

Spectrographic Acoustic Vocal Characteristics of Elderly Women Engaged in Aerobics

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Summary: Objectives. This study was carried out to characterize the voice of the elderly women engaged in aerobics through spectrographic analysis.

Methods. The vocal emission /a:/ of 58 elderly women engaged in aerobics for the spectrographic analysis of broadband (BBS) and narrowband (NBS) was collected, through the Real-Time Spectrogram of KayPENTAX program, that provides information about the glottal source, the position of the vocal tract and the characteristics of vowels and consonants. ANOVA (*Análise de Variância*) test was used for associations and Pearson correlation test with a significance level of 5%.

Results. To the BBS, the elderly women had medium intensity of the tracing color of the formants (F_s), low presence of noise, and medium definition of F_1 and F_2 . There was a medium defining F_3 and F_4 and regularity for age 60 years, medium definition F_4 and high regularity of the tracing for 70 years, and medium definition of F_3 and F_4 and regularity of the tracing for 80 years. For the NBS, the elderly women had medium intensity of tracing color, little presence of noise, harmonic substitutions by noise and subharmonic; 60 and 80 years had medium definition of harmonics and regularity of tracing and high definition; and regular for 70 years. For 70 and 80 years, there was a presence of harmonics and medium presence for 60 years. There was a negative correlation between F_2 and the group of 60 years and F_3 with the general age.

Conclusions. Even with myofunctional, structural, and functional changes of the larynx caused by advancing age, which may affect the vocal characteristics, the elderly women of this study showed few changes in tracing spectrogram.

Key Words: Voice–Aging–Gymnastics–Elderly–Voice disorders–Spectrography.

INTRODUCTION

Presbyphonia or vocal aging must be assumed as something normal, which is part of the human evolution,¹ being possible to affect the structures and laryngeal functions by modifying the vocal quality of subjects with more advanced age.^{2,3} Frequently, voice features are very affected and suffer a noticeable worsening. In a way to soften the alterations brought through time, physical activity seems to benefit the mind, the body, and consequently the voice itself. Some authors observed that gymnastics can improve the maximum phonation time, increase the vocal loudness and vital capacity,⁴ and the longest time of practice of this modality may reduce the deviations in vocal quality.⁵

As voice can be influenced by several factors (social, biological, psychological), it can express emotions and also very remarkable features that make a subject different from another one, as in the case of the elderly people who, through the process the phase of the aging, can present different vocal features such as reduction of the fundamental frequency (f_0), of the standard deviation of f_0 ,⁶ decrease of shimmer,⁷

reduced respiratory capacity and maximum phonation time,^{6,8} inadequacy or decrease of the level of loudness,^{8,9} difficulty to sustain phonation,⁸ in addition to increased jitter measurements,⁷ hoarse, breathy, and shaky voice quality,⁹ and reduction of the frequency of formants (F_s).¹⁰

To analyze these vocal features, multidimensional instruments were required, such as perceptive-auditory assessments and computerized analysis of voice, collaborating in the assessment, diagnosis, and vocal rehabilitation. Both types of analysis are complementary, once not all alterations of vocal parameters can be perceived by the human ear, and only acoustic analysis does not provide important data that are obtained with perceptive-auditory assessments.¹¹

The analysis used in this study is the spectrographic, which enables the investigation of the acoustic wave and its basic components, providing information on the glottal source and vocal tract position in a determined vowel, which are expressed in a three-dimensional graph (spectrogram), obtained from the association between frequency, sound pressure, and time.¹² It is a useful method, noninvasive; its results may be influenced by factors such as age, race, and gender,¹³ and they enable a “visual feedback” for patients and speech therapists.

Just as different vocal qualities and the distribution features of acoustic energy may be associated to spectral components related to voice alterations,¹⁴ it is possible that the structural and functional laryngeal alterations present in elderly people may change and relate themselves to determined vocal elements analyzed in the spectrograph. Faced with the lack of literature on the spectrographic analysis in the voice of elderly people who are physically active, this study was carried out to contribute data to identify the vocal characteristics of the elderly who practice physical activity, using for that, a group of women,

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once they are the majority in the surveys. In addition, the results can be the basis for further research on the relationship between physical activity and the voice, cooperating so that physical activity may in the future be combined with speech therapy, aiming to enhance the effect of phonotherapy with elderly people, as the physical activity offers several benefits related to general health that indirectly affect the larynx.

PATIENTS AND METHODS

This study is observational, analytical cross-sectional, quantitative, correlational, and contemporary type, carried out in Salvador (BA), in the Otorhinolaryngology Department, of *Complexo Hospitalar Universitário Professor Edgard Santos (C-HUPES)* of *Universidade Federal da Bahia*, in the period from May 2013 to February 2014. It was approved by the Research Ethics Committee of the C-HUPES under the protocol 081/2012.

