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Development and application of a vocal health and hygiene game in adults

Desenvolvimento e aplicação de um game sobre saúde e higiene vocal em adultos

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Keywords

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ABSTRACT

Purpose: To develop a game on vocal health and hygiene (VoxPedia) and apply it to adults aiming to investigate knowledge about vocal health and the vocal self-assessment in this population. **Methods:** The study sample was composed of 293 adults, of which 204 were women and 129 were voice professionals, invited to participate through digital media. Participants completed to the following forms and instruments: 1) Informed Consent Form (ICF); 2) Identification Data form; 3) Voice Handicap Index: 10 (VHI-10) protocol; 4) Vocal Health and Hygiene Questionnaire (VHHQ); 5) VoxPedia quiz. **Results:** The VoxPedia quiz was developed using simple and dynamic questions that allowed the participants to know their performance in real time. Data collected through this quiz showed that voice professionals reported reduced voice handicap and had higher scores in the VHHQ and VoxPedia. Voice professionals or not, participants who answered wrongly to the nature of impact of health aspects in the VHHQ reported increased voice handicap in the VHI-10; however, despite the self-reported handicap, most of them did not report voice complaints. In contrast, when voice complaints were reported, the participants not always perceived handicap or searched for vocal therapy. **Conclusion:** The VoxPedia quiz presented some concepts on vocal health and hygiene to the participants. In addition, it enabled the study of the relation between knowledge about vocal care and voice self-assessment. The data suggest that individuals with greater knowledge about vocal health and hygiene show better voice self-assessment, those with worse voice self-assessment do not perceive voice problems, and those who perceive voice problems do not necessarily seek professional assistance.

Descritores

Voz
Fonoaudiologia
Autoavaliação
Aplicativos Móveis
Software
Terapia Assistida por Computador

RESUMO

Objetivo: Desenvolver um *game* sobre saúde e higiene vocal (VoxPedia) e aplicá-lo em adultos, para investigar o conhecimento em cuidados vocais e compreender a autoavaliação vocal dos respondentes. **Método:** Participaram 293 adultos, 204 mulheres e 129 profissionais da voz, convidados através de mídias digitais. Os participantes responderam: 1) Termo de Consentimento Livre e Esclarecido (TCLE); 2) Dados de Identificação; 3) Protocolo do Índice de Desvantagem Vocal (IDV-10); 4) Questionário de Saúde e Higiene Vocal (QSHV); 5) Aplicação do quiz VoxPedia. **Resultados:** O VoxPedia foi desenvolvido com questões simples e com dinâmica que permitiu aos participantes conhecerem seu desempenho em tempo real. Os dados adquiridos através do quiz mostram que os profissionais da voz relataram menos desvantagem vocal e acertaram mais itens no QSHV e questões do VoxPedia. Profissionais da voz ou não, os participantes que erraram a natureza do impacto dos aspectos de saúde no QSHV referiram maior desvantagem vocal no IDV-10. Contudo, apesar da desvantagem autorreferida, a maioria não relata problemas de voz. Em contrapartida, quando o respondente relatou problemas de voz, nem sempre houve desvantagem percebida ou busca por terapia vocal. **Conclusão:** O VoxPedia apresentou alguns conceitos de saúde e higiene vocal aos participantes. Além disso, possibilitou o estudo das relações entre conhecimento em cuidados vocais e autoavaliação vocal. Os dados sugerem que os indivíduos com mais conhecimento em cuidados vocais têm melhor autoavaliação de voz; participantes com pior autoavaliação vocal não percebem problemas de voz; e aqueles que percebem problemas vocais não necessariamente procuram cuidados profissionais.

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INTRODUCTION

Vocal health and hygiene are important components in the prevention and treatment of dysphonia. These aspects are elements of the so-called indirect voice therapy approach, which focuses on voice care guidance[1,2]. This approach has its effects extended when combined with direct therapy[1,3], which includes vocal exercises. Indirect voice therapy focuses on expanding the vocal perception of individuals so that they can identify and manage their vocal production in unfavorable situations.

In general, people can identify the key external factors and habits that favor and impair voice health[4-6], and are able to relate negative factors and habits to vocal symptoms[5]. In addition, greater knowledge about voice care has been associated with the ability of individuals to preserve the health of their voice[4,7,8].

