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READILY AVAILABLE BUT HOW ACCESSIBLE? AN ANALYSIS OF THE WEB ACCESSIBILITY OF HEALTHCARE-RELATED RESOURCES

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***Abstract*:** With advances in technology, more health information is readily available to the public. Individuals with disabilities rely on online healthcare-related resources to access educational information and promote informed decision-making in their care. The Web Content Accessibility Guidelines (WCAG) were created to provide universal web practices which complement the needs of all individuals, such as those with low vision or screen readers users. However, many websites and the resources within them (e.g., PDFs) do not prioritise WCAG, leaving individuals with disabilities at a disadvantage in terms of their autonomy and health literacy. The objective of this study is to investigate and describe the common web accessibility errors present on international occupational therapy and pediatric websites and the resources within them. This mixed methods study evaluates compliance to WCAG success criteria using automatic web accessibility evaluation tools, specifically WAVE and AChecker, and manual checks to capture the human element. Descriptive statistics were used to examine the frequency of errors across several success criteria within the sample websites and PDFs. A subsequent thematic analysis was used to further examine how and why these errors violate the WCAG success criteria. Through automatic evaluation tools, many websites and resources did not comply with numerous WCAG 2.0 success criteria. Through

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manual checks of the web pages and resources within them, 5 themes were identified: inaccessible images, challenges accessing additional resources, poor structural formatting, lack of tagging in PDFs, and minimal colour contrast. The results of this study can inform web developers and contributors (e.g., Occupational Therapists) on how to successfully produce accessible websites and PDFs to provide equal access to health information. In conclusion, this study adds to the current understanding that many public-facing websites and the resources within them (e.g., PDFs) are not accessible, including healthcare-related websites meant to support informed decision-making among individuals with disabilities.

Keywords: Web Accessibility, Disability, Health-Related Resources, WCAG 2.0, Health Information, Usability, Web Development, Accessibility Errors, Universal Design

Introduction

As technology advances, more scientific information is made available to the public via the Internet. It is important that reliable information on healthcare-related websites is accessible to everyone, including those with disabilities. Individuals with disabilities rely on websites to access information that can help them understand their health and disability, engage in informed decision-making, take an active role in their healthcare, and experience increased independence and better health outcomes (Cook et al., 2005; Chinn & Homeyard, 2017; Zeng & Paranto, 2004, as cited in Mason et al., 2021). Occupational therapists (OTs) working with pediatric clients with disabilities and their families share websites to support their clients, hoping they experience these positive outcomes. These websites provide a collection of OT and pediatric health-care related information that potentially informs clients and families of the role and scope of OT, settings in which OTs work, the type of interventions OTs offer, and OT and pediatric health-related publications.

In recent years, web inaccessibility has become a prevalent issue, especially with the number of individuals with disabilities increasing across the world

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(Wagner, 2021). Governments have recognized the need for web content accessibility, and a variety of countries in North America, Europe, and Asia, as well as Australia, have addressed web accessibility by imposing laws and policies and amending non-discrimination laws within human rights acts to ensure inclusivity (Mueller et al., 2018). These laws and policies are based on the Web Content Accessibility Guidelines (WCAG).

The WCAG was created by the World Wide Web Consortium (W3C) in collaboration with individuals and organizations internationally to provide universal guidance on how to make web content more accessible to individuals with disabilities (Henry, 2019). The WCAG, which has had four releases, WCAG 1.0, 2.0, 2.1, and 2.2, is one of the most recognized web accessibility standards around the world (Henry, 2019). The fifth release, WCAG 3.0, is under development (W3C, 2023a). The WCAG contains several layers of guidance for promoting accessibility. The first layer includes four principles which outline that web content should be (1) perceivable, (2) operable, (3) understandable, and (4) robust (Alajarmeh, 2021). For each principle, there are guidelines (thirteen in total) with three different conformance levels: Level A (easiest level to achieve), AA, and AAA (most difficult level to achieve). For a website to be considered accessible, conformance with Level AA should be met (UsableNet, 2021). Each guideline has a set of testable success criteria. Some examples of success criteria indicated by WCAG include non-text content, contrast (minimum), and info and relationships (W3C, 2018). The last layer includes techniques that help meet success criteria. The W3C encourages web developers to employ all layers of guidance to accommodate a wide range of users.

Literature Review

After reviewing existing literature, it is evident that most of the information, including healthcare information, offered through the internet is not accessible based on WCAG. A recent study assessing the web accessibility of popular health websites around the globe found that 91.3% of the sampled home pages had accessibility failures, with the most common errors being low contrast, empty links, missing alternative text, empty buttons, and missing form labels (Mason et al., 2021). Another example of a study that examined

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top-ranked hospital homepages worldwide found issues related to the perceivable, robust, operable, and understandable WCAG principles (Acosta-Vargas et al., 2020). These researchers measured the level of accessibility using online automatic evaluation tools including WAVE and TAW, and then used manual evaluations to validate these scores (Acosta-Vargas et al., 2020). One commonly reported error involved images not being designed with the correct alternative text, therefore not supporting the function of screen readers (Acosta-Vargas et al., 2020). In addition, healthcare-related websites in Europe had many errors detected, mostly with alternative text (Sik-Lanyi & Orbán-Mihálykó, 2019). Further emphasizing the breadth of accessibility errors that occur, a study in Korea reported that blind and second-level sight-impaired individuals who evaluated government and public agency healthcare websites found that these websites had problems across all four principles of accessibility (Yi, 2020). These findings support the need for web accessibility awareness amongst web developers worldwide to promote inclusive health-related websites and reduce the barriers to individuals with disabilities.

Schmutz and colleagues created three versions of a municipal website based on three levels of accessibility by the WCAG 2.0 and tested the websites with two populations (people with visual impairments and people with no disabilities). The website with the lowest level of conformance to WCAG indicated prolonged task completion times, reduced completion of tasks in those with visual impairments, and poor perceived usability and aesthetics (Schmutz et al., 2017). The study also found that both non-disabled users and users with visual impairments benefited when using websites that have higher conformance to WCAG as they all experienced increased performance and more positive user ratings. This study demonstrated that websites that correspond to a high level of accessibility are more inclusive and user-friendly for everyone, and are compatible with multiple assistive devices, including screen readers, screen magnifiers, and braille boards. There is a clear demand for accessible websites to accommodate the needs of individuals with disabilities, which inadvertently supports non-disabled individuals.

