

Quality of Life in Voice, Vocal Changes and Voice Intelligibility of Teachers

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Abstract— *Objective: to analyze the quality of life in voice and vocal changes in teachers of Reference High Schools, and to analyze the levels of noise in classrooms and intelligibility of the teacher's voices in the same schools. Methods: the present study was performed in five all-day schools and half-day schools in the city of Petrolina/PE, Brazil. Three classrooms in each school were evaluated (n=15) in the morning and in the afternoon shifts. Eighteen teachers participated in the study and the following instruments were used: Quality of Life in Voice Protocol (QVV) and a semi-structured interview script. In order to verify noise, a decibel meter and a dosimeter were used. Results: Teachers had lower vocal quality of life in the total and physical domains, while most reported feeling vocal alterations. On the other hand, the environmental analysis indicated high levels of noise and a possible interference in the intelligibility of the teacher's speeches. Conclusion: The data demonstrate the need for more studies regarding the topic, and more care with the voices of the teachers.*

Keywords— *Quality of life in voice; Vocal changes; Noise; Intelligibility of speech.*

I. INTRODUCTION

Voice is defined as “the sound produced by the passage of air through the vocal folds and modified in the resonance cavities and articular structures” [1], by which the perception in spite of its quality results of the combination of biological, psychological and social factors.

Vocal quality involves the voice characteristics and it is related to the impression that it transmits, considering the physical, psychological and social educational dimensions of the construct. The first aspect contemplates the physiological and anatomical attributes of the individual, while the psychological dimension takes in account the subject's personality and his emotional state in the moment of his speech. The socio-educational dimension, on the other hand, pays attention to factors that are culturally transmitted, such as the accent, slang and specific expressions of a particular group. In the analysis of vocal quality, it is also important to identify nonverbal voice-related signs, such as constant throat clearing, breath tremor, among others, which influence oral communication [2]. Therefore, voice-related quality of life includes the perception of the subject about vocal health and its alterations [3], being important the analysis of the

individual and what is his understanding about his own health, so that it is possible to develop appropriate interventions for these subjects.

The human voice may present limitations when transmitting the verbal message or alteration in its quality, and the difficulty or alteration of the natural voice is called dysphonia, which is configured as a vocal limitation, which can present in different levels of speech. intensity. The mild degree of dysphonia is characterized as occasional, resulting in minimal difficulty in performing vocal activities, which makes the voice still audible in moderate degree, however, the individual presents efforts to speak and fatigue eventually. The vocal aggravation occurs in intense and extreme degrees: in the first, the dysphonia is constant and the voice barely audible, causing an effort to perform or even the inability to perform vocal activities; In the extreme degree, the voice becomes inaudible, with absence or almost absence of voice [1].

The constant presence of noise provokes health damage to the individual. The occupational exposure level to noise, to characterize the ambient insalubrity, according to Brazilian law, NR-15, annex 1, of the Ministry of Labor, to an 8-hour daily exposure is of, at maximum, 85 dB(A) [4]. In every raise of 5 dB(A) it is made necessary to reduce

the period of exposure by half or add other protection measures (as the use of PPE to prevent hearing damage. Although it is necessary to point out that the reduction of this noise should not be lower than 30 dB(A), so it doesn't adapt to the background noise, because when it is very low, any noise, as low as it may be, starts to bother the worker [5].

In a work environment noise varies according to the activity developed, with high frequency noises causing the most disturbance. Noises can cause damage in verbal communication, making it difficult to understand the message when its intensity increases. In verbal communication there is a need not only to hear or to be heard by another person, but also to understand the message. This understanding of speech is related to background noise and the speaker's voice, and for it to occur effectively it is necessary that the speaker has a voice level of at least 10 dB (A) higher than background noise when dealing with familiar matters. When the subject is unfamiliar, it needs a difference of, at least, 20 dB (A) [6]. That is, in a high noise environment, speakers need to increase the level of their voices for verbal communication to occur, and this can cause from medium to long term vocal damage.

In the special case of school environment, the recommended environmental noise level varies according to the ambience, between 45 and 55 dB for circulation environments, 35 to 45 dB for libraries, drawing rooms and music rooms, and between 40 to 50 dB for laboratories and classrooms [7].

The teaching-learning activity often demands intensive use of voice and lack of care due to various vocal changes. Teachers with vocal alterations present more pronounced symptoms due to the use of voice, such as hoarseness, voice loss, tiredness and effort to speak, when compared with professionals who do not present these alterations [8].