However, although showing some knowledge about voice care, people with and without voice complaints, with different professions/occupations, have reported vocal signs and symptoms[9-11]. The difference is that individuals with a high vocal demand, whether they are voice professionals or not, present a large number and frequency of these signs and symptoms[9,12,13]. Moreover, the large number of signs and symptoms[10,14] and the use of more strategies to cope with the problem[14] are also what differentiate individuals with voice disorders who seek the assistance of a voice specialist from those who do not.

The specific scientific literature indicates that the presence of signs and symptoms in this population is quite common. Therefore, the difficulty seems to lie in the use of knowledge about voice care as a strategy for preventing vocal disorders[2] and in the perception people have of their own voice[15], and not necessarily in the lack of knowledge. Without the understanding that persistent vocal changes are not expected, regardless of profession/occupation, people end up delaying the search for professional assistance, and only do so when they already have many vocal signs and symptoms. Thus, in addition to addressing the concepts of vocal health and hygiene, indirect therapy should assist patients with incorporating healthy habits into their routine and avoiding habits and factors that are detrimental to their vocal health.

To this end, speech-language pathologists can use different resources, including the most technological ones. There is a growing body of research developing and testing purpose-built applications and games, often based on gamification design principles, including in the health area[16,17]. Gamification is a methodology that seeks to apply gaming elements, mechanisms, dynamics and techniques to expand the possibilities of individuals to tackle and solve problems autonomously and creatively in various areas of life[18,19].

In speech-language pathology (SLP), specifically in the area of voice, some applications for mobile devices (smartphones) have already been tested[20-23]. They are intended for use in the adult population, and function primarily as a source of information on vocal health and hygiene and a self-monitoring resource for vocal exercise prescribed by voice specialists.

Therefore, it is believed that games designed for specific purposes in the field of voice and used as a resource of the indirect approach can complement voice therapy and favor the acquisition and adaptation of new knowledge in vocal care in the daily lives of people with different vocal demands. In this context, this study aimed to develop a game on vocal health and hygiene, in the format of a quiz, and apply it to adults, voice professionals or not, in order to identify their knowledge about vocal health and hygiene and understand how these people self-rate their voice.

METHODS

Development of the Vocal Health and Hygiene Questionnaire (VHHQ)

This cross-sectional study was approved by the Research Ethics Committee of the Centro de Especialização em Fonoaudiologia Clínica – CEFAC (opinion no. 1.991.375; CAAE: 66030617.3.0000.5538).

The VoxPedia is a game in the format of a quiz developed for the adult population with the purpose of presenting some aspects associated with vocal health and hygiene. It contains 18 questions on the theme that were prepared based on the 13 items of the Vocal Health and Hygiene Questionnaire (VHHQ) selected through vote by 28 speech-language pathologists specialized in voice (Chart 1). These speech-language pathologists were invited to participate by e-mail, and chose the questions independently. They were instructed to choose 10 out of the 13 VHHQ items they considered most relevant to be addressed in clinical practice. The items selected were those that received a score >10 for meeting the relevance criterion in SLP practice and being pertinent to the objectives of this study.