The resources found on websites also need to be considered. A pilot study suggested that people face challenges viewing resources within databases, such as journal articles (Nganji, 2015). Most publishers use the portable

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document format (PDF) when publishing journal articles; however, if the PDF file is inaccessible, then persons with disabilities will be denied access to its contents (Nganji, 2015). Using key WCAG 2.0 criteria, such as tagging among a sample of journal articles, this study found that only 4.5% of the selected articles were tagged. Thus, most documents were not compatible with text-to-speech software, such as Adobe Acrobat XI Pro Read out Loud (Nganji, 2015). This study demonstrated that although journal articles within databases can be identified, the content within them may not be compatible with accessibility devices.

These studies demonstrate a lack of accessibility of websites, including healthcare-related websites, and PDFs, as they do not adhere to WCAG success criteria, leaving individuals with disabilities at a disadvantage because they cannot access this educational web content. However, research has not been published evaluating the accessibility of occupational therapy and pediatric healthcare-related websites. Assessing and understanding the accessibility of these websites and the resources within them could promote inclusion and greater accessibility.

Research Purpose and Questions

To continue the observations from the pilot study and build on the existing research, further investigation was needed to analyze other forms of web content, such as occupational therapy and pediatric healthcare-related websites. It is important to address this research gap because these websites are a primary supplier of resources and evidence for OTs and their clients. Since OTs often work with persons with disabilities, websites must be accessible to help inform individuals with disabilities while making health-related decisions (Mackenzie et al., 2017). The purpose of this study is to investigate and describe the common web accessibility errors present on international occupational therapy and pediatric websites and the resources within them (e.g., PDFs), based on WCAG success criteria. In this mixed methods study, the following questions will be addressed: 1) How often do international occupational therapy websites and pediatric health-related websites and PDFs violate the accessibility criteria outlined by WCAG? and (2) How and why are essential web accessibility criteria of WCAG violated?

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Methods

A sequential explanatory mixed methods research design was selected to address the proposed research questions. A mixed methods approach was chosen because research shows that automatic evaluation tools are not always accurate and may not address all aspects of web accessibility, and therefore, should be complemented by the perspectives and judgements of manual checkers (W3C, 2021; Nganji, 2015; Acosta-Vargas et al., 2020).

Study Sample

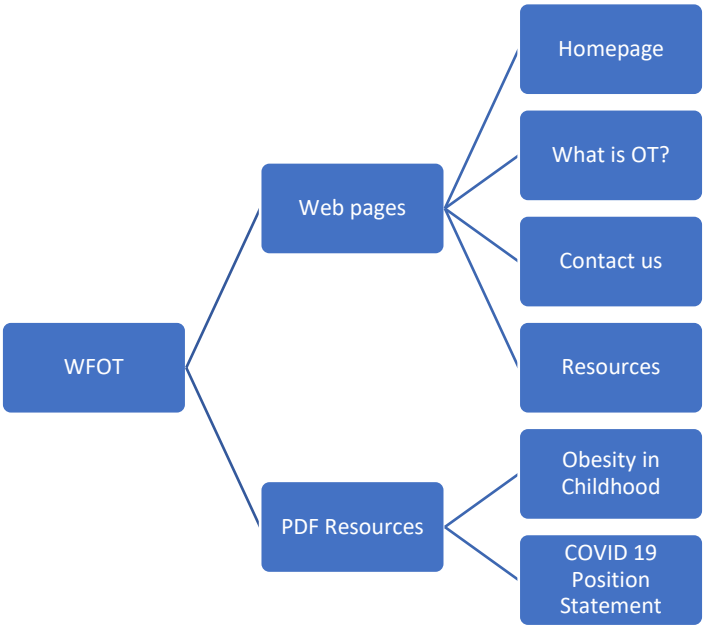
Through convenience sampling, a comprehensive list of occupational and pediatric healthcare-related websites was compiled by the team.

The following were the inclusion criteria:

- Occupational therapy and/or pediatric healthcare-related content
- Developed by Canadian, African, or international organizations
- Published in English
- Healthcare-related resources (in PDF format) provided within the website

Since online resources are available to people worldwide and the research team members are located in Canada and Cameroon, the sample was intended to allow for the exploration of web accessibility of international websites. Through random selection, 7 websites were selected from this list for in-depth analysis. Within these websites, the authors determined high-traffic web pages that users visit to gather healthcare-related information. These categories were homepage, contact us, resources, about us, and what we do, as shown in the example in Figure 1.

Figure 1: Example of web pages and PDF resources from a website in the sample (e.g. WFOT)



Ultimately, a sample of 28 web pages were selected for the quantitative and qualitative components of the study. During data collection, one web page server was no longer available thus there was limited data from this web page. In addition, it is important to investigate the accessibility of the resources provided on these web pages because many individuals rely on these resources for additional information to support their decision-making. Thus, the first 12 resources (e.g. position statements, brochures, annual reports, educational handouts) encountered when navigating the sample of web pages were selected to be included in the study sample.

For the qualitative component, the authors were used as research tools to provide subjective descriptions of the web content of the sample. The authors are experts or emerging professionals in web accessibility and are able to ensure detailed and accurate judgements in supplement to the automatic evaluation tools as suggested by Alajarmeh (2021).

Selection of Automatic Evaluation Tools

Web accessibility errors were determined using online automatic evaluation tools. Relying on one automatic web accessibility evaluation tool is not recommended. Thus two tools were used in conjunction to take advantage of

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the benefits of each (e.g., tool accuracy and the number of success criteria evaluated) (Vigo et al., 2013). This process increased the soundness, the internal validity, and the construct validity of the results (Vigo et al., 2013).

The automatic evaluation tools used in this study were WAVE (WebAIM, 2023) and AChecker (AChecker.com, 2018). Both tools evaluated web accessibility using WCAG 2.0 success criteria. At the time of the study, there were no automatic evaluation tools developed based on WCAG 2.1, thus, these tools were the most relevant. WAVE was selected because errors, alerts, and features are outlined in a summary and a detailed description of each violation. AChecker was selected because the tool evaluates each line and provides known, likely, and potential errors.

