

# Prevalence and Associated Factors With Voice Disorders in Brazilian Community-dwelling Older Adults

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**Summary: Objectives.** This study aimed to estimate the prevalence and factors associated with voice disorders (VDs) in Brazilian community-dwelling older adults.

**Study design.** This is a cross-sectional study.

**Methods.** The sample comprised 463 older adults (60 years or more) of both sexes living in a Brazilian northeastern city. Variables were related to socioeconomic and demographic profile, lifestyle, and general health conditions, in addition to the validated “Screening for Voice Disorders in Older Adults” (RAVI) questionnaire. A bivariate analysis was performed using the Pearson chi-square test or the Fisher exact test, and the magnitude of the association was the prevalence ratio (PR). Poisson regression model was performed, considering only the variables with a critical value of  $P < 0.20$ . The significance level was 5%.

**Results.** There was a prevalence of women (60.9%), and the average age of participants was 70 ( $\pm 7.74$ ) years. The prevalence of VDs was 51.4% (95% confidence interval [CI]: 46.8–55.9). The most common symptoms were throat sensation of phlegm (46.9%) and dry throat (46.7%), both related to physical sensations of laryngeal discomfort. Multivariate analysis indicated that the prevalence of VDs was independently associated with hyposalivation (PR = 2.28, 95% CI = 1.80–2.88), smoking (PR = 2.04, 95% CI = 1.65–2.52), self-reported hearing loss (PR = 1.51, 95% CI = 1.28–1.78), and not seeking a physician or other health professional care for VDs (PR = 0.73, 95% CI = 0.60–0.88).

**Conclusion.** VDs are prevalent among Brazilian community-dwelling older adults and are associated with variables related to general health and lifestyle.

**Key Words:** Voice—Voice disorders—Dysphonia—Aging—Cross-sectional studies.

## INTRODUCTION

Aging is a dynamic and progressive process that encompasses organic, functional, and psychosocial changes in an individual.<sup>1–3</sup> Changes that occur throughout aging are also reflected in voice, one of the fundamental elements for human communication. It is through voice that an individual expresses ideas, thoughts, and feelings, and integrates socially<sup>4</sup>; voice is influenced both by individual characteristics and by cultural, social, and temporal aspects.<sup>5</sup>

Voice disorders (VDs) occur when the voice did not work, perform, or sound as it normally should so that it interfered with communication.<sup>6</sup> In addition, VDs can also interfere with physical, emotional, and social capacities, leading to a higher risk of social isolation, unproductiveness, depression, anxiety, and worsening general health.<sup>6,7</sup>

In 2016 and 2017, the validation process of the “Screening for Voice Disorders in Older Adults” (RAVI), a Brazilian Portuguese questionnaire, was published.<sup>8–10</sup> The RAVI has 10 questions and was designed for epidemiologic purposes. The RAVI questionnaire has been used previously with Brazilian older adults living in nursing homes, and the prevalence of VDs was 39.3% (95% confidence interval [CI]: 30.4–48.1).<sup>11</sup>

However, there are few reports on the prevalence of VDs in the community-dwelling older adults, especially on a population-based perspective possibly due to the fragility of the data collection tools used in the few studies previously undertaken.<sup>12</sup>

Epidemiologic diagnosis is a first step in the development of care policies and is a useful way to identify deficiencies and areas for improvement in the health system. Investigating the prevalence and the associated factors with VDs from an epidemiologic perspective may provide further insight into the magnitude of this disorder. Furthermore, the results can guide organization and implementation of actions, and support projects and programs that meet the specificities of care regarding communication for this population. Therefore, the objective of this study was to determine the prevalence and the associated factors with VD in Brazilian community-dwelling older adults.

## METHODS

This was a cross-sectional study with approval report number 1.433.966/2016 from the Research Ethics Committee of the institution (Brazil).

The study population comprised 463 elderly individuals aged 60 years and older, living in Natal, a Brazilian northeastern city. There is no official register of older adults living in the studied city. Then, we performed a quota sampling. The sample size was calculated using the formula  $n = z^2(1 - P)/\epsilon^2 \cdot P$ , where  $z$  is the value that corresponds to a 95% confidence level (1.96),  $P$  is the estimated prevalence of VDs in older adults (50.4%),<sup>11</sup> and  $\epsilon$  is the expected margin of error (10%). In addition, an expected 20% of sample loss was considered. Quota sampling was based on the 2010 Brazilian census.<sup>13</sup> These data showed that the representativeness of older men and women in the 60–69, 70–79, 80–89, and over 90-year-old age groups in

Accepted for publication February 28, 2018.

