insert Table 5 and 6]

[Insert Figure 1]

Discussion

The aim of the present study was to ensure the cultural and linguistic suitability of the ICBT for tinnitus intervention for a US population, and by doing so, to overcome the barriers identified in accessing health care due to language and cultural differences. A further aim was to translate the intervention to ensure it was accessible in Spanish, for the large Spanish-speaking population. The final aim was to lower the readability level of the materials to ensure accessibility for the majority of US population. A four-phase approach was followed to improve the cultural and linguistic accessibility of the materials. Modifications were made to the intervention material to consider the language, cultural, and linguistic context of the US population. Adaptations included removing any references evaluated as discriminatory. The adaptions also addressed vocabulary or contexts that could be perceived very differently between cultures in order to ensure equal accessibility across those cultures. Ultimately, this practice will facilitate the content's use by additional novel populations. Due to differences between British and US spelling, numerous spelling changes were required such as "color" instead of "colour". Use of words that were unfamiliar or less commonly used in the US were replaced with more familiar words such as "store" instead of "shop." References to, or images of, items not commonly seen in the US were also removed.

Creating a Spanish version of ICBT for tinnitus was prioritized to ensure that the large Hispanic population in the US would have access to this tinnitus intervention. This process was not

without complications, especially regarding word choice. All the English videos had to be dubbed by a Spanish speaker and Spanish subtitles were added. All aspects of the intervention, including the worksheets and quizzes, required translation. Although unrelated to audiology, the existing literature indicated that interventions targeting ethnic minorities were more effective for those populations than those developed for majority populations, at least in terms of outcomes and improved self-knowledge (see systematic review related to Diabetic interventions by Hawthorne, Robles, Canning-John, & Edwards, 2010; Ricci-Cabello, et al., 2014; Zeh, Sandhu, Cannaby, & Sturt, 2012) and mental health interventions (Griner & Smith, 2006).

As health literacy is a strong predictor of health status (Kickbusch, Pelikan, Apfel, & Tsouros, 2013), the RGL of the intervention materials were lowered. The average RGL of the original Swedish and UK versions were found to be above the recommended 6th RGL at levels of 9.3 (SD: 1.0) and 8.8 (SD: 1.0) respectively. The text was simplified to shorten sentences, reduce the complexity and syllable length of the words, and increase word familiarity. These adjustments ensured that the RGL's were within best practice guidelines at 5.5 (SD: 0.5) for the English version and 5.9 (SD: 0.42) for the Spanish version. The SMOG readability scores for the Spanish version were higher in comparison to the other formulae. The SMOG scores are, however, based on strict criteria assuming 100% comprehension; they were criticized in the past for analyzing scores as one or two grade levels higher than expected (Hedman, 2008). Significant RGL differences were found between the US versions of the materials and the previous UK and Swedish versions as the readability was significantly lower for the modified versions. Although efforts have been made in re-writing some hearing aid use guides, diagnostic reports, and questionnaires in audiology to improve readability (Manchiah, Kelly-Campbell, Bellon-Harn, &

Beukes, Submitted), this is the first known study addressing improving readability of an Internet-delivered audiological intervention. This study is thus of value, due to it increasing intervention access to a Hispanic population and lowering the readability levels, which can increase health-related outcomes. Furthermore, improved for the Hispanic population as they can access the intervention in their first language. Further larger-scaled studies are required to assess whether these aims are achieved in practice.

Limitations

It is possible that all cultural differences between American English and American Spanish speakers were not identified. Further studies using these materials should prioritize finding ways of identifying remaining cultural differences.

Caution must be exercised when choosing and interpreting the readability formulae and also when generalizing these results to ease of reading and comprehension (U.S. Centers for Medicare and Medicaid Service, 2012). Readability formulae ignore many factors that contribute to comprehension, RGL may be imprecise, and revising the health education materials solely based on RGL has potential to reduce the materials' value (e.g., shortening the words and sentences just to reduce RGL may render materials inaccurate). Nevertheless, principles of plain language, readability and cultural sensitivity are a good starting point in improving the accessibility of health materials.