Data Collection from Web pages

The quantitative component was aimed to determine the number of errors in success criteria detected on each web page using WAVE and AChecker. Based on the accessibility reports derived for each web page at a cross-section, all errors were collected and organized into a Microsoft Excel spreadsheet that outlined the number of total violations based on success criteria at conformance levels A and AA.

The qualitative component involved further investigation into common web accessibility errors identified by the quantitative data. Manual evaluations were guided by WCAG success criteria and team discussions capturing various user perspectives. This basic qualitative descriptive approach allowed for an in-depth understanding of the user experiences regarding the level of accessibility. Written descriptions were systematically recorded in Microsoft Word documents for all web pages analyzed. This data was leveraged to validate whether the web accessibility errors labelled as likely or potential, were accurate, and to identify how the errors occurred, as these errors require human investigation. All qualitative data was recorded in organized tables on Microsoft Word. Reflexive journals, memos, and audit trails were maintained throughout the study to establish strong rigourData Collection from PDF Resources

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To evaluate the web accessibility of the sample of resources, the PDF Accessibility Checker tool within Adobe Acrobat XI Pro was utilized to generate accessibility reports. All success criteria were not assessed due to limited resources. Thus there was a focus on 7 success criteria, as shown in Appendix 1. Based on the design of this software, the reports indicated whether the PDF passed or failed in specific success criteria. Afterwards, each failure was investigated manually for subjective experiences and observations, such as colour contrast, alternative text, page titles, and reading order.

Data Analysis

To confirm whether a web page is accessible, the data from the automatic evaluation tools must be further evaluated by knowledgeable humans (WebAIM, 2023; W3C, 2021), therefore we used both quantitative and qualitative analysis to obtain a full picture of the web page accessibility. The quantitative data was analyzed through descriptive statistics to examine the level of compliance and the frequency of errors across several success criteria within the sample websites and PDFs. A subsequent coding of the researchers' perspectives was completed to further examine how and why these errors violated WCAG 2.0 success criteria, using Braun & Clarke's thematic analysis process (2006). Multiple investigators were involved in finding common web accessibility error themes as a form of triangulation.

This qualitative data was compared to the quantitative data to determine the agreement between the researcher's perspectives and the results from the automatic evaluation tools. By integrating findings from the quantitative and qualitative components, recommendations to improve web accessibility while developing web content and PDF resources were developed and proposed.

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Results

Quantitative Results

Table 1. Average Number of Errors Based on Type of Web page (depending on automatic evaluation tool used)

Type of Website	WAVE Average Number of Errors	WAVE Range or Error Frequency	AChecker Average Number of Errors	AChecker Range of Error Frequency
Homepage	51.00	8 - 105	37.00	6 - 115
What is OT? Or About Us	26.29	5 - 66	41.29	11 - 101
Contact Us or Find an OT	33.67	3 - 85	31.33	11 - 101
Resources, Events or Downloads	34.50	19 - 68	26.75	3 - 69
What do we do? Or Our Work	38.00	2 - 85	20.00	14 - 27

The overall number of errors based on types of web pages was examined using the two automatic evaluation tools. Using WAVE, homepages had 51 errors on average, resulting in the greatest number of errors compared to the other types of web pages, as shown in Table 1. According to AChecker, the “What is OT?”/”About Us” web pages had the greatest number of errors, specifically 41.29 errors on average. The range of the number of errors varied among the types of web pages. For example, using WAVE, some homepages had 8 errors, while others had 105 errors in total. These differences demonstrated the high variation in the web accessibility of the study sample.

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Figure 2: Level of Compliance of Web page Sample to WCAG 2.0 Success Criteria Using WAVE