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Journal of Voice, Vol. 33, No. 5, pp. 806.e1–806.e7  
0892-1997

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<https://doi.org/10.1016/j.jvoice.2018.02.025>

the city of Natal was, respectively, 23% and 32%, 11% and 18%, 4.7% and 9%, and 0.84% and 1.94%. Therefore, of the 463 individuals interviewed, 106 and 148, 51 and 83, 21 and 41, and 4 and 9 men and women composed the first, second, third, and fourth age groups, respectively.

The inclusion criteria consisted of older adults of both sexes, Brazilian nationality, with preserved cognitive capacity defined according to the result of the Short Portable Mental Status Questionnaire (SPMSQ),<sup>14</sup> and living in Natal at the time of data collection. Older adults with a reduced level of consciousness, a self-reported hearing loss without a well-adapted electronic amplification device, and total or partial laryngectomized and tracheostomized individuals were excluded.

Data collection was undertaken in places with a large number of older adult attendance in the city such as supermarkets, squares, and basic health units located in the four administrative zones that included all of the 36 districts of the city. The population was approached by members of the research team who explained the objectives of the study and, if the person agreed to participate, a free and informed consent form was signed and the interview was started.

The RAVI questionnaire<sup>8–10</sup> (Appendix A) was used to estimate the prevalence of VDs. The RAVI questionnaire has 10 questions that included auditory-perceptive and vocal tract discomfort symptoms. The RAVI questionnaire indicates the presence of VDs when the total score is above 2 points, indicating that the respondent should be further evaluated using a procedure with high specificity for diagnostic confirmation.

The variables investigated in this study to identify associated factors with VDs are presented in Appendix B. All variables were dichotomized and grouped into three categories: socioeconomic and demographic factors, lifestyle, and general health.

Initially, a bivariate analysis was performed using the Pearson chi-square test or Fisher exact test, and the magnitude measure of the association was the prevalence ratio (PR). To test the influence of covariables and to identify associated factors, a multivariate analysis was performed using the Poisson regression model, as indicated by the dichotomous nature of the

dependent variable. For insertion into the model, only variables with a critical value of  $P < 0.20$  were considered. For all calculations, the level of significance was 5%.

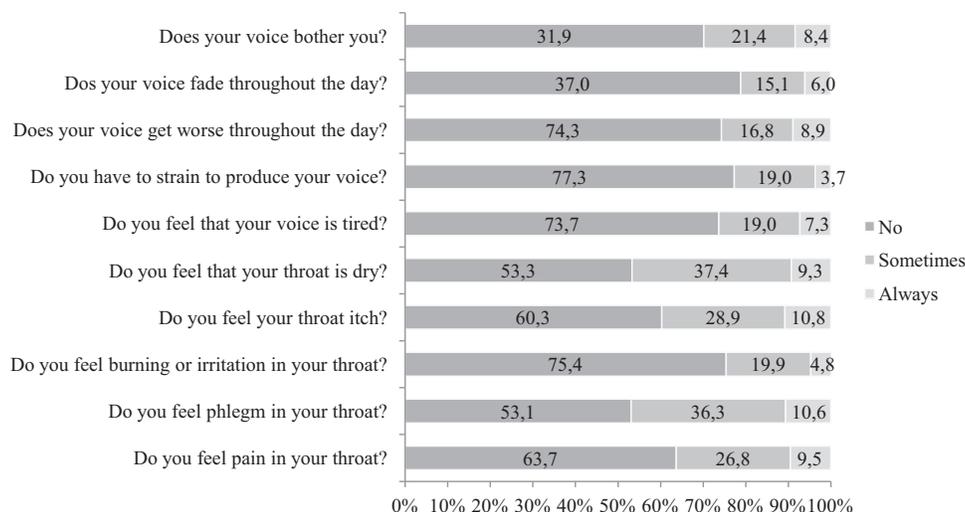
## RESULTS

A total of 282 (60.9%) women and 181 (39.1%) men were evaluated, with a mean age of 70 ( $\pm 7.74$ ) years. An analysis of the socioeconomic and demographic factors revealed that the study population comprised mostly of 60–69-year-old adults (54.6%), living in the east side of the city (34.6%), Caucasian race (self-reported) (55.7%), low education (38.9%), no private health insurance (56.2%), with children (88.6%), married (54.0%), retired (52.7%), and with autonomy in managing their own financial resources (74.3%).