We carried out the mapping of private institutions that had aerobics through a list required to the *Sindicato dos Profissionais de Educação Física do Estado da Bahia (SINPEF-BA)*, which is a representative institution of the physical education professionals of the state of Bahia. Four-hundred seventy registered gyms were checked, and, from these ones, 148 institutions offered aerobics activity and agreed to the dissemination of research. They received the Institutional Authorization Form with the aims and the explanations of the assessments that would be carried out in the future with the elderly women who agreed to participate.

The gyms were selected through systematic random process, being chosen one gym from two, according to the interval of choice. The elderly women, who were chosen, interested in participating of the research, provided their identification and telephone number to the researcher who was in charge of the schedule assessments. Thus, from each gym, only one elderly woman was chosen, also at random. At the end of the process, it was necessary to return to the beginning of the list because minimum n was not complete ($n = 52$). This situation happened to avoid another selection, so we chose two other elderly women from the gyms which were determined previously. Therefore, at the end of this process, we reached a number of 98 elderly women engaged in aerobics.

These were the following inclusion criteria for this study: women aged older than 60 years, noninstitutionalized, aerobic practitioners for at least 6 months and twice a week⁵ with laryngeal affections related to presbylarynx only, with or without vocal complaints.

Moreover, the adopted exclusion criteria were as follows: elderly woman with hearing impairment, once they may modify the self-monitoring of voice, compromising voice quality¹⁵; with historical reports of neurologic problems (cerebrovascular accident, Parkinson disease, dementia) and acute respiratory infections, which could interfere in vocal performance or understanding the orders during the assessment; having the flu on the assessment day, due to the possible presence of vocal fold edema¹⁶; with reports of endocrine disorders (diabetes mellitus as they may trigger dysphonia by dehydration, named xerofonia); with alterations of the

stomatognathic system that could interfere with the vocal emission to be collected; with physical or motor disabilities; tobacco or alcohol users, as these agents are aggressive to the larynx and can lead to the formation of laryngeal diseases; with a history of laryngeal surgery and/or any surgery procedure in the head and neck; who had attended to prior speech therapy, to reject the possibility that the subject was vocally conditioning by the practicing of phonotherapeutic techniques; who participated in singing lessons; with laryngeal affections which are not inherent to presbylarynx, such as vocal nodules, Reinke edema, vocal polyps, granulomas, epidermoid cyst, papilloma, mucosal bridge, varicosity, laryngeal paralysis, laryngeal focal dystonias, partial laryngectomy, laryngeal diseases related to gastroesophageal reflux (diffuse laryngeal edema, laryngospasm, posterior laryngitis, laryngeal stenosis, leukoplakia, laryngeal carcinoma); with a surgery history or lung diseases, by affecting voice production; and those who used anti-anxiety drugs as they can have consequences as imprecise articulation, thickly, lack of f_0 and vocal loudness and drying effect on vocal tract, antidepressants for producing dryness of the vocal folds, and inhibitors of angiotensin-converting enzyme, which can cause chronic cough leading to vocal abuse, and may cause secondary laryngeal involvement; and those who did not agree to participate.

The criteria for exclusion and inclusion were first implemented at the day of the anamnesis, followed by otorhinolaryngologic medical assessment, which aimed to identify the presence of laryngeal affections—the ones expected in cases of presbylarynx as well the ones not caused by aging, performed through videolaryngostroboscopy. Later, we performed the hearing screening, to verify the alterations in the auditory thresholds of subjects, analyzing the thresholds at 500, 1000, 2000, and 4000 Hz, tested at 25 dB (scan mode) only by air,¹³ in a soundproof booth and the audiometer Interacoustics Ad 27, that analyzes between 250 Hz and 8000 Hz. Finally, we carried out the assessment of the stomatognathic system, evaluating aspects of mobility, tension and posture of the speech organs, as well as the functions of swallowing and chewing, with the aim of disregard the potential anatomical alterations in phonoarticulatory structures that make difficult the efficiency of the articulation and imply in the wrong vocal emission that was requested for data collection.

After this process, the sample consisted of 58 elderly women engaged in aerobics, one from the 98 selected elderly, four were excluded by presenting laryngeal affections not resulting from aging, one by presenting hearing loss in a severe level in both ears, with all were sent to specific treatment; and 35 elderly women were lost because they did not complete all assessments. All participants were informed and signed the informed consent in accordance with the ethical principles set by the regulation 466012, from the National Commission of Ethics in Research.

The recording of the vocal emission of the vowel /a:/, sustained in usual pitch and loudness, with emissions in maximum phonation time without using the expiratory reserve, with the participants in the orthostatic position,¹³ the voice recorder and video digital Zoom Q3 Handy Professional Recorder, with audio format PCM quantization 16 bit, 96 kHz sampling frequency, with image sensor VGA CMOS and Frame rate: 30 frames/

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