Due to the wide range of readability formulae in use, variation in results was expected to depend on the formula selected, and RGL results may have differed if alternative formulae were

selected. Variability was, however, minimized by focusing on the average of three readability formula scores, instead of individual formula results. Although this study adjusted the materials to be culturally and linguistically suitable, these adjustments could not account for prior knowledge, interest level and motivation to undertake the intervention. Many other factors will ultimately contribute to an individual's engagement in an intervention. Although readability was assessed, other aspects such as quality, suitability, understandability, and comprehension of health information were not considered in this study. For instance, tools not used in this study such as the Patient Education Materials Assessment Tool [PEMAT]; (Shoemaker, Wolf, & Brach, 2014) can be used to evaluate understandability.

Study Implications and Future Directions

In addition to readability assessments, end users need to assess whether the materials are understandable, as readability does not imply comprehension (Doak, Doak, & Root, 1996). Although the intervention was adapted, further efforts need to be directed at ensuring all means of patient interaction follow similar guidelines related to accessibility. This is particularly important for any recruitment materials online, given that at least 80% of American adults search the Internet to obtain information about health conditions (Fox, 2006). The modifications made aimed to make ICBT more accessible. Further studies are required to assess whether these changes relate to satisfaction with care and improvements in outcomes. It is likely that improved cultural and linguistic adaptations are not the only mediators of outcome. Other potential barriers to favourable outcomes need to be identified and addressed. These may include low motivation, poor compliance or limited intervention engagement. Further larger scale studies are underway to assess these factors and intervention outcomes. Firstly, a pilot study including both Spanish

and English speakers will be undertaken. A randomized controlled trial will follow to evaluate the efficacy of using ICBT on a population in the US including both English and Spanish speakers.

Conclusions

This paper has described a four-step process undertaken to adjust and ICBT intervention to be culturally and linguistically suitable for a US adult tinnitus population. The English intervention materials were also translated into Spanish to provide access of this ICBT intervention to the Hispanic community. Literacy levels were adjusted to be within the RGL guidelines of below the 6th-grade level, making it more accessible to those with lower literacy levels. Although the cultural and linguistic adjustments made are not the only determinants of an intervention's outcomes, the adjustments made supported the goal of improving ICBT accessibility to a wider population.

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Acronyms used in the figure: F-K RGL: Flesch-Kincaid Reading Grade Level;

SMOG: Spanish Statistical Measurement of Gobbledygook.

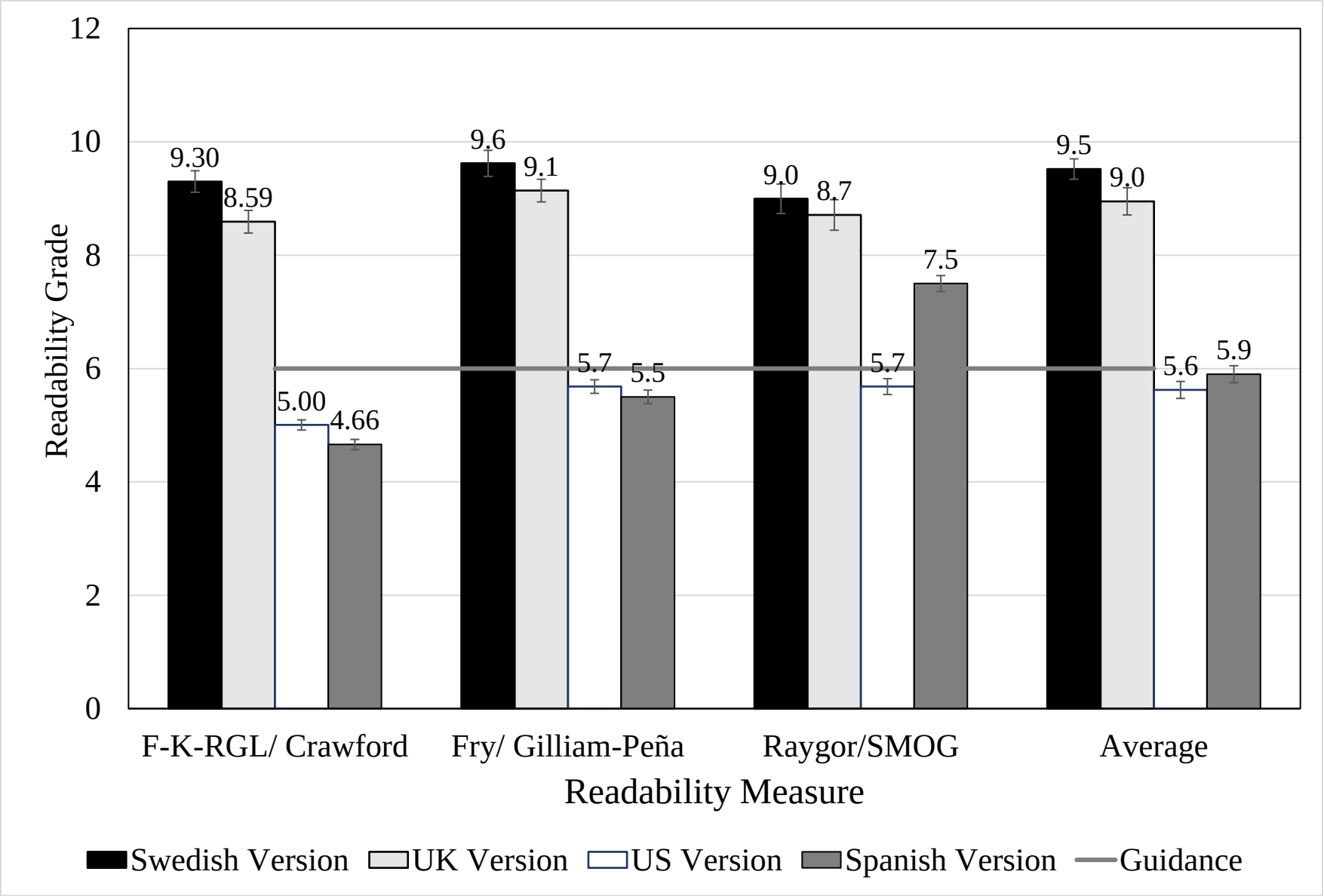
12
10
8
6
4
2
0
Readability Grade
9.30
8.59
5.00
4.66
9.6
9.1
5.7
5.5
9.0
8.7
5.7
7.5
9.5
9.0
5.6
5.9
F-K-RGL/ Crawford
Fry/ Gilliam-Peña
Raygor/SMOG
Average
Readability Measure
Swedish Version
UK Version
US Version
Spanish Version
Guidance