Lifestyle-related variables were as follows: many of the participants did not ever smoke (57.2%) or consume alcohol (58.1%). The majority of respondents replied that they did not constantly use the voice in the workplace in the past (79.5%) and denied that they used their voice extensively on a daily basis (80.1%). The largest proportion of elderly people had regular company to talk to (88.3%) and considered themselves to be active (91.6%).

Regarding general health, 67 (14.5%) older adults have already sought a physician or other health professional care for VDs. A large percentage of participants reported having no problems such as gastroesophageal reflux (69.5%), respiratory allergies (69.1%), sinusitis (79.3%), colds (8%), or sore throat (68.9%). The majority of individuals (71.7%) classified their voice as either excellent, very good, or good. There were respondents who reported difficulties with swallowing (20.3%), self-reported hearing loss (41.9%), temporomandibular dysfunction (13.4%), hyposalivation (44.3%), and depressive symptoms (27.6%). A total of 80.3% of participants reported living independently.

The prevalence of VDs in the community-dwelling older adults was 51.4% (95% CI: 46.8–55.9). According to the RAVI questionnaire results (Figure 1), throat sensation of



**FIGURE 1.** Screening for voice disorders in community-dwelling older adults (n = 463), according to the RAVI questionnaire items. RAVI, *Rastreamento de Alterações Vocais em Idosos*.

phlegm and dry throat sensation were the most common symptoms, followed by throat sensations of itchiness, pain, and burning (Figure 1).

Initially, the bivariate analysis identified an association between VDs and gastroesophageal reflux, respiratory allergies, colds, inflammation of the throat, smoking, self-reported difficulties with swallowing, self-reported hearing loss, temporomandibular dysfunction, hyposalivation, depressive symptoms, and seeking a medical or other health professional care for VDs (Table 1). The multivariate analysis indicated that

hyposalivation, smoking, self-reported hearing loss, and seeking a medical or other health professional care for VDs keep their statistical association with VD in the community-dwelling older adult population (Table 1). The adjusted prevalence of VD was 2.28 times higher in those with hyposalivation, 2.04 times higher in smokers or former smokers, and 1.51 times higher in those who reported a hearing loss. In the case of the older adults who have not sought a physician or other health professional care for VDs, the prevalence of VDs was 27% lower.

**TABLE 1.**  
**Associated Factors With Voice Disorders in Community-dwelling Older Adults (Bivariate and Multivariate Analyses) (n = 463)**

	VDs		Bivariate Analysis		Multivariate Analysis	
	n	%	P-value*	PR (95% CI)	P-value <sup>†</sup>	PR <sup>adjusted</sup> (95% CI)
Gastroesophageal reflux						
Yes	88	62.4	<b>&lt;0.001</b>	1.33 (1.12–1.59)	—	—
No	150	46.6		1.00		
Respiratory allergies						
Yes	95	66.4	<b>&lt;0.001</b>	1.48 (1.25–1.75)	—	—
No	143	44.7		1.00		
Cold (three colds over a year)						
Yes	86	63.7	<b>&lt;0.001</b>	1.37 (1.15–1.63)	—	—
No	152	46.3		1.00		
Sore throat (three colds over a year)						
Yes	95	66.0	<b>&lt;0.001</b>	1.47 (1.24–1.74)	—	—
No	143	44.8		1.00		
Smoking (smoking for ≥1 y; current or past)						
Yes	168	84.8	<b>&lt;0.001</b>	3.21 (2.60–3.96)	<b>0.001</b>	2.04 (1.65–2.52)
No	70	26.4		1.00		
Constant use of voice in the workplace in the past						
Yes	55	57.9	0.155	1.16 (0.95–1.42)	—	—
No	183	49.7		1.00		
Current use of professional voice						
Yes	59	64.1	<b>0.003</b>	1.32 (1.10–1.60)	—	—
No	179	48.2		1.00		
Sought a physician or health professional care for voice disorders						
No	200	50.5	<b>0.045</b>	0.78 (0.63–0.97)	<b>0.001</b>	0.73 (0.60–0.88)
Yes	42	62.7		1.00		
Self-reported difficulties in swallowing						
Yes	62	66.0	<b>&lt;0.001</b>	1.38 (1.15–1.65)	—	—
No	176	47.7		1.00		
Self-reported hearing loss						
Yes	151	77.8	<b>&lt;0.001</b>	2.40 (1.99–2.90)	<b>0.001</b>	1.51 (1.28–1.78)
No	87	32.3		1.00		
Temporomandibular disorder						
Yes	44	71.0	<b>&lt;0.001</b>	1.46 (1.21–1.77)	—	—
No	194	48.4		1.00		
Hyposalivation						
Yes	176	85.9	<b>&lt;0.001</b>	3.57 (2.85–4.47)	<b>0.001</b>	2.28 (1.80–2.88)
No	62	24.0		1.00		
Depressive symptoms						
Yes	78	60.9	<b>0.011</b>	1.27 (1.06–1.52)	—	—
No	160	47.8		1.00		