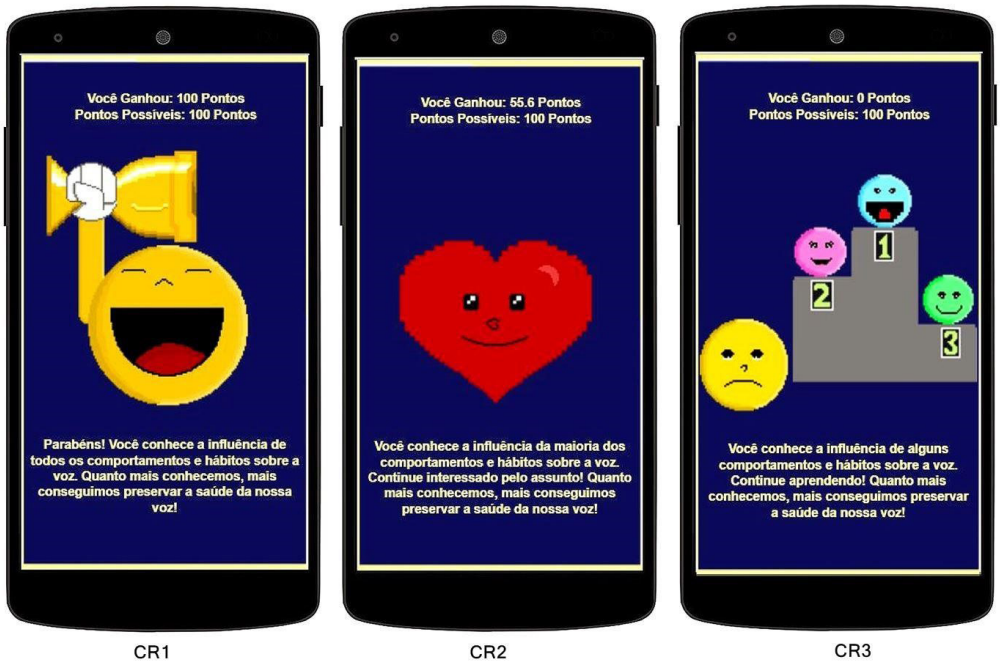
Each screen in the VoxPedia quiz contains a question accompanied by three response alternatives, and there is only one correct answer (Figure 1). Upon selection of an alternative, an animation is displayed on the screen indicating whether the choice was wrong or correct; if the correct response was chosen, the player receives points. The sum of the points ranks the performance of the player who has completed the quiz, and the player's score, the maximum possible score, an animation, and a sentence are displayed on the game screen. There are three possible phrases and animations that reveal the player's performance in the quiz. They are automatically selected based on three ranges of cut-off values: 1 to 7, 8 to 16, and 17 or 18 correct responses. Thus, the following scores and their meanings are assigned to VoxPedia players: ≤7 (up 40% of correct responses), some of the voice behaviors and habits are known; 8-16 (41 to 89% correct responses), most of the voice behaviors and habits are known; ≥17 (90 to 100%), all of the voice behaviors and habits are known (Figure 2).

The images and animations of the game were designed using Piskel, an online editor used to create pixel art, game sprites, and animated GIFs. Piskel is a free, open-code, web-based tool developed and elaborated by GitHub, a community of software developers. Pixel art was chosen with the intention of rescuing the classical technique used in the graphics of the first video games. The game was created using the Construct 2 (Business version) software, an HTML5-based game engine used to create multi-platform 2D games.

Chart 1. Items of the VHHQ with score higher than 10 votes and questions of the VoxPedia game based on these items

Most voted items of the VHHQ	Questions of the VoxPedia quiz	Answer choices
Effortless speech	What happens when we speak in an effortful way?	a) Our voice improves because this assists with maintaining its quality
		b) Nothing happens; our voice neither improves nor worsens
		c) Our voice worsens because we strain the muscles
Speech in noise	What effects can speaking for a long time in noisy environment have on our voice?	a) We can feel voice fatigue
		b) We do not feel anything
		c) We can feel that our voice warms up
Vocal abuse	What is vocal abuse?	a) Exercises we do to warm up the voice and speak well
		b) Behavior that worsens the voice, causing fatigue and changes
		c) Behavior we use to save the voice in noisy environment
	What happens when we yell, speak, or sing for a long time in noisy environment?	a) Vocal abuse
		b) Vocal warn-up
		c) Vocal relaxation
	Who is most at risk for a voice problem?	a) Communicative people who use speech and gestures in conversation
		b) Very quiet people who do not like to talk in a group of people
		c) People who speak too much and loudly
Yelling	What can happen to our voice when we yell too much?	a) The voice may become high-pitched
		b) The voice may become low-pitched
		c) The voice may become hoarse
Breathing-speech incoordination	What may be associated with vocal fatigue?	a) Tiredness or pain in the neck region
		b) Pain in the muscles of the tongue and lips
		c) Pain in the body muscles
	What is the most natural way to breathe while speaking?	a) Make short pauses to breathe before we run out of breath
		b) Make long pauses to breathe as soon as we run out of breath
		c)) Make pauses to breathe only when we have already run out of breath
Lack of liquid consumption throughout the day	What can happen to our voice when we drink little water throughout the day?	a) It may become slurred and we may find it difficult to open our mouth
		b) It may become powerful and warmed up
		c) It may become dehydrated and even hoarse
Vocal warm-up	What is the purpose of vocal warm-up?	a) It is useless because the voice warms up with use
		b) It prepares the larynx muscles for voice use
		c) It worsens the voice because it is best to be silent
Vocal fatigue	Which of these three situations is more likely to cause vocal fatigue?	a) Tell a friend a story in a comfortable volume
		b) Imitate your favorite singer by singing loudly at a concert
		c) Sing an entire opera using good voice technique
Healthy vocal habits	What habits can be healthy for both body and voice?	a) Balanced diet and regular exercises
		b) Make use of throat lozenges and sprays and clear your throat
		c) Drinking alcohol, smoking and using drugs
	What is the best way to speak in everyday life?	a) Whisper so that you can save your voice
		b) Speak comfortably to avoid voice fatigue
		c) Speak strongly in order to keep your voice warmed up throughout the day
Vocal exercise	What is the purpose of voice exercises?	a) Balance the functioning of the muscles that produce the voice
		b) Treat allergic conditions
		c) Treat gastroesophageal reflux
Inadequate body posture	What is the best body posture when speaking?	a) It does not matter, because the body is not important in communication, only the voice
		b) Upright body, well-aligned shoulders, and head looking forward
		c) Bent body, head down, and slumped shoulders
	What is the advantage of maintaining an upright posture during speaking?	a) Show little understanding of speech content
		b) Convey the anxiety and insecurity of the speaker
		c) Show confidence and mastery of the topic spoken
Use of microphone in teaching	Why should we use a microphone to teach or lecture?	a) To save the voice, because a microphone amplifies it, avoiding yelling
		b) To masculinize our voice, because the microphone makes the voice low-pitched
		c) To shout and get everyone's attention
Sleep well	What effect can a bad night's sleep have on our voice?	a) None
		b) Fatigue it
		c) Make it better than it was when we went to bed