Among the factors that may be associated with the worsening of teachers' quality of life are the bad working conditions, vocal tiredness and poor relationship with students, which may lead to the absenteeism of these professionals [9]. In addition, environmental factors stand out such as noise level, for example, if an individual is exposed to a noise level above 60 dB for an extended period, they may have difficulty concentrating and learning [10].

Literature data indicate that in most situations, conditions in the school environment do not favor the vocal health of the professionals who work there. For example, when comparing teachers and professionals who did not use their voice professionally in Belgium, it was found that the prevalence of vocal complaints was

significantly higher in teachers than in other professionals. The most frequently reported symptoms were hoarseness, vocal loss and loss of voice amplitude [11].

At national level, the study by Fabrício, Kasama and Martinez [3] found that the symptoms of vocal disorders most prevalent in university teachers in the city of São Paulo / SP were hoarseness, cough, dry throat and difficulty to be heard in noisy places. These professionals also reported that attitudes towards symptoms did not involve the search for appropriate treatment, but the use of strategies such as reducing voice use or simply not doing anything, and that when they sought some treatment, they opted for the homemade ones (gargling, for example). Nevertheless, the participants in this study assessed themselves as having a good quality of life in relation to voice.

Rossi-Barbosa, Barbosa and Caldeira [12], in turn, found that public school teachers in the city of Montes Claros/MG had a good quality of life in voice, with most participants (76.6%) having stated that their voice was 'excellent' or 'good'. It was also verified a relation between the time of profession and vocal quality, demonstrating that longer teaching time was related to a greater impact on the participants voice.

Behlau et al. [13] conducted an epidemiological study comparing the frequencies and adversities of vocal disorders in full-time teachers and non-teachers (professionals from various professions), with participants from all Brazilian states. In the results, they observed that the group of teachers manifested more vocal alterations at some point in their lives, and that they currently show a higher prevalence rate of these alterations (11.6% for teachers and 7.5% for non-teachers).

With the objective of improving the quality of secondary education, the state of Pernambuco creates the Integral Education Program by Complementary Law No. 125/08, thus establishing all-day full schools and half-day, being named Reference Schools in High Schooling. These schools have differentials compared to regular schools, such as the fact that teachers have exclusive dedication, working hours of 40 hours (full) or 32 hours (semi-full) weekly. Also, an increase in salary, receiving a bonus of location, being added 199% to the base salary of the teacher with 40 hours per week, and 159% to the base salary of those with 32 hours per week [14].

Given the above, this study aimed to analyze the quality of life in voice and vocal alterations in teachers of Reference Schools in High Schooling in the city of Petrolina/PE, and to investigate its relationship with noise in the classroom environment in these schools.

II. METHODS

The present study was conducted in five high school reference schools in the city of Petrolina/PE (all-day and half-day). In these schools, three classrooms were chosen ($n = 15$), each corresponding to one of the three high school grades, to assess the noise levels. The choice of each room was made by on-site visit, having as criteria the rooms facing the noisiest road.

The sample consisted of 18 teachers (17 female teachers and 1 male teacher) who teach in the selected classrooms of each school. The ages of these teachers ranged from 31 to 55 years ($M = 43.28$; $d.p = 7.93$). The criteria for inclusion in the sample were: to be a semi-full or full school teacher from the public school in the city of Petrolina/PE, to teach in the classrooms chosen for environmental analysis, to have at least one year of experience as a teacher and to participate in the study voluntarily. And as exclusion criteria: being away from work or on leave for health reasons and just being a physical education teacher.

III. INSTRUMENTS

To assess the teachers' quality of life in voice, the Quality of Life Voice Protocol (QVV) [15] was used, composed of 10 items that are divided into the physical and social-emotional domains. To analyze the vocal alterations, a semi-structured interview was performed, asking the teacher: "Have you ever felt vocal alterations? If so, which ones? How did it go?" And "Have you ever felt that you forced your voice too much when teaching? Occurs frequently? Are you careful to avoid problems with your voice?"