\*Chi-square test.

<sup>†</sup>Multivariate Poisson regression.

Abbreviations: CI, confidence interval; PR, prevalence ratio; VDs, voice disorders.

Bold values = significance level ≤ 0.05.

## DISCUSSION

The results of this study indicate that slightly more than a half of the Brazilian community-dwelling older adults presented with VDs. The prevalence observed in this study surpassed the largest proportion (29.1%) found in population-based studies with older adults living in the community,<sup>12</sup> which was the result of an American study<sup>6</sup> regarding noninstitutionalized people, in which the presence of VDs was defined by a nonvalidated assessment tool.

In Brazil, there is no previous information on the prevalence of VDs in community-dwelling older adults from an epidemiologic perspective. Only one study<sup>15</sup> has produced a robust result in this area. However, data on VD occurrence (52.4%) do not represent the prevalence of this condition in old age, but across the lifetime.

When the RAVI questions were analyzed separately, symptoms related to laryngeal discomfort were most frequently reported, a result similar to that found in studies with institutionalized<sup>11</sup> and noninstitutionalized older adults.<sup>6</sup> This finding indicates that older adults with VDs are more likely to identify physical sensations of discomfort of the vocal tract than the auditory-perceptive characteristics, no matter where the individual is living.<sup>11</sup>

Multivariate analysis highlighted hyposalivation, smoking, self-reported hearing loss, and seeking a physician or other health professionals care as associated factors with VDs. Clearly, associated factors with VDs in this population were related to general health and lifestyle variables.

Hyposalivation has been reported to be a condition that predisposes to dysgeusia, pain, a burning sensation in the mouth, dental caries, dysphagia, and dysphonia.<sup>16</sup> Because of the multifactorial etiologic nature of this condition, it has yet to be determined whether advancing age is the sole cause of a decrease in salivary flow.<sup>17</sup> Regarding dysphonia, no direct links were identified with hyposalivation, but there were links with xerostomia, which is a subjective patient sensation of a decrease in salivary flow.<sup>17</sup> In the general population, xerostomia has been identified as a variable associated with prior, chronic, or current VDs and with a poor quality of life.<sup>18</sup>

Smoking was also an associated factor with VDs in this study and has been previously established as a risk factor for laryngeal diseases, including laryngeal cancer. This risk is even greater in the older adult population.<sup>19–21</sup> There is evidence that the larynx is the most sensitive organ to histopathological changes after exposure to cigarette smoke and that prolonged exposure to smoke changes vocal quality, causes irritation of the vocal tract, edema in the vocal folds, coughing, a burning sensation, secretions, and infection.<sup>22,23</sup>

Additionally, self-reported hearing loss was associated with VDs. Voice and hearing have a symbiotic relationship, especially regarding auditory monitoring of speech. Therefore, older adults with difficulties in these communicative elements can have an impaired quality of life,<sup>24</sup> resulting in symptoms of depression, distress, social isolation, and negative self-assessment of general health.<sup>25,26</sup> According to the results of the present study, the community-dwelling older adults with self-reported hearing loss have approximately twice the prevalence

of VDs compared with those without complaints on hearing. The result may suggest that, especially in the group in which the disabilities coexist, the chances of communicative restriction and psychosocial withdrawal are greater, accelerating both functional and quality of life decline.