Table 1: Examples of cultural adaptions of the ICBT materials

Category	Description	Previously used	Replaced with
Spelling	Words ending in /ise/ were replaced with those ending in /ize/ /ou/ was replace by /o/	Minimise Colour Breath Learnt Programme	Minimize Color Breathe Learned Program
Metaphors/ idioms	Common cultural sayings were removed or adjusted	Get in a habit Have a go	Get into a rut Try
Vocabulary	Words that are unfamiliar in the US were removed or replaced	Hoover Car parks General practitioners Shop As Queue	Vacuum Parking lots Doctor Store Because Line
Concepts	References to items not commonly used in the US were removed	Kettle examples Tea examples	Instead used Coffee machine as electrical kettles are rarely used Rather used coffee examples as drinking coffee is more common
Images	European landscape images replace with neutral or US images	Tulip field European landscapes	Either neutral images of woods, the ocean, and mountains or familiar images such as those from Monument

			Valley, Crater Lake, or the Grand Canyon

Table 2: Resources for writing health information that is easily readable and/or accessible.

Healthy People 2020 – National Action Plan to Improve Health Literacy: https://www.healthypeople.gov/2020/tools-resources/evidence-based-resource/national-action-plan-improve-health-literacy
National Institute of Health (NIH) – Plain Language Online Training: https://plainlanguage.nih.gov/CBTs/PlainLanguage/login.asp Plain language Web site: www.plainlanguage.gov
Family Physician's Practical Guide to Culturally Competent Care: http://www.thinkculturalhealth.org/
Center for Disease Control and Prevention (CDC) - Gateway to Health Communication & Social Marketing Practice: https://www.cdc.gov/healthcommunication/
Harvard University School of Public Health: https://www.hsph.harvard.edu/healthliteracy/
U.S. Centers for Disease Control and Prevention: www.cdc.gov/healthcommunication
U.S. Centers for Medicare and Medicaid Services: www.cms.gov/Outreach-and-Education/Outreach/WrittenMaterialsToolkit
U.S. Department of Health and Human Services: www.health.gov/healthliteracyonline