To analyze the environmental noise level in the classrooms, it was used an Instrutherm decibel meter, Sound Level Meter DEC-5030, with an octave and a third of an octave band filter. It was used the weighting circuit "A", response circuit "low"; measuring range from 30 to 130 dB(A), properly calibrated. For the measurement of occupational noise, an Instrutherm dosimeter model DOS-500, weighting circuit - "A", response circuit - "slow - slow" and measuring range 70 to 140 dB were used. The analyzes followed the Brazilian norms NBR 10.152 [16] and NR-15 [4].

IV. DATA COLLECTION AND ANALYSIS PROCEDURES

The Voice Quality of Life Protocol is a self-applied instrument that was delivered to participants to fill individually in their own work environment and according to their availability.

Noise analysis was performed using a decibel meter in the classrooms with the presence of students, in the morning and afternoon shifts, at seven previously selected points (as shown in fig. 1). One of these points sought to measure the signal from the transmitter, that is, the sound pressure level of the teacher in the classroom during the classes. The data found were compared with the following current standards: NBR 10.152 [16] and NR-15 [4].

The interview with the teachers took place individually, in a place in the school itself, with as little interference as possible.

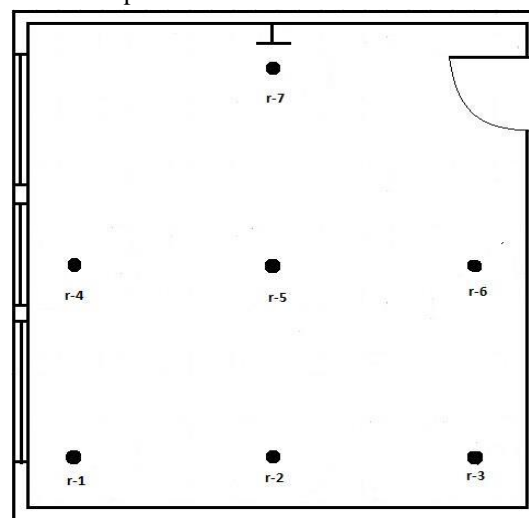


Fig. 1: Classroom noise measurement points

The interviews were analyzed using the content analysis technique [17], following the following steps: first there was a fluctuating reading; then categories were formed that grouped responses with similar content and an analysis protocol was created. Next, there was a careful reading of all interviews, answering the protocol and observing the categories that emerged in the speeches. Finally, the categories were numbered and entered into a database using the statistical software SPSS, version 20.0, through which all quantitative analyzes were performed.

V. ETHICAL ASPECTS

The study was approved by the Human Research Ethics Committee of the Federal University of Vale do São Francisco, under number 48795115.5.0000.5196. Collection began only after compliance with the ethical requirements provided for in Resolution No. 466/12 of the National Health Council.

VI. CONCLUSION

A In general, teachers' quality of life with voice had high scores in the three domains evaluated (total, physical and socio-emotional). These scores could vary between 0 and 100, so that the closer to 0 the worse the vocal quality. The domain that presented lower mean score than the

others was the physical one ($M = 73.28 \pm 17.61$), while the socio-emotional one had the highest index ($M = 85.06 \pm 16.62$), and the total domain presented the average score of $78.97 (\pm 15.46)$. Spearman's test indicated the existence of positive correlations between the total domain and the physical domain ($s = 0.92$; $p < 0.01$), and socio-emotional ($s = 0.76$; $p < 0.01$), and between the physical domain and the social-emotional domain ($s = 0.70$; $p < 0.01$).

88.9% of respondents stated that they already felt some kind of vocal alteration that interfered with their activities. Among the reported vocal disorders, the most common was hoarseness, followed by vocal cord callus and pharyngitis (Fig. 2). As reported by P1, this type of change is very common in teachers' daily life: "Yes, yes, normal... we use a lot of our voice... But there is no way you can work nine classes every day and not feel your throat irritated, voice a little tired, already a little hoarse, I think it is natural" (P1).