Despite finding an association between hearing loss and VDs, more studies with instrumental auditory evaluation are necessary to confirm this finding.<sup>24</sup> It is known that the older adult with moderate to profound hearing loss have alterations in vocal production, as they need to make more effort or increase the vocal intensity to be able to hear themselves speak.<sup>24</sup>

According to our results, the prevalence of VDs is lower in the older adults who have not sought a physician or other health professional care for VDs. It is assumed that this group of older adults is less concerned about their communication and their physical, social, and mental well-being. Even when they perceive some change in their voice pattern, they choose not to seek a qualified professional, which leads to an epidemiologic and clinical underdiagnosis of VDs. According to previous data,<sup>27</sup> individuals with voice or laryngeal disorders who sought the care of a physician or health professional presented with positive changes in the voice at the end of the treatment, thus confirming the effectiveness of the intervention by a specialized professional in the management of VDs.

The prevalence of VDs found in this study indicates that this is not a rare finding in Brazilian community-dwelling older adults, even exceeding the prevalence reported in an institutionalized elderly population within the same city. In addition, it is a communicative capacity disorder associated with other factors, which requires attention within the health-care system to identify issues early and to act on them. The results presented in this study could help on the development of strategies related to the significance of vocal communicative integrity for the maintenance of the cognitive, functional, physical, and psychosocial capacities in community-dwelling older adults.

This study has some limitations. First, the study design is cross sectional and does not allow cause and effect interpretations between variables. Second, as most of the information was self-reported and the target population comprised older adults, memory and response bias may have occurred. Third, the lack of an official register of older adults living in the studied city did not allow sampling to be probabilistic.

In contrast, this study is the first epidemiologic investigation to determine the prevalence and the associated factors with VDs in community-dwelling older adults using a validated and reliable tool for this purpose. In addition, this was the first study to describe the prevalence of VDs in community-dwelling older adults using a controlled and robust sampling process (quote sampling).

## CONCLUSIONS

VDs are common in Brazilian community-dwelling older adults. The associated factors with VDs were hyposalivation, smoking, self-reported hearing loss, and seeking a physician or health professional care for VDs. Intervention strategies can be

implemented to address these associated factors both by health professionals and within the population itself. Regular screening procedures with adequate tools for epidemiologic purposes are necessary for early identification of VDs in community-dwelling older adults not only in Brazil but also in other countries.

### Acknowledgments

The authors are indebted to Fundação de Apoio à Pesquisa do Estado do Rio Grande do Norte—FAPERN (*edital FAPERN/CNPq 003/2011, Programa de Apoio a Núcleos Emergentes—PRONEM*) for funding this research (process number 77228/2013).

## APPENDIX A. RASTREAMENTO DE ALTERAÇÕES VOCAIS EM IDOSOS (RAVI; SCREENING FOR VOICE DISORDERS IN OLDER ADULTS)\*

As perguntas que farei são relacionadas à sua voz e às possíveis sensações de irritação ou desconforto na sua garganta. Quando sua resposta for “sim,” indique qual a alternativa que melhor expressa o quanto o sintoma é frequente no seu dia a dia (“às vezes” ou “sempre”).

*The questions I will be asking are related to your voice and possible sensations of irritation and discomfort in your throat. When your answer is “yes,” please indicate which option best expresses how often you have experienced the symptom in your daily life (“sometimes” or “always”).*

### Rastreamento de Alterações Vocais em Idosos (RAVI) (Screening for Voice Disorders in Older Adults)

Questões (Questions)	NÃO (NO) (0)	SIM (YES)	
		ÀS VEZES (SOMETIMES) (1)	SEMPRE (ALWAYS) (2)
1. Sua voz lhe incomoda? (Does your voice bother you?)			
2. Sua voz some ao longo do dia? (Does your voice fade throughout the day?)			
3. Sua voz piora ao longo do dia? (Does your voice get worse throughout the day?)			
4. Sente que faz esforço para a voz sair? (Do you have to strain to produce voice?)			
5. Sente cansaço na voz? (Do you feel your voice is tired?)			
6. Sente sua garganta seca? (Do you feel your throat is dry?)			
7. Sente coceira na garganta? (Do you feel your throat itch?)			
8. Sente queimação, ardência na garganta? (Do you feel burning or irritation in your throat?)			
9. Sente pigarro na garganta? (Do you feel phlegm in your throat?)			
10. Sente dor na garganta? (Do you feel pain in your throat?)			
	Pontuação Total (Total Score)		

\*The English language translation was conducted by the authors of the article only for publication purposes. There is still no translation or cultural adaptation of the RAVI for English.