Table 3: Examples of how readability was improved

Strategy	English Materials		Spanish Materials	
	Previous Used	**Replaced With**	**Previous Used**	**Replaced With**
Sentences length reduction	Resulting in more annoyance Ensure you select times when your phone can be switched off and you will not be disturbed. It is a relaxation program that is divided into six steps	Increased annoyance Choose a time when your telephone does not need to be on There are six steps in this relaxation program	Tenga en cuenta: si está quitando artículos valiosos de su bolsillo, como teléfonos o llaves, asegúrese de colocarlos en un lugar seguro mientras practica la relajación. Hacer frente a	Tenga cuidado si se quita artículos valiosos. Asegúrese de colocar teléfonos o llaves en un lugar seguro mientras se relaja. Lidiar
Word complexity reduction	Ability Additional Anxiety Associated Experiencing Information Occasionally Situations	Skill Extra/ further Stress Linked To experience Facts/ data A few times Events	Sucediendo Utilize Seleccione Vincular Específicamente Experimentando Mejoramiento Incicialmente	Pasando Use Escoja Ligar En especial Sintiendo Mejora Al principio
Word length reduction	Corresponding Generally	Other Often	Frecuentemente Específicamente	A menudo En especial

	Therefore	Thus	Generalmente Exageradamente	En general Manera extrema
Words familiarity adjustments	Difficult	Hard	Disminuir	Bajar
	Abdominal/ stomach	Belly	Abordar	Luchar
	Decrease	Reduce	Diafragmático	Abdominal
	Frequent	Often	Experimentando	Sufriendo
	Benefit	Value	Perturbado	Molestado
	Disturbed	Bothered	Previamente	Antes
	Numerous	Many	Perspectivas	Punto de vista
	Perform	Do		
	Previously	Before		
	Sequence	Order		

Table 4: Readability Formulae used to evaluate the intervention materials

English Formula	**Equation used for determining the reading grade level of text**
Flesch-Kincaid Reading Grade Level (F-K RGL)	(0.39 x average number of words per sentence) + (11.8 x average no. of syllables per word)-15.50
Fry	The intersection on a graph with the y-axis indicating the number of sentences and the x-axis the number of words
Raygor Readability Estimate (RRE)	The intersection on a graph with the y-axis indicating the number of sentences per 100 words and the x-axis the number of words with more than six letters
Spanish Formula	
Gilliam, Peña, Mountain Fry Graph	The intersection on a graph with the y-axis indicating the number of sentences and the x-axis the number of words
Crawford	[number of sentences per 100 words x (-.205)] + [The number of syllables per word averaged from 100 words x .049) – 3.407
Spanish Statistical Measurement of Gobbledygook [SMOG]	$3 + \sqrt{[\text{number of words with 3 or more syllables}]}x[\frac{30}{\text{number of sentences}}]$

Table 5: Reading Grade Levels for different versions of the ICBT materials

ICBT for Tinnitus Chapter number	Swedish Version				UK Version				US Version				Spanish Version			
	RGL for each readability formula			Average of the three formulae	RGL for each readability formula			Average of the three formulae	RGL for each readability formula			Average of the three formulae	RGL for each readability formula			Average of the three formulae
	F-K RGL	Fry	RRE	Mean (SD)	F-K RGL	Fry	RRE	Mean (SD)	F-K RGL	Fry	RRE	Mean (SD)	Crawford	Gilliam-Peña	Spanish SMOG	Mean (SD)
1	9	8	8	8.20 (0.35)	9	9	9	8.87 (0.23)	5	6	6	5.57 (0.75)	5	6	8	6.30 (1.57)
2	11	12	12	11.77 (0.40)	9	10	10	9.57 (0.75)	5	6	7	6.13 (0.81)	5	6	8	6.27 (1.72)
3	9	10	9	9.43 (0.51)	9	9	8	8.53 (0.50)	6	6	6	5.83 (0.29)	5	6	8	6.40 (1.64)
4	9	10	10	9.73 (0.46)	8	9	9	8.70 (0.52)	5	5	5	4.90 (0.17)	5	6	8	6.23 (1.46)
5	9	9	8	8.70 (0.61)	7	8	6	7.03 (1.00)	5	6	5	5.27 (0.64)	4	5	6	5.27 (1.03)
6	10	10	8	9.20 (1.06)	7	8	7	7.47 (0.50)	5	6	4	5.03 (1.00)	4	5	7	5.37 (1.19)
7	10	10	8	9.30 (1.13)	9	10	8	9.10 (1.01)	5	6	4	5.00 (1.00)	4	5	6	5.30 (1.08)
8	10	10	8	9.23 (1.08)	7	7	6	6.53 (0.50)	6	6	6	5.87 (0.23)	5	6	7	6.07 (1.20)
9	10	10	9	9.50 (0.50)	9	9	10	9.30 (0.61)	6	6	6	5.83 (0.29)	5	5	7	5.67 (1.42)
10	10	10	9	9.63 (0.55)	10	10	9	9.57 (0.51)	6	6	5	5.50 (0.50)	4	4	7	5.00 (1.56)
11	9	10	9	9.33 (0.58)	8	9	8	8.40 (0.53)	5	6	6	5.63 (0.64)	5	6	7	6.00 (1.30)
12	9	9	9	8.80 (0.26)	8	8	8	8.10 (0.17)	5	5	6	5.20 (0.72)	5	5	8	5.90 (1.92)
13	9	9	9	8.90 (0.17)	10	10	11	10.23 (0.68)	5	5	6	5.23 (0.68)	5	6	7	6.07 (1.30)
14	11	12	11	11.33 (0.58)	9	10	10	9.63 (0.64)	5	6	6	5.63 (0.64)	5	6	8	6.23 (1.66)