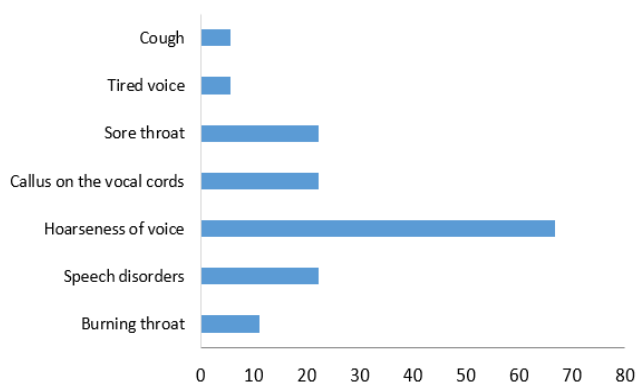


Fig.2: Voice disorders in teachers

When asked what actions they took to take care of their voice, they highlighted water intake (44.4%), gargling (16.7%), talking less and less intensely (22.2%), natural medicines (11.1%), eating apples (11.1%), not eating citrus fruits (5.6%), using a microphone (5.6%), and using medicines (5.6%). No participant stated to have treatment with speech therapist, or perform procedures guided by this type of professional during the period of the interviews, except for water intake. Finally, 11.1% said they had no specific care for their voices. Despite this apparent neglect, almost all respondents (94.4%) stated that they have already forced their voice too much when teaching, and out of these, 38.9% said that this occurs with significant frequency.

Environmental noise assessments in classrooms were conducted from March to October 2016. The standard for acoustic comfort is NBR 10152 [16], which recommends that the noise level in the classroom be between 40 and 50 dB(A). In addition, NR 15 [4] of the Ministry of

Labor and Social Welfare provides that workers should not be exposed to a noise level exceeding 85dB(A) for a daily workday of 8 hours without adequate protection.

The analysis of Table 1 indicates that all classrooms presented average noise levels higher than recommended by NBR 10152¹⁶. The classrooms that presented the highest noise level were the afternoon 3rd year of school A and the 2nd morning and afternoon of school D. In these classrooms, it is important to note that in the afternoon of the 3rd year of school A the teacher delivered the tests at the beginning of the class, causing concern and, even after the end of the delivery, the students continued talking a lot. In the class in which the measurement took place in the class of the 2nd morning class of school D, a content review activity was performed, and the students discussed the questions among themselves and the teacher. In the afternoon shift, the revision activity was corrected, and the subject teacher had to raise the intensity of the voice several times and complain to the students to pay attention, because they were very restless.

For the teacher's voice to be intelligible, Bentler [18] recommends that the level of his speech be higher than the noise level of the room. In addition, the signal to noise ratio (S/R) must be greater than 1.0 dB(A) for the voice to be audible. Another fact that indicates that the teacher's voice in the analyzed schools may be compromised is that even when the Signal is higher than the noise, the S/R index presents values very close to 1.00, which indicates that the noise may be interfering in the speech intelligibility of these professionals. However, even with the teacher's speech being compromised by noise, the teachers reached, in most of the rooms investigated, values above 80 dB(A), and in some almost 90 dB(A).

As can be seen in Table 1, in some rooms the average noise level was higher than the teacher's speech, which may cause impairment of the professional's speech over time. In the remaining classrooms, even with a positive Signal-Noise difference, the value of this difference was low, which also suggests the prevalence of interference with teachers' speech intelligibility in those environments.

Concerning occupational noise, in all analyzed schools, except for the room of the 3rd morning school year E, participants were exposed to a noise level higher than recommended by NR 15 (levels above 90 dB(A)) when it comes to worker exposure in a high noise environment. That is, the rooms that did not comply with the standard do not present acoustic comfort for their participants (Table 2).

Table 1: Ambient noise level

School		1st year		2st year		3st year	
		Morning	Evening	Morning	Evening	Morning	Evening
School A	Leq=R	84.49	82.42	82.04	83.76	79.72	86.07
	Sign	89.2	85.50	80.5	81.00	83.3	88.5
	S/R	1.06	1.04	0.98	0.97	1.04	1.03
	S-R	4.71	3.08	-1.54	-2.76	3.58	2.43
School B	Leq=R	76.33	78.08	82.78	81.86	73.81	78.32
	Sign	77.9	77.7	86.1	84.9	76.4	79.8
	S/R	1.02	1.00	1.04	1.04	1.04	1.02
	S-R	1.57	-0.38	3.32	3.04	2.59	1.48
School C	Leq=R	83.0	79.60	75.41	77.92	78.29	79.87
	Sign	86.6	84.00	79.4	78.8	81.4	74.5
	S/R	1.04	1.06	1.05	1.01	1.04	0.93
	S-R	3.60	4.40	3.99	0.88	3.11	-5.37
School D	Leq=R	84.8	79.63	86.06	86.85	83.21	79.91
	Sign	85.4	78.2	89.6	90.7	81.1	82.7
	S/R	1.01	0.98	1.04	1.04	0.97	1.03
	S-R	0.60	-1.43	3.54	3.85	-2.11	2.79
School E	Leq=R	82.0	85.6	79.5	84.0	81.4	78.0
	Sign	87.9	89.0	83.3	83.3	81.2	82.2
	S/R	1.07	1.04	1.05	0.99	1.00	1.05
	S-R	5.93	3.45	3.80	-0.80	-0.17	4.25