Caption: %=percentage of player evolution
Figure 1. Illustration of the screens containing the first three questions of the VoxPedia quiz



Caption: CR1 = 90-100% correct responses; CR2 = 41-89% correct responses; CR3 = <40% correct responses
Figure 2. Screens with the three possible final performances in the VoxPedia containing animation and player's score

Aiming to facilitate the participation of respondents, the game was designed to be accessed from different platforms, such as personal computers, tablets or smartphones, and was thus hosted on a website[24] compatible with mobile devices. In addition, the quiz was designed to collect participants' responses on their knowledge about vocal health and hygiene and voice self-assessment. Therefore, the options selected by the participants during the game were saved in a database that was later used for data collection and tabulation.

Pilot project

The VoxPedia game was tested on 10 people, with and without voice technical skills, namely, one speech-language pathologist, one psychopedagogue, one physician, one lawyer, two psychologists, two receptionists, and two physical therapists in order to gather some perception on the overall aspect, readability and intelligibility of questions, and gameplay of the game.

All volunteers (n=10; 100%) said they appreciated the animations for wrong and correct responses, color and font of the letters, background color for readability, and easy gameplay of the VoxPedia game. As aspects that could be improved, 50% of the volunteers reported that the technical terms of the questions hindered their understanding, that more animations could be added, and that it would be interesting to have the option pause/resume. After the pilot test, the questions were rewritten using simpler language and new animations were added. However, options to pause and resume, as well as to move backwards, forwards or skip were not added, because any of these actions could result in data loss.

The pilot test also revealed that the data collected in real time through the players' records were being properly saved in the database and could, subsequently, be used for tabulation and analysis.

Research protocol

In order to achieve the study objective, in addition to developing the VoxPedia game, it was necessary to apply it and collect other information not included in the quiz. To this end, a research protocol including the following forms and instruments was developed: 1) Informed Consent Form (ICF); 2) Identification Data form; 3) Voice Handicap Index: 10 (VHI-10) protocol[25]; 4) Vocal Health and Hygiene Questionnaire (VHHQ)[26]; 5) VoxPedia quiz.

The identification data requested included name, age, profession/occupation, e-mail, and two Yes/No questions: "Have you had/Do you have a voice-related problem?" and "Have you been/Are you in voice therapy?"