15				No module				No module	4	4	4	3.97 (0.06)	5	5	7	5.53 (1.38)
16	9	10	10	9.70 (0.52)	9	10	10	9.70 (0.52)	5	6	5	5.27 (0.64)	5	5	8	5.70 (1.57)
17	9	9	8	8.73 (0.64)	9	10	9	9.47 (0.50)	5	5	6	5.23 (0.68)	5	5	7	5.57 (1.44)
18	9	9	9	9.13 (0.23)	9	10	9	9.43 (0.51)	5	5	6	5.23 (0.68)	4	5	7	5.47 (1.36)
19	10	10	11	10.30 (0.61)	10	10	10	9.87 (0.23)	5	6	6	5.70 (0.52)	5	6	8	6.30 (1.77)
20	8	8	7	7.57 (0.51)	9	9	8	8.70 (0.61)	6	6	7	6.20 (0.72)	5	6	8	6.20 (1.51)
21	8	8	8	8.00 (0.00)	8	8	8	7.83 (0.29)	6	6	7	6.20 (0.72)	5	6	8	6.10 (1.45)
22	9	9	9	8.90 (0.17)	8.2	9	10	9.0 (0.90)	5	6	6	5.60 (0.69)	5	6	8	6.27 (1.42)

Acronyms: F-K RGL: Flesch-Kincaid Reading Grade Level; RRE: Raygor Readability Estimate; SD: Standard deviation

Table 6: Comparison of the overall readability scores for each version of the ICBT materials

Version of the material	**Readability measure**	**Between-group differences Kruskal-Wallis: (*$p < 0.05$)**	**Dunn's Pairwise Post Hoc Comparison between the different versions**	**Bonferroni Adjusted results mean difference in scores, significance (*$p < 0.05$)**
Swedish	**Flesch-Kincaid Grade level**	χ^2 (2) = 45.02;= p = 0.001*	US-UK	-27.64; p = 0.001*
UK			US- Swedish	-36.36; p = 0.001*
USA			UK-Swedish	-8.71, p = 0.77
Swedish	**Fry Grade level**	χ^2 (2) = 45.60;= p = 0.001*	US-UK	-29.79; p = 0.001*
UK			US- Swedish	-34.21; p = 0.001*
USA			UK-Swedish	-4.43, p = 1.00
Swedish	**Raygor estimate age**	χ^2 (2) = 40.08;= p = 0.001*	US-UK	-29.67; p = 0.001*
UK			US- Swedish	-31.43; p = 0.000*
USA			UK-Swedish	-1.76, p = 1.00
Swedish	**Average grade when combining the various readability formula**	χ^2 (3) = 66.25;= p = 0.001*	US-UK	-46.40; p = 0.001*
UK			US- Swedish	-50.74; p = 0.001*
USA			UK-Swedish	-4.33, p = 1.00
Spanish			US-Spanish	-11.14, p = 0.83
			Spanish-UK	35.27, p = 0.001*
			Spanish-Swedish	39.60, p = 0.001*