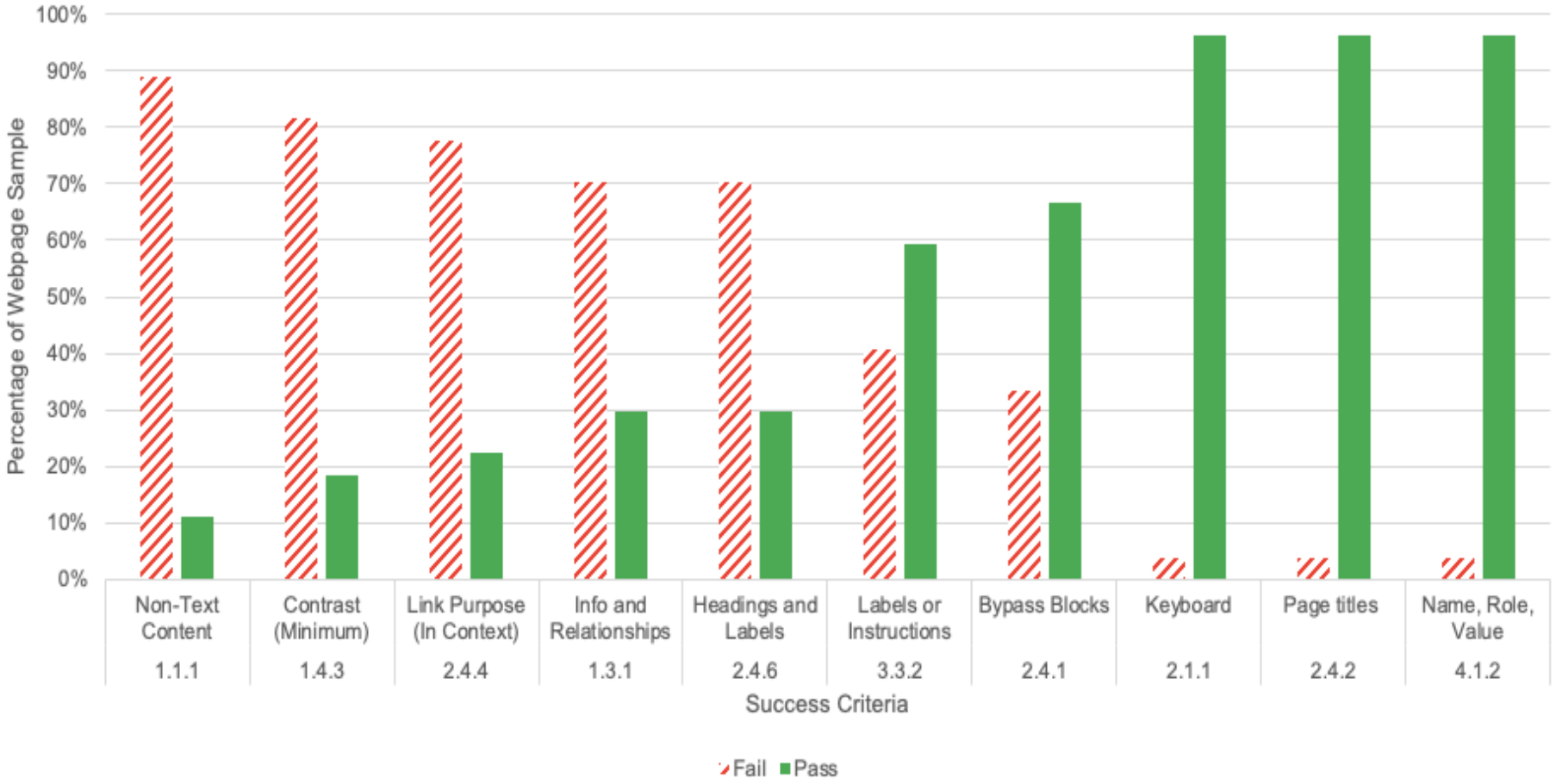

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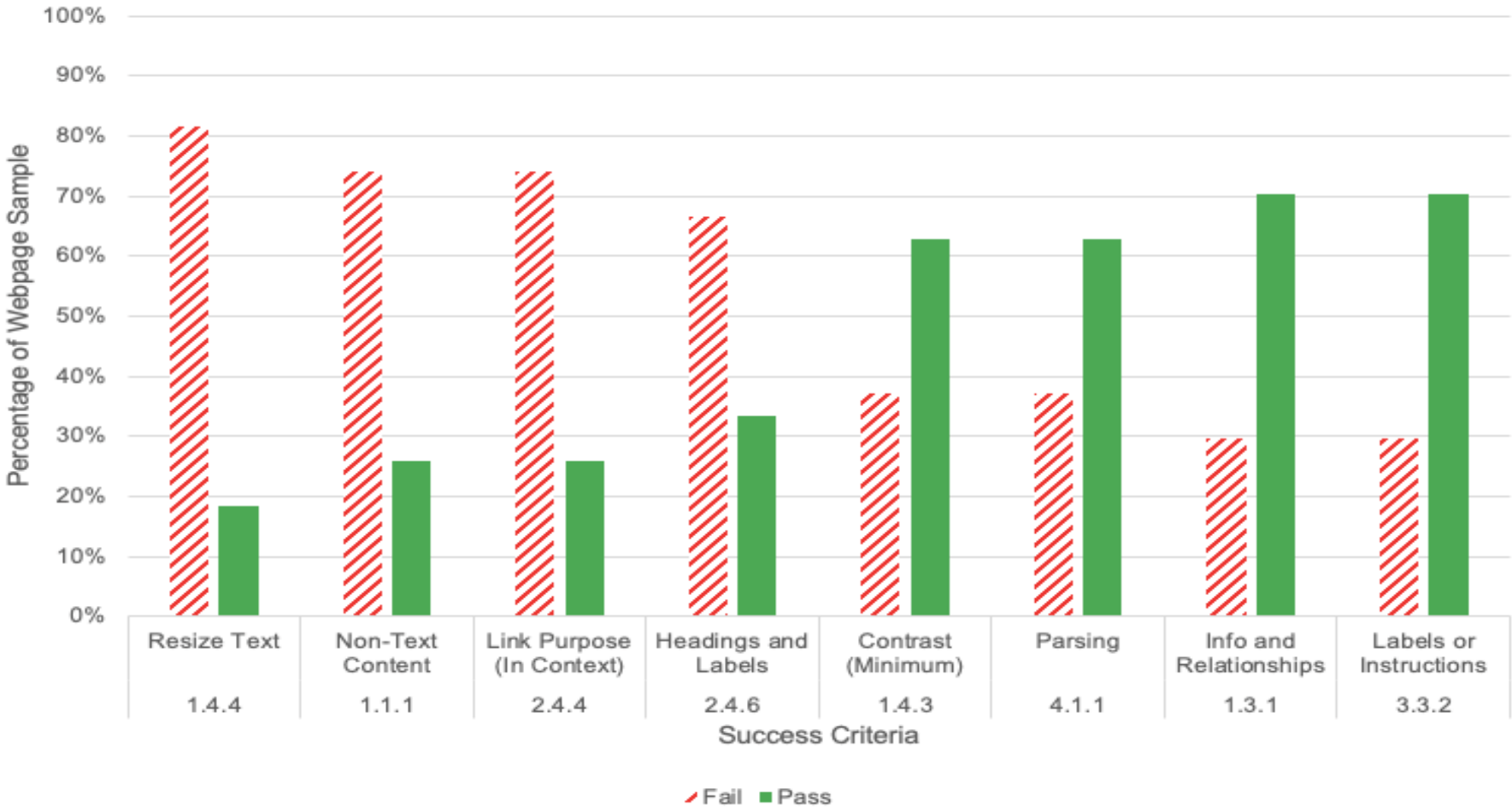
Figure 3: Level of Compliance of Web page Sample to WCAG 2.0 Success Criteria Using AChecker