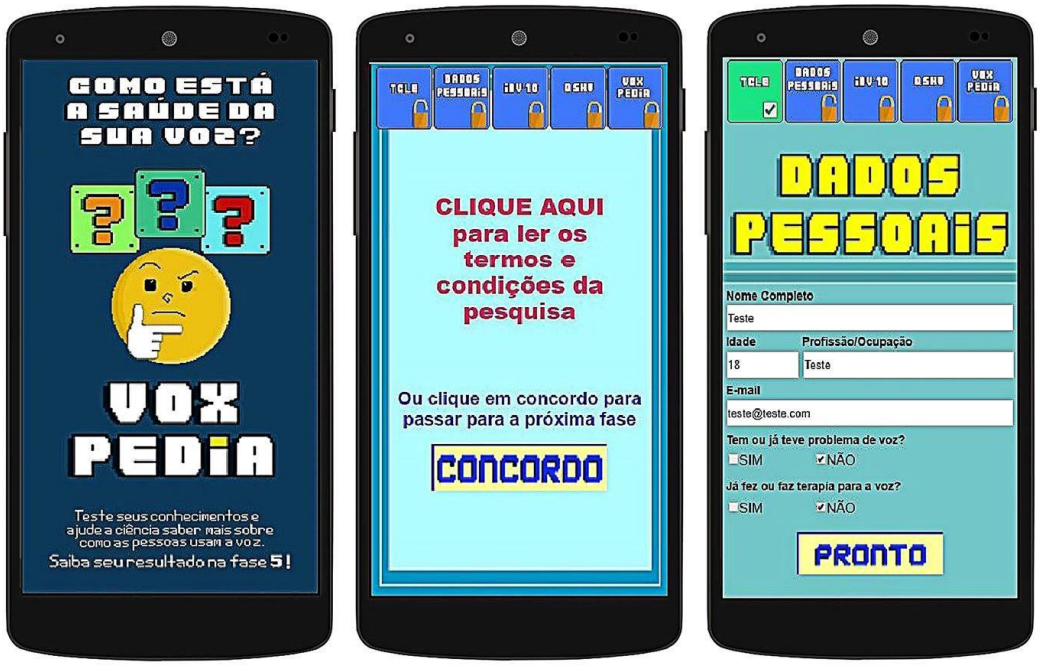
The VHI-10 self-assessment protocol is a short version containing 10 questions used to assess the vocal impairment perceived by individuals. Each question has five response choices: never = 0 points, almost never = 1 point, sometimes = 2 points, almost always = 3 points, and always = 4 points. The total score is calculated by the sum of the question scores and may range from 0 to 40 points, with a score of 0 indicating no disadvantage and a score of 40 indicating maximum disadvantage[25]. The cut-off value that differentiates people with and without vocal disadvantage is 7.5 points[26]. Thus, all individuals with a score >7.5 present some vocal impairment.

The VHHQ is a self-assessment questionnaire containing 31 items on vocal health and hygiene. Respondents are instructed to complete the VHHQ according to their perception on their knowledge about the theme. Each item has three answer choices: positive, neuter, and negative. Each correct response is worth one point. The cut-off value is 23 points, thus vocally healthy individuals tend to present scores ≥23[27].

Data collection

Aiming to optimize the process and make it more interesting to the participants, the whole content of the research protocol was fed into the system in an attractive way, similar to the game screens, that is, in the quiz format. This content was organized as follows: Cover; Phase 1 - presentation of the ICF; Phase 2 - personal identification data (Figure 3); Phase 3 - presentation of the VHI-10; Phase 4 - presentation of the VHHQ; Phase 5 – VoxPedia.

Participants were invited by e-mail and through digital media such as WhatsApp and Facebook. The invitation was open to



Caption: P1 = phase 1; P2 = phase 2
Figure 3. Cover and screens of Phases 1 and 2 of the VoxPedia quiz

anyone aged ≥18 years interested in playing the VoxPedia game. They accessed a website through their personal computers, tablets, or smartphones to play the game, thus all the data were collected online.

Respondents needed to follow the directions given at each level to advance to the next stages, and could follow their progress by a lock animation that opened every time they completed a level and through a progress bar that showed, in percentage, their progress in the level they were in. Each topic of the VHI-10 was presented individually, and the participants had to select one of the five response alternatives. Every time the players selected a response, a sound warned them that their answer had been recorded. The items of the VHHQ were also presented individually, and the respondents should choose one of the three response alternatives requested in the questionnaire. At each choice, the players were given a correct or wrong notice by means of a quick animation. Although the VHHQ allowed the classification of wrong and correct responses, adding up one point for each correct answer, the players' responses were not calculated in the final quiz score (Figure 4).