Para o entrevistador: Atribua um ponto às respostas “às vezes” e dois pontos às respostas “sempre.” Nenhum ponto deve ser atribuído à resposta “não.” O escore total será o resultado da soma dos valores atribuídos às respostas “às vezes” e “sempre.” O escore mínimo é 0 e o escore máximo é 20. Quanto mais próximo do escore máximo, pior o resultado.

*To the interviewer: Assign 1 point to “sometimes” responses and 2 points to “always” responses. No point should be given to “no” responses. The total score will be the result of the summation of the values assigned to the “sometimes” and “always” responses. The minimum score is 0; the maximum score is 20. The closest to the maximum score, the worse the result.*

## APPENDIX B. VARIABLES EXAMINED FOR IDENTIFICATION OF FACTORS ASSOCIATED WITH VOICE DISORDERS IN BRAZILIAN COMMUNITY-DWELLING OLDER ADULTS

Category	Variable
Socioeconomic and demographic	Sex
	Age
	Administrative area
	Race (self-reported)
	Education
	Private health insurance
	Children
	Marital status
	Occupational situation
	Management of financial resources
Lifestyle	Smoking (smokers for $\geq 1$ year—at least 20 cigarettes/day—current or past)
	Frequent consumption of alcohol (more than five drinks/week—current or past)
	Constant use of voice in the workplace in the past
	Company to talk on a daily basis
General Health	General daily inactivity (subjective)
	Gastroesophageal reflux
	Respiratory allergies
	Sinusitis
	Colds (three times over a year)
	Sore throat (three times over a year)
	Sought a physician or health professional care for voice disorders
	Self-assessment of voice
	Self-reported difficulties in swallowing
	Self-reported hearing loss
Temporomandibular disorder (Simplified Questionnaire for Temporomandibular Disorder diagnosis in adults)*	
Hyposalivation (Xerostomia Questionnaire for detecting hyposalivation)†	
Depressive symptoms (Geriatric Depression Scale Abridged)‡	
Dependency	

\*Cutoff value for normal range =  $<7$ .  
†Cutoff value for normal range =  $\leq 1$ .  
‡Cutoff value for normal range =  $\leq 5$ .