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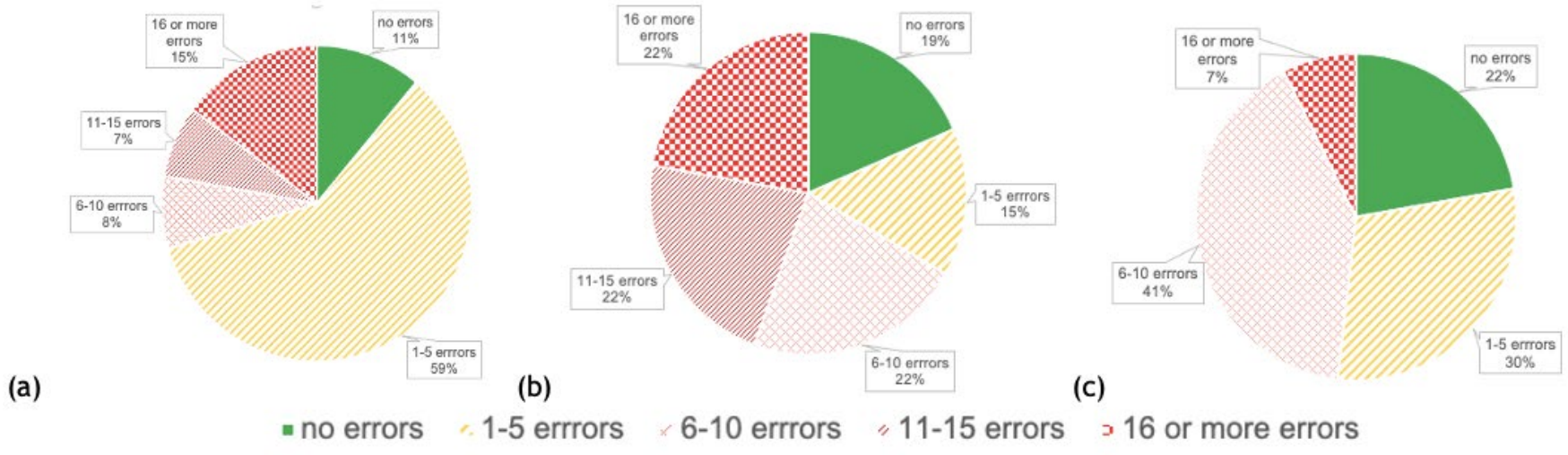
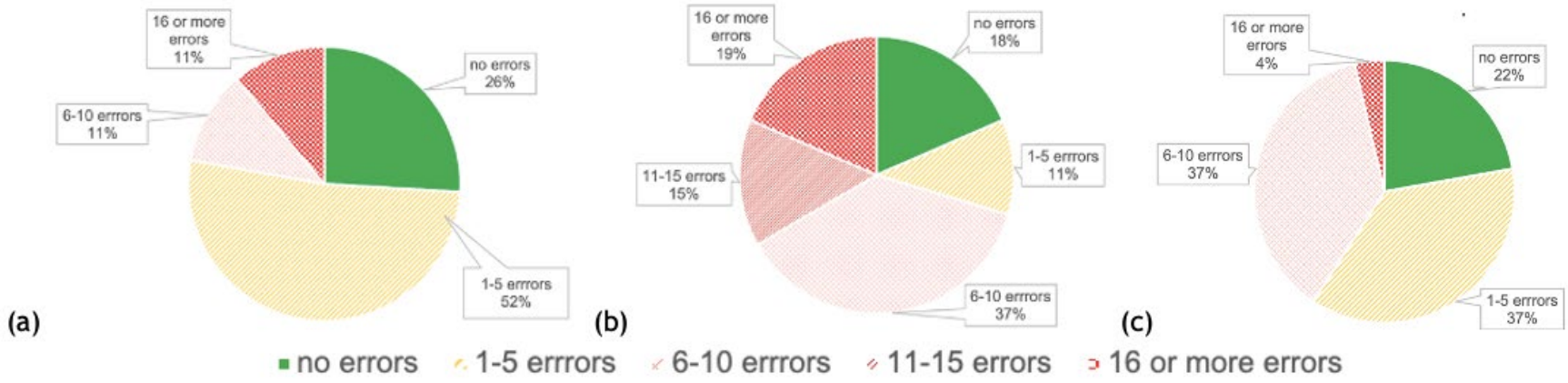
After examining the total number of errors, the level of compliance with specific WCAG 2.0 success criteria was investigated using the two automatic evaluation tools across a sample of 27 web pages. Using WAVE, the top three violated success criteria starting with the most violated were 1.1.1 Non-Text Content, 1.4.3 Contrast (minimum), and 2.4.4 Link Purpose (in context), as shown in Figure 2. Using AChecker, the top three violated success criteria starting with the most violated were 1.4.4 Resize Text, 1.1.1 Non-Text Content, and 2.4.4 Link Purpose (in context), as shown in Figure 3. Success criteria 1.1.1 and 2.4.4 were among the most violated success criteria for both WAVE and AChecker, while 1.4.3 and 1.4.4 being among the most violated success criteria was unique to each checker.

Figure 4: Frequency of Errors in Specific Success Criteria using WAVE



Success criteria presented: (a)Non-text Content, (b) Colour Contrast, (c) Link Purpose

Figure 5: Frequency of Errors in Specific Success Criteria using AChecker



Success criteria presented: (a)Non-text Content, (b)Resize Text, (c) Link Purpose

To further investigate the top violated success criteria, the frequencies of errors are presented in Figures 4 and 5. According to both WAVE and AChecker, more than half of the web pages had between 1 to 5 non-text content errors. WAVE identified that 22% of the sample had 16 or more colour contrast errors. Both WAVE and AChecker identified that more than 70% of the sample had between 1 to 10 link purpose errors. AChecker, 37% of the sample had between 6 to 10 resize text errors.