The VoxPedia was presented to the study participants as in the pilot test, and their expected actions during the game were also similar. This was because the pilot test volunteers indicated need for only minor adjustments in the quiz.

After collection and tabulation of the data, individuals aged ≥18 years, with or without voice complaints, were included in the study. Individuals who did not fill in their age and occupation and/or answer the questions more than once were excluded from the survey.

Three hundred twenty-four people responded to the protocol of this study; 31 individuals were excluded because were aged <18 years and/or failed to complete important information such as age and occupation/profession. The study sample was composed of 293 adults aged 18-72 years (mean age=32.95 ±12.17 years), 204 women and 89 men, who completed the information and the VoxPedia quiz. Of the total of participants, 129 (44.03%) were voice professionals and 82 (27.99%) were speech-language pathologists. Only 78 (26.62%) reported voice complaints, 60 (20.48%) presented vocal disadvantage, and 39 (13.31%) were or had been in voice therapy.

Data analysis

Data were tabulated and analyzed by descriptive and inferential statistics and were processed using Excel Office 2016 and Statistica 17.0 software.

Descriptive analysis was performed by mean, standard deviation, minimum and maximum values for the continuous quantitative variable age. Descriptive analysis by relative frequency and percentage was conducted for the nominal qualitative variables gender, voice complaint report, voice therapy, voice professional, speech-language pathologist, and the results of each question of the VHHQ and VoxPedia.

For inferential statistics, normality of the variables (VHI-10, VHHQ, and VoxPedia) was tested with application of the Shapiro-Wilk test, and none of them had normal distribution. Thus, comparison of the results of these variables according to gender, voice complaint report, voice therapy, and voice professional (study groups) was conducted using the nonparametric Mann-Withney test. A significance level of 5% (p<0.05) was adopted for statistical inferential analyses.

P3 P4

Caption: P3 = phase 3; P4 = phase 4
Figure 4. Screens of Phases 3 and 4 of the VoxPedia quiz showing the VHI-10 and VHHQ, respectively

RESULTS

Tables 1 to 5 show the results of the present study.

Study participants presented, on average, a vocal disadvantage score of 4.03; they responded correctly to 27.31 items of the VHHQ and 17.37 questions of the VoxPedia quiz (Table 1).

Women and voice professionals reported less vocal disadvantage and responded correctly to more VHHQ items compared to men and non-professionals, respectively (Table 2). Regarding the VoxPedia quiz, voice professionals also scored better than non-professionals, and no difference was observed in this instrument as a function of the gender of participants.

Participants who scored below the cut-off value in the VHHQ questionnaire reported greater vocal disadvantage (p=0.020) compared to those who had scores above the cut-off value, and the mean scores in the VHI-10 protocol were 3.76 and 6.48 points for those with scores above and below the cut-off value, respectively (Table 3).

Study participants who reported voice complaints in the past and at the time of the survey obtained higher scores in the VHHQ questionnaire and VoxPedia quiz (Table 4) compared to those who did not report them (Table 5).

Among the study participants whose results in the VHI-10 protocol showed vocal disadvantage, the majority denied having or having had voice problems (n=35; 58.33%), whereas most of those who reported past and/or present voice complaints did not present vocal disadvantage (n=58; 67.94%). In addition, among the participants who reported voice problems, a higher frequency of individuals who had not undergone voice therapy was observed (n=45; 57.69%), as shown in Table 5.

Table 1. Descriptive analysis of the outcome protocols

Outcome	Mean	SD	Q25	Median	Q75
VHI-10	4.03	5.04	0.00	2.00	5.00
VHHQ	27.31	4.50	26.00	29.00	30.00
VoxPedia	17.37	1.09	17.00	18.00	18.00

Caption: SD=standard deviation; Q25=first quartile; Q75=third quartile; VHI-10=Vocal Handicap Index-10; VHHQ=Vocal Health and Hygiene Questionnaire

Table 2. Analysis and comparison of the results in the VHI-10, VHHQ, and VoxPedia as a function of gender and being or not a voice professional