Leq - equivalent continuous sound level

Table 2: Average occupational noise level

School	Turn	1st year	2st year	3st year
School A	Morning	94.98	89.43	92.70
	Evening	91.94	97.97	97.97
School B	Morning	94.68	95.83	87.37
	Evening	87.60	91.70	93.29
School C	Morning	95.89	91.78	91.42
	Evening	81.07	91.21	91.74
School D	Morning	94.68	95.83	87.37
	Evening	87.60	91.70	93.29
School E	Morning	91.07	88.52	83.21
	Evening	10.,15	94.41	93.96

Regarding the classroom of the 3rd morning of the E school, the measurement occurred with the presence of 15 students, when the normal would be more than 30 students, which may have reduced the noise due to the small number of students in the classroom.

VII. DISCUSSION

The average score of vocal quality of life in the participants approached 100, which indicates that the perception of health that these individuals have about the voice is very good, corroborating the findings of Rossi-Barbosa, Barbosa and Caldeira [12]. Another noteworthy fact is that although the scores were high in all domains (physical, socio-emotional and total), what presented the lowest average score was the physical domain, suggesting that the physiological aspects of the voice are more easily perceived than the emotional ones. This facilitation can happen as a result of the direct relation of physical aspects with the impairment of work and routine activities. On the

other hand, questions related to socio-emotional domain start from the perspective of the influence of vocal quality on subjective aspects (for example, they become depressed or anxious).

Although the quality of life of the participants had high average scores, in the semi-structured interview most participants stated that they had already felt vocal alterations. These data corroborate the study by Fabrício, Kasama and Martinez [3], in which the teachers presented high average scores in the instrument that evaluated the vocal quality of life, although they also stated that they felt vocal alterations. This suggests that the participants in the present study have not yet developed identifiable harms by objective measures, but that they have some level of awareness of how stressful the teaching profession can be for the voice, to the point that most claim that the profession caused vocal symptoms.

The acoustic factors presented values higher than recommended by NBR 10152 [16], reaching values of almost 90 dB(A). According to Millanvoye [10], noises above 65 dB(A) can cause the individual to suffer with difficulty in concentration and learning, which would be a worrying factor for a classroom environment. In addition, it is recommended that the individual remain up to 8 hours in a maximum 85 dB(A) [4] environment. Since teachers at reference schools have a high workload in the same classrooms, exposure to these noise levels can have negative health consequences for these professionals, as well as impairing student learning.

The findings of the present study corroborate the studies by Coutinho Filho [19], Silva, Silva and Coutinho [20], Dalvite et al. [21], and Silva and Santos [22], in the sense that care with the acoustic environment in classrooms seem to be an overlooked or ignored factor by the responsible authorities. It is noteworthy that the studies mentioned above were performed in regular schools, unlike the present study, which was conducted in Reference Schools. However, it is clear that the data on the acoustic conditions of the classrooms are similar in both types of schools mentioned here.

Another fact that draws attention is the fact that much of the noise identified in classrooms is caused by the operation of fans and air conditioning, which points to the need for appropriate ergonomic planning for these environments. This factor is one more that contributes to teachers to increase the intensity of the voice, which may cause damage to their health.

In addition, most teachers stated that they had already forced their voice too much when teaching and associated with it, it was found that teachers, at the time of class, had high voice index (signal), reaching levels above 80 dB(A).

Such reality may have serious consequences for their vocal health, if there is no intervention to improve the quality of environmental conditions in the investigated classrooms. In this regard, it is important to remember that participants often reported feeling vocal changes such as hoarseness, throat inflammation, vocal cord callus and speech problems. In addition, they reported not developing preventive attitudes in caring for their voices, which may lead to more severe negative consequences in the future. This lack of search of adequate treatment in relation to the voice of the participants of the present study corroborates the findings of Fabrício, Kasama and Martinez [3], in which the participants, when looking for some kind of care, mostly chose to reduce the voice intensity or resorted to home treatments.

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