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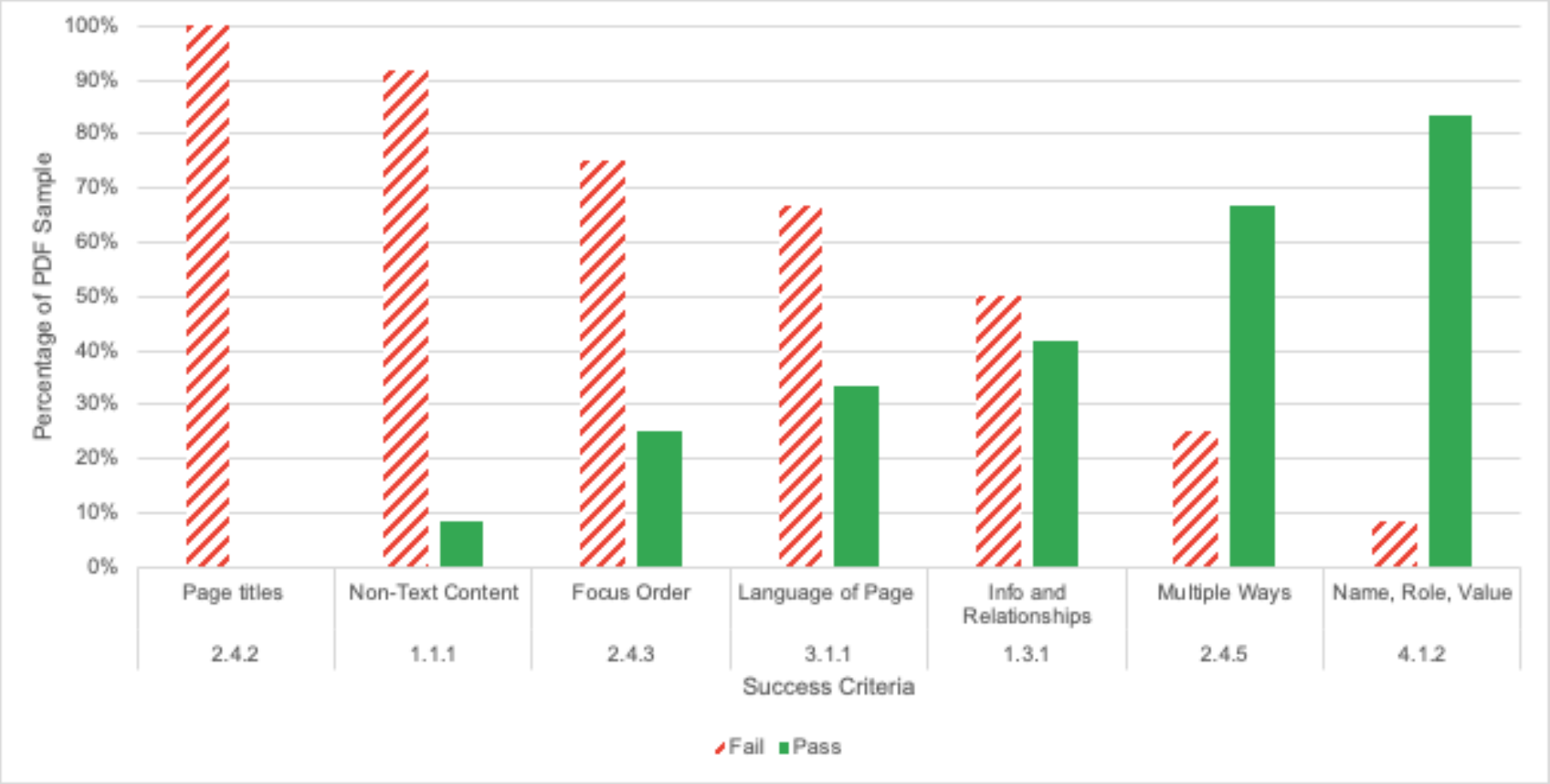
Figure 6: Level of Compliance of PDF Resource Sample to WCAG 2.0 Success Criteria Using Adobe Acrobat XI Pro



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The level of compliance with WCAG 2.0 success criteria was investigated using Adobe Acrobat XI Pro across a sample of 12 PDFs. The top three violated success criteria starting with the most violated were 2.4.2 Page Titles, 1.1.1 Non-Text Content, and 2.4.3 Focus Order. Success criteria 2.4.2 was violated by 100% of the sample, while 1.1.1 was violated by over 90% of the sample and 2.4.3 was violated by over 70% of the sample.

Web page Qualitative Results

Using the process described in the methods section for manual checks of the sample of web pages, 3 themes emerged:

Theme 1: Inaccessible Images

Images presented on web pages often did not have appropriate alternative methods of perceiving images that meet individuals' needs, such as when using a screen reader.

Subtheme 1.1: Missing Alternative Text

On some web pages, images were missing alternative text to describe what was occurring in the image. These images included regular and linked images (e.g., previews of linked articles) or images acting as buttons (e.g., website logos or social media icons). Some web pages had carousels, a series of images that are presented one at a time with a set time spent on each one. None of the carousels encountered had alternative text such as an overlaying description or link to a long description. Some images in the carousel had important information (e.g., event details) while others were decorative. Some images did not have alternative text but had a caption nearby that was either not descriptive enough or the image was decorative.

Subtheme 1.2: Inappropriate Alternative Text

In addition, some images had alternative text, but the alternative text was inappropriate. For example, some images had alternative text that was not relevant to the image or did not describe what was happening in the image (e.g., the image file name was provided as alternative text). Other images had alternative text that was not descriptive enough to describe what was

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occurring in the image or had null alternative text when there should have been a description. Some images had shadows to add a visual effect, yet the shadow was coded as an image and provided alternative text.

Subtheme 1.3: Redundant Alternative Text

Some images had alternative text that was not necessary. For example, some images had alternative text that provided more information than what was presented within the image. Other images had nearby text that was the same as the alternative text provided for the image, making it repetitive. Similarly, some images had both alternative text and a caption or title; however, neither were descriptive enough. Finally, some images were unnecessary (i.e., did not add to the user's educational experience) or were decorative with unnecessary alternative text instead of null alternative text.

Subtheme 1.4: Text in Images

Some images had text within them. These images include those in carousels without alternative text as well linked images with lots of text (e.g., posters, previews of specific files, or advertisements) without alternative text or with inappropriate alternative text. Some images had alternative text or text near the image describing it, but it did not include the text in the image, only a description of what was happening in the image. Finally, some images had null alternative text despite having important and relevant text within the image.

Theme 2: Challenges Accessing Additional Resources

When additional resources were provided, the navigation to access these resources was unclear and difficult to follow.

Subtheme 2.1: Missing Link Purpose

On some web pages, linked text or images (e.g., logos redirecting to the homepage, social media icons) were missing for the purpose of the link, indicating where the link takes you and what its function is.

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Subtheme 2.2: Suspicious Links

Some web pages had suspicious links in that the links would appear as “click here” instead of providing a functional description. Some links were also used as placeholders. For example, one link led to a pseudo-email error.

Subtheme 2.3: Redundant Links

Another error encountered was redundant links such as a redundant link in an empty space on the web page, making it difficult to navigate. Other redundant links include repeated links or links that lead to the current page.