Outcome	Mean	SD	Q25	Median	Q75	p-value
			VHI-10			
Female	3.5	4.38	0	2	4	0.023
Male	5.22	6.16	1	3	8	
			VHHQ			
Female	28.03	3.91	27	29	30	<0.001
Male	25.66	5.29	24	27	29	
			VoxPedia			
Female	17.44	0.87	17	18	18	0.123
Male	17.19	1.47	17	18	18	
			Voice professional			
			VHI-10			
Yes	2.92	4.27	0	1	3	<0.001
No	4.9	5.43	1	3	8	
			VHHQ			
Yes	28.23	4	28	30	30	<0.001
No	26.59	4.75	25.5	28	30	
			VoxPedia			
Yes	17.49	0.91	17	18	18	0.030
No	17.27	1.2	17	18	18	

p<0.05 – Mann-Whitney test
Caption: SD=standard deviation; Q25=first quartile; Q75=third quartile; VHI-10=Vocal Handicap Index-10; VHHQ=Vocal Health and Hygiene Questionnaire

Table 3. Analysis and comparison of the results in the VHI-10 as a function of scoring above or below the VHHQ cut-off point

Outcome	VHHQ										p-value
	Above the cut-off					Below the cut-off					
	Mean	SD	Q25	Median	Q75	Mean	SD	Q25	Median	Q75	
VHI-10	3.76	4.82	0.00	2.00	5.00	6.48	6.29	1.00	4.00	10.00	0.020

p<0.05 – Mann-Whitney test
Caption: SD=standard deviation; Q25=first quartile; Q75=third quartile; VHI-10=Vocal Handicap Index-10; VHHQ=Vocal Health and Hygiene Questionnaire

Table 4. Analysis and comparison of the results in the VHHQ and VoxPedia as a function of reporting or not voice complaints

Outcome	Voice complaint										*p*-value
	No					Yes					
	Mean	SD	Q25	Median	Q75	Mean	SD	Q25	Median	Q75	
VHHQ	27.20	4.25	26.00	28.00	30.00	27.63	5.14	28.00	29.00	30.00	0.044
VoxPedia	17.32	1.10	17.00	18.00	18.00	17.49	1.05	17.00	18.00	18.00	0.033

p<0.05 –Mann-Whitney test
Caption: SD=standard deviation; Q25=first quartile; Q75=third quartile; VHHQ=Vocal Health and Hygiene Questionnaire

Table 5. Association between the variables voice handicap and voice complaint

Voice complaint	Voice handicap				*p*-value
	No		Yes		
	n	%	n	%	
No	180	61.43	35	11.94	0.003
Yes	53	18.09	25	8.53	

p<0.05 – Pearson's Chi-squared test

DISCUSSION

Voice therapy should include both direct and indirect approach procedures. Both approaches aim to develop efficient oral communication with reduced phonatory effort and match vocal quality to the individual's personal, social and professional needs[1]. To assist their clients/patients with achieving this goal, speech-language therapists have at their disposal a series of technological resources that are currently part of people's everyday lives. Games, among many other technological resources, have been responsible for people's leisure and fun for a long time. Recently, this technology has been used based on the concepts of gamification. Games developed for specific purposes have goals that go beyond fun, and are intended to broaden the engagement, participation and learning of individuals also in other contexts[17,19].

In this study, we chose to develop the VoxPedia, a quiz on vocal health and hygiene, and apply it to a sample of adults with or without vocal complaints, voice professionals or not. To this end, the VoxPedia was created with questions about vocal health and hygiene, written in simple language and accessible to all. Thus, players can reflect on their existing vocal care skills and perhaps learn something new. In addition to the gamification premise, elements, mechanisms, and dynamics common to games, such as sounds, animations, challenge levels, score, and final performance, have been added to this instrument[18,19]. Thus, players have real time return for each of their actions in the game and know their overall performance in the quiz.

Data collected from the application of the VoxPedia game and the self-assessment protocols and identification data provided by the respondents allowed us to study the knowledge about vocal care and the relationship with vocal self-assessment in this population. Thus, it was possible to know that, on average, the participants of this study do not report vocal disadvantage and have knowledge about vocal care (Table 1), corroborating the findings of previous surveys that have revealed that people have knowledge about factors and habits that can be healthy and harmful to their voice[4,5].