## REFERENCES

- United Nations. World population ageing; 2013. Available at: <http://www.un.org/en/development/desa/population/publications/pdf/ageing/World-PopulationAgeing2013.pdf>. Accessed 11 June 2016.
- Veras RP. Population aging today: demands, challenges and innovations. *Rev Saude Publica*. 2009;43:548–554 [in Portuguese].
- Ministério da Saúde. *Atenção à saúde da pessoa idosa e envelhecimento*. Brazil: Ministério da Saúde; 2010. Available at: [http://bvsms.saude.gov.br/bvs/publicacoes/atencao\\_saude\\_pessoa\\_idosa\\_envelhecimento\\_v12.pdf](http://bvsms.saude.gov.br/bvs/publicacoes/atencao_saude_pessoa_idosa_envelhecimento_v12.pdf). Accessed 14 June 2015 [in Portuguese].
- Menezes LN, Vicente LCC. Vocal aging of institutionalized elderly people. *Rev CEFAC*. 2007;9:90–98 [in Portuguese].
- Ceballos AGC, Carvalho FM, Araújo TM, et al. Auditory vocal analysis and factors associated with voice disorders among teachers. *Rev Bras Epidemiol*. 2011;14:285–295.
- Roy N, Stemple J, Merrill M, et al. Epidemiology of voice disorders in the elderly: preliminary findings. *Laryngoscope*. 2007;117:628–633.
- Merrill RM, Anderson AE, Sloan A. Quality of life indicators according to voice disorders and voice-related conditions. *Laryngoscope*. 2011;121:2004–2010.
- Pernambuco LA, Espelt A, Magalhães Junior HV, et al. Screening for voice disorders in older adults (Rastreamento de Alterações Vocais em Idosos—RAVI)—Part I: validity evidence based on test content and response processes. *J Voice*. 2016;30:246 e9–e17.
- Pernambuco LA, Espelt A, Costa EBM, et al. Screening for voice disorders in older adults (Rastreamento de Alterações Vocais em Idosos—RAVI)—Part II: validity evidence and reliability. *J Voice*. 2016;30:246 e19–27.
- Pernambuco LA, Espelt A, Lima KC. Screening for voice disorders in older adults (RAVI)—Part III: cutoff score and clinical consistency. *J Voice*. 2017;31:117.e17–117.e22.
- Pernambuco LA, Espelt A, Góis ACB, et al. Voice disorders in older adults living in nursing homes prevalence and associated factors. *J Voice*. 2017;31:510.e17–510.e21.
- Pernambuco LA, Espelt A, Balata PMM, et al. Prevalence of voice disorders in the elderly: a systematic review of population based studies. *Eur Arch Otorhinolaryngol*. 2015;272:2601–2609.
- Instituto Brasileiro de Geografia e Estatística (IBGE). Indicadores Socio-demográficos e de Saúde no Brasil. Available at: [https://ww2.ibge.gov.br/english/estatistica/populacao/indic\\_sociosaude/2009/indicosaude.pdf](https://ww2.ibge.gov.br/english/estatistica/populacao/indic_sociosaude/2009/indicosaude.pdf). Accessed 10 September 2016 [in Portuguese].
- Pfeiffer E. A short portable mental status questionnaire for the assessment of organic brain deficit in elderly patients. *J Am Geriatr Soc*. 1975;23:433–441.

15. Behlau M, Zambon F, Guerrieri AC, et al. Epidemiology of voice disorders in teachers and nonteachers in Brazil: prevalence and adverse effects. *J Voice*. 2012;26:665e9–665e18.
16. Saleh J, Figueiredo MA, Cherubini K, et al. Salivary hypofunction: an update on aetiology, diagnosis and therapeutics. *Arch Oral Biol*. 2015;60:242–255.
17. Han P, Suarez-Durall P, Mulligan R. Dry mouth: a critical topic for older adult patients. *J Prosthodont Res*. 2015;59:6–10.
18. Cohen SM. Self-reported impact of dysphonia in a primary care population: an epidemiological study. *Laryngoscope*. 2010;120:2022–2032.
19. Gonzalez J, Carpi A. Early effects of smoking on the voice: a multidimensional study. *Med Sci Monit*. 2004;10:649–656.
20. Svhultz P. Vocal fold cancer. *Eur Ann Otorhinolaryngol Head Neck Dis*. 2011;128:301–308.
21. Zygogianni AG, Kyrgias G, Karakitsos P, et al. Oral squamous cell cancer: early detection and the role of alcohol and smoking. *Head Neck Oncol*. 2011;3:2–10.
22. Vasconcelos SV, Mello RJV, Silva J, et al. Effects of smoking on the elderly people's vocal cords dimensions. *Int Arch Otorhinolaryngol*. 2009;13:24–29.
23. Pinto AGL, Crespo AN, Mourão LF. Influence of smoking isolated and associated to multifactorial aspects in vocal acoustic parameters. *Braz J Otorhinolaryngol*. 2014;80:60–67.
24. Cohen SM, Turley R. Coprevalence and impact of dysphonia and hearing loss in the elderly. *Laryngoscope*. 2009;119:1870–1873.
25. Santos SB, Oliveira LB, Menegotto IH, et al. Hearing difficulties perceived by long lived and nonlong-lived residents of a long stay institution for the elderly. *Estud Interdisc Envelhec*. 2012;17:125–143 [in Portuguese].
26. Acar B, Yurekli MF, Babademez MA, et al. Effects of hearing aids on cognitive functions and depressive signs in elderly people. *Arch Gerontol Geriatr*. 2011;52:250–252.
27. Cohen SM, Dinan MA, Kim J, et al. Otolaryngology utilization of speech-language pathology services for voice disorders. *Laryngoscope*. 2015;126:906–912.