Subtheme 2.4: Links to Inaccessible PDFs

There were several web pages that had links to PDFs which were not accessible once opened.

Theme 3: Poor Structural Formatting

Web pages that lack structure limit easy navigation within the web page while using assistive devices and applications, such as screen readers.

Subtheme 3.1: Lack of Appropriate Heading Sequence

Within some web pages, all text was labelled as “body” and no heading labels were provided to specify the varying levels of headings. Other web pages had heading labels; however, they were hidden within forms, footers and headers, or heading levels were skipped, resulting in confusion while navigating the order of the web page. Within some web pages, all heading levels were provided, but were not representative of the flow of the web content or did not follow a logical sequence.

Subtheme 3.2: Lack of Appropriate Labelling

In addition to the lack of heading sequencing, other elements on the web page were not labelled appropriately. For example, form fields were not labelled with a form label or purpose. Another common example was using style elements to match list styling; thus list semantics, such as <ul> or <ol>, were not provided. Similarly, many table columns, rows, and data cells were not labelled appropriately, thus reducing the compatibility with assistive devices.

Subtheme 3.3: Lack of consistency between menu and body

Other errors encountered on web pages were the inconsistency between the menu item order and the heading sequence, and that menu items were hidden; thus the tab order was challenging to navigate and perceive.

PDF Qualitative Results

Through manual checks of the sample of 12 PDF resources, 2 themes emerged:

Theme 1: Minimal Colour Contrast

The use of colours allows for visually appealing PDF resources. However, many web pages contained content and background with limited contrast. When there is minimal colour contrast, many users will find it difficult to read the web content.

Subtheme 1.1: Challenges Heading and Body Text

Within some PDFs, the selected colours of heading text, including titles, headings, text box headings and subheadings, did not satisfy the WCAG 2.0 contrast criteria of 4.5:1 with the background colour. Similarly, some body text, including email links, dates, paragraphs, and page numbers, did not satisfy the WCAG 2.0 contrast criteria of 4.5:1 with the background colour.

Subtheme 1.2: Logo designed with poor colour contrast

Some logos of organizations were designed with poor colour contrast; thus, the image was difficult to perceive or differentiate with its background or the design elements within it.

Theme 2: Lack of PDF tagging

PDF resources have many elements within the file, however, each element was not tagged appropriately with <image>, <H1>, <P>, <Table>, or <L>. Due to the lack of tagging, it was challenging to navigate through the elements on the file using assistive devices.

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Subtheme 2.1: Illogical reading order

When using a screen reader, such as the "Read out loud" feature on Adobe Acrobat, some documents were not read in a logical order. For example, when reading some PDFs, images were skipped, or the text in images was not read. Another common error was the disruption of reading flow due to footers, tables, columns, text boxes, and empty pages. Some resources had a table of contents with no tagging; thus reading sequence between the section name and page number was not logical. Overall, the lack of tagging by the authors caused additional confusion when reading the document.

Subtheme 2.2: Lack of appropriate alternative text

Since most resources were not tagged, many images were not identified as figures, thus no alternative text was provided. Some resources compensated with descriptive captions around the image on the page. However, the image was not detected by the screen reader, thus the caption was not necessary.

Discussion

This study aimed to investigate and describe the common web accessibility errors present on international occupational therapy and pediatric websites and the resources within them (e.g., PDFs), based on WCAG success criteria. Using a mixed methods approach, two research questions were addressed: 1) How often did international occupational therapy websites and pediatric health-related websites and PDFs violate the accessibility criteria outlined by WCAG? and (2) How and why are essential web accessibility criteria of WCAG violated? The results of this research have provided valuable insight into where and why these errors occur as well as the high prevalence in which they occur, thereby severely impacting the experience of individuals with disabilities attempting to access these health-related websites.

Prevalence of Accessibility Criteria Errors

Based on the sample studied, none of the web pages and PDFs were accessible, as they contained at least 2 or more errors, with some web pages having as many as 115 errors. This speaks to the prevalence of accessibility issues and

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variation in the frequency of errors across web pages encountered by users accessing international health-related information. Among the web pages sampled, homepages had the highest prevalence of errors, which poses a unique navigation challenge, as the website is inaccessible from the first point of access. This means that individuals with disabilities will be placed at a disadvantage when determining what the website may offer, limiting their access to valuable information that is most relevant to their current needs.

Common Accessibility Criteria Errors

The results show that errors violating success criteria 1.1.1: Non-text Content were some of the most pervasive. This finding is consistent with previous studies that found missing alternative was one of the most common errors (Acosta-Vargas et al., 2020; Mason et al., 2021; Sik-Lanyi & Orbán-Mihálykó, 2019). In our study, we found that many images (including linked images and those in carousels) did not have alternative text and upon subjective investigation, it was found that even when alternative text was provided, it was often inappropriate or missing meaningful information. Among the PDF samples, we found that because many of the PDFs were not tagged, there was no alternative text for images in these specific PDFs. Alternative text is important, especially for those with visual impairments, as they are not able to perceive the image through visual senses and rely on devices such as screen readers to read the alternative text that describes what is happening in the image.

Another major issue found among web pages and PDFs was difficulty with navigation. Nganji found that most journal articles sampled were not compatible with screen readers due to the lack of tagging (2015). His finding is consistent with the current study's findings because most PDF resources were not tagged with <H1>, <H2>, <p>, <link>, or <figure> for each element. Tags are significant for accessibility because these tags provide chronological and visual structure for the assistive device to facilitate navigation for users. Similarly, it is evident that web pages also require an appropriate heading sequence. Heading structure is significant because it provides a chronological order for the web content and provides relational data of the web content. These features can assist in the comprehension of the entire web page,

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without the need for visual input. For example, screen reader users can jump between the major sections of the web page or resource to find relevant information to support their decision-making. If heading levels are skipped or illogical, it adds confusion to the screen reader user when navigating the web page or resource. Another issue that created difficulty with the navigation of web pages included violations of success criteria 2.4.4: Link Purpose as well as errors regarding redundant links. When the purpose of the link is not provided, the individual will not know where the link is sending them (e.g., returning to the homepage) when using a screen reader. Redundant links, such as a link in a footer within an empty space, can make it difficult for the individual to pass or skip that area easily when tabbing (using the tab key to navigate through the content).