Voice professionals are at high risk for the development of voice impairment because of their high voice demand at work, which often occurs in unfavorable environmental and emotional conditions. As the voice is a key working instrument in this population, it is essential that these individuals have knowledge about vocal care that allows them to maintain good vocal health[8,10-13]. This expectation was confirmed because when non-professionals were compared to voice professionals, the latter showed higher scores in the Vocal Health and Hygiene Questionnaire (VHHQ) and VoxPedia game and reported less vocal disadvantage in the Voice Handicap Index: 10 (VHI-10) protocol (Table 2).

Comparison between male and female individuals showed that the latter reported less vocal disadvantage and obtained higher scores in the VHHQ than the first. However, no difference in performance in the VoxPedia quiz was observed between men and women (Table 2). Considering that the VoxPedia was developed based on the VHHQ, it is likely that after responding to this questionnaire male individuals acquired some knowledge about vocal health and hygiene that was important to be used in the game, which equaled the level of correct answers between genders in this quiz.

In contrast, participants who scored below the cut-off value in the VHHQ obtained almost double the points in the VHI-10 compared to those who scored above the cut-off value (Table 3). These data (Tables 2 and 3) suggest a directly proportional relation between vocal care knowledge and vocal health maintenance[4,7], that is, the greater the knowledge about habits and factors that may benefit or impair vocal health, the better conditions people present to preserve their voice.

Interestingly, individuals who reported voice complaints had higher scores in the VHHQ and VoxPedia (Table 4) compared to those who did not report them. Initially, this result seems to contradict the findings previously discussed, considering that vocal problems may be associated with little knowledge about vocal health care. Nevertheless, most individuals who reported voice complaints presented better vocal self-assessment at the time of data collection (Table 5). In contrast, most of the

participants with worse vocal self-assessment denied having vocal problems.

Two considerations should be made: first, the mere fact that individuals report current or past vocal impairment may already indicate greater vocal self-perception compared to those who could not identify any voice changes, even reporting vocal disadvantage; second, many individuals do not consider vocal disadvantage as important evidence of voice disorders (Tables 4 and 5). Similar behaviors were observed in participants of other studies. A survey showed that voice professionals rated their voices as good despite reporting vocal disadvantage[28]. In another research, 88% of a sample of Flemish population without vocal complaints reported at least one vocal symptom[9]. However, among the Flemish individuals, the frequency and intensity of vocal symptoms increased with increasing voice demand; whereas, in the present study, the self-reported disadvantage was greater in non-voice professionals, which means, at least in theory, that they have lower vocal demand.

Absence of vocal complaints in the presence of vocal disadvantage delays the search for professional assistance, because the individuals do not consider they have a voice problem (Table 5). However, even among individuals who have reported vocal complaints, only the minority had undergone voice therapy. Studies conducted with teachers with vocal symptoms that investigated the search for professional assistance have shown that those who sought for help presented more vocal symptoms than those who did not[10,14]. This finding may indicate a tendency to consider vocal disadvantages or changes as normal, and that will be resolved spontaneously. Thus the search for professional assistance occurs only when individuals realize that their voice problem limits and restricts their participation in vocal activities[14].

Considering the difficulty people have to perceive their voice problems and often delay the search for professional help, the VoxPedia game can be an interesting resource to be used by speech-language pathologists in the context of indirect vocal therapy, as a tool that favors reflection, or even the learning of some vocal care aspects, and can serve as a basis for further discussion on the theme. It is worth noting that, in the present study, a trial version of the VoxPedia quiz was used, which will still undergo some modifications before being released for use.

CONCLUSION

The VoxPedia quiz was developed specially for this research based on gamification design principles. Through this game, some questions on vocal health and hygiene, written in simple and accessible language, were presented to the study participants. Elements common to video games, such as animations, challenge levels, score and final performance, were used. Thus, the players were able to have real time return for each of their actions in the game and, in the end, knew their overall performance in the quiz.

The data obtained through this quiz enabled appraisal of the relations between knowledge in vocal care, self-assessment and self-perception. Analysis of the data suggests that individuals with greater knowledge about vocal health and hygiene show better voice self-assessment, participants with worse vocal self-assessment do not perceive voice problems, and those who perceive vocal problems do not necessarily seek professional assistance.

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Author contributions

APR: responsible for the study design, collection, tabulation, analysis and interpretation of the data, writing of the manuscript; IG and TV: co-advisers responsible for the design, critical revision and approval of the study; MB: adviser responsible for the critical revision and approval of the study.