Many elements of web pages violated WCAG 2.0 Success Criteria 1.4.3: Colour Contrast, based on WAVE. In addition, through manual checks of PDF, most resources had at least one element that did not satisfy the minimum colour contrast requirement of 4.5:1. In fact, some web pages had several colour contrast errors because these web pages were designed using an inaccessible colour theme. Since the selected colours were repeatedly used in the web page, thus amplifying the frequency of errors occurred. Colour contrast is vital for web accessibility because adequate colour contrast between the foreground and background is necessary for comprehension of the content for all users, especially those with low vision.

One issue that was prevalent and unique to websites was violations of success criteria 1.4.4: Resize Text. For example, some web pages had <i> (italic) and <b> (bold) text elements in an attempt to emphasize a word or phrase. However, this does not meet the success criteria because the visually rendered text was not scaled in a way that can be read by individuals with mild visual impairments without the use of an assistive device (e.g., a screen magnifier). When the individual zooms in on this kind of text, it can be difficult for the individual to read, as the content may no longer be visible on the page or has lost its function.

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Complexity of Web pages and PDFs

Complex web pages and PDFs are designed with multiple elements including menus, columns, heading sections, links to news articles or blogs and information carousels. Through subjective reports contributed by the authors, it is evident that web pages and PDFs with high complexity presented with a higher frequency of errors. For example, the homepage is the main landing page, which is responsible for displaying what information is provided within the website and guiding the user to the location of that content. Therefore, homepages are designed with complex design elements which require additional attention to ensure that these elements are designed according to WCAG principles.

Recommendations

Based on the findings, we present several recommendations:

Appropriate Alternative Text

Web developers should provide alternative text for regular images, linked images, logos, social media icons, and images in carousels that are detailed enough to describe what is happening in the image. The alternative text should also include any text that is present in the image. If the image is decorative, null alternative text (i.e., alt="") should be used to indicate this. When creating PDFs, developers should manually tag or auto-tag elements including images (e.g., <figure>) in the PDF and then provide a text alternative in the image properties. Providing alternative text allows visual information to be provided in electronic text which can be rendered visually, auditorily, tactilely, or a combination of these, making it accessible to various individuals in a form that meets their needs.

Clear Link Navigation

Web developers should use link text that is meaningful and identifies the purpose of the link so that individuals know its purpose and direction (e.g., to the homepage). Therefore, individuals can decide whether they want to follow the link. Web developers should also avoid repeating links within close proximity to avoid complexity and confusion. Additionally, developers should

avoid placing links in empty spaces on the web page or using text that states "click here" instead of providing context. All these techniques allow ease of navigation for those using assistive devices or those who are tabbing from link to link. Finally, developers should ensure that when PDFs are linked, that the PDF is accessible or that HTML content is used in addition or in place of the PDF.

Scaleable Text

Web developers should ensure that text is scaled so that it can be resized without the use of assistive devices (e.g., screen magnifier) up to 200 percent without interfering with the content or function (W3C, 2023b). This means that individuals with minor visual impairments will be able to read the information directly. Web developers can do this by using technology that supports individuals to zoom in on content, using percent for font sizes, giving users controls on the web page to change the size of the text, and using em units for font. For example, web developers can replace <i> (italic) and <b> (bold) text elements with or in the code to convey that the word/phrase needs to be emphasized.

Structured and Purposeful Labelling

Web developers should prioritize providing structure to a web page, including heading levels, lists, tables, images, forms and search bars. When using web content editor software, it is recommended to review all structural elements after publishing using automatic evaluation tools (WordPress.com Support, n.d.). When using Adobe Acrobat programs, there is a quick method to tag elements of the PDF resource automatically. This labels headings, figures and body content with the appropriate tags to ensure that the resource will be read in a logical sequence and thoroughly. Upon review, if the tags are not representative of the content of the resource, the resource author can manually label elements appropriately.

Greater Colour Contrast

When designing a colour theme for a web page or resource, it is beneficial to check all colours using a colour contrast evaluation tool. These tools specify if the contrast between the foreground and background satisfies the WCAG 2.0

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success criteria and allows for easy perceivability of the content. Another consideration related to colour contrast is designing the text, images and decorative elements of a company logo using an accessible colour theme. To improve the colour contrast of text or body content, web developers can bold, outline letters in black or increase the font size of the text. Another method to improve colour contrast is to avoid using busy backgrounds since busy backgrounds introduce more visual confusion when reading the web page or resource.

Occupational Therapy Relevance

This research matters to OTs because OTs work with individuals with various disabilities, including visual impairments, auditory impairments, cognitive decline, or motor challenges. When working with these individuals OTs want to enable occupation through holistic strategies and advocating for equity. OTs strive to support autonomy, such as prescribing assistive devices (e.g. screen readers, magnifiers) to alleviate the visual demands of exploring the internet for health-related information in order to make evidence-based decisions. Being able to identify errors because OTs should be informed of the barriers clients might face due to web inaccessibility and be able to advocate for specific changes. OTs can act as change agents in improving web accessibility of occupational therapy-related and pediatric resources, as well as a broader scope of web content.

Limitations

Our study has several limitations despite the steps taken to improve the quality of this research. For example, automatic evaluation tools used in the study do not have the capacity to check for all 38 WCAG success criteria. Thus, some types of errors may not have been detected, ultimately skewing the data as some errors reported as most prominent may not be in reality. To mitigate this issue, we included two automatic evaluation tools and manual checks in our research design so the limitations of one type of evaluation could be compensated by the other. We also could not complete screen reader compatibility tests during our qualitative data collection because we lacked human resources and time. This type of data would be beneficial; therefore,

such data collection would be a future direction for our research. In terms of positionality, we recognize that we are able-bodied individuals, and we did not include the perspective of those with lived experiences. We designed our study to focus on the number of errors and types of errors. Future studies can investigate these perspectives as demonstrated in Yi's (2020) study.

Conclusion

Occupational therapy and pediatric health-related websites are intended for use by individuals receiving medical and social therapeutic intervention, and therefore, individuals with disabilities are more likely to frequent these websites. As demonstrated in this study's findings, these websites are not designed with individuals with disabilities in mind, creating a large barrier in healthcare.

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