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# Profile and speech-language rehabilitation of patients with laryngeal cancer

## *Perfil e reabilitação fonoaudiológica de pacientes com câncer de laringe*

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**Keywords**

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## ABSTRACT

**Purpose:** to describe the clinical and sociodemographic profile and analyze the voice rehabilitation outcomes of patients with laryngeal cancer. **Methods:** cross-sectional study with 204 individuals with laryngeal cancer treated between 1989 and 2015. The variables describing the patients' profile were presented in absolute values (n) and percentage (%). The association between the speech-language therapy outcome and the sociodemographic and clinical characterization variables was verified by means of uni- and multivariate techniques. **Results:** 95.1% of the patients are male; 53.43% are aged 60 or more; 77.37% have elementary education; 44.12% are in the service industry; 81.63% smoke and consume alcohol; 30.4% are stage T3. Absence of nodules was found in 72.00%, and of metastasis, in 85.6% of patients. The most frequent therapeutic procedure was complete or partial laryngectomy (69.61%). There was an association among education, disease stage, habits, and therapeutic outcome with speech-language therapy ($p<0.001$). **Conclusion:** Several causes can affect the prognosis of vocal rehabilitation in patients with laryngeal cancer. Optimization and diversification of new therapeutic procedures are challenges for these patients' speech-language rehabilitation.

**Descritores**

Neoplasias de Cabeça e Pescoço
Fonoaudiologia
Fonoterapia
Reabilitação dos Transtornos da Fala e da Linguagem
Otolaringologia

## RESUMO

**Objetivo:** descrever o perfil clínico e sociodemográfico e o desfecho da reabilitação fonoaudiológica de pacientes com câncer de laringe. **Método:** estudo transversal com 204 pessoas atendidas entre 1989 e 2015. A associação entre desfecho da fonoterapia e variáveis de caracterização sociodemográfica e clínicas foi verificada por técnicas univariadas e multivariadas. **Resultados:** prevalência do gênero masculino (95,10%), 60 anos ou mais (53,43%), ensino fundamental (77,37%), setor de serviços (44,12), tabagistas e etilistas (81,63%); estágio T3 (30,4%), ausência de nódulos (72,00%) e de metástase (85,6%). O procedimento terapêutico mais frequente foi a laringectomia total ou parcial (69,61%). Houve associação da escolaridade, estágio da doença, hábitos e procedimento terapêutico com desfecho da fonoterapia ($p<0,001$). **Conclusão:** fatores sociodemográficos e clínicos podem interferir no prognóstico da reabilitação vocal de pessoas com câncer de laringe. A otimização e diversificação de novos procedimentos terapêuticos são desafios na reabilitação fonoaudiológica destas pessoas.

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## INTRODUCTION

Laryngeal cancer is the most common type of head and neck cancer and the second most common respiratory tract cancer in the world. Its annual incidence is estimated around 156,877 new cases and 83,376 deaths[1,2]. In the United States, 13,150 new cases of laryngeal cancer are expected for 2018, affecting 10,490 men and 2,660 women,[2] and 7,670 new cases are expected in Brazil—6,390 in men and 1,280 in women[3]. Data from Sistema de Informação sobre Mortalidade (SIM) [Mortality Information System] shows that 4,141 Brazilians died from this type of cancer in 2013, of which 3,635 men and 506 women[3].

The age-adjusted global rate is 5.7 cases per 100,000 inhabitants, although it is higher among men above 40 years of age[1-4]. In Brazil, the risk of disease incidence in 2018 will be of 6.17 cases per 100,000 men and of 1.20 cases per 100,000 women[3]. This is, therefore, a global public health issue.

Approximately two thirds of laryngeal tumors appear in the vocal folds (glottis) and one third, in the supraglottal larynx (above the vocal folds). Prognostics is positive upon early diagnosis (80% to 100% of cure)[1]. The incidence of these tumors is influenced by environmental factors and lifestyle, such as: smoking, alcoholism, and exposure to occupational hazard chemicals (asbestos, strong inorganic acids, cement dust, and free crystalline silica), heredity, human papillomavirus (HPV) infection, gastroesophageal reflux, and a diet poor in fruits and vegetables and rich in salted meat and fats[5].

Tumor treatment options are surgery, radio- and/or chemotherapy—in association or monotherapy[6]. The choice of procedure depends upon cell type, degree of differentiation, tumor location and size, its macroscopic characteristics, potential bone and muscle involvement, the presence of lymph node metastases, as well as the patient's socio-economic and demographic profile. In addition, it is also important to take into account the preservation of patients' speech, salivation, swallowing mechanism, and their physical, social, and occupational conditions[7]. The surgical treatment may involve full laryngeal resection (complete laryngectomy), in the case of advanced tumors (T3 and T4), or partial laryngeal resection (partial laryngectomy), in less severe cases[8].

The more or less aggressive therapeutic procedures may cause difficulties in cervical mobilization, dysphagia, and alterations in taste and voice, which requires the intervention of a speech-language therapist alongside the medical team. In this sense, the speech-language therapist is the health care professional in the team qualified and responsible for assessment, functional diagnosis, and rehabilitation of swallowing and voice functions in laryngeal cancer patients.

The importance of speech-language therapy has become increasingly popular since the first complete laryngectomy in laryngeal cancer, performed by Billroth, in 1873, for treatment of a glottal tumor with larynx resection, where vocal rehabilitation was described as part of the treatment[9]. In the 1970's, patients who had undergone complete laryngectomy and were self-taught in vocal rehabilitation developed this work in Brazil. Speech-language therapist Antônio Amorim, who volunteered at hospital AC Camargo for 14 years, has also played a role in the rehabilitation of laryngectomized patients. Later, speech-language therapy sought to improve diagnostics and therapy practice in an attempt to adapt these techniques to partially laryngectomized patients, both for voice and swallowing. Since then, the development of this field has taken a place in syllabuses for under graduation and other courses, internship programs, specializations, and in research and publications[10].

The speech-language therapist carries out assessment, functional diagnosis, and rehabilitation of swallowing and voice functions of individuals with laryngeal cancer[11]. Speech-language rehabilitation of people with laryngeal cancer depends on the stage and treatment prognostics. There are three rehabilitation methods for patients who have undergone complete laryngectomy: esophageal speech, electrolarynx, and tracheoesophageal prostheses[12]. Patients undergoing surgery—often associated with radio- and/or chemotherapy—require speech/voice and swallowing therapy, whereas patients treated with radio- and/or chemotherapy alone require dysphagia and voice therapy[13]. Thus, this study is justified by virtue of the complexity and evolution of laryngectomized patients' rehabilitation, and given that speech-language therapy has sought to build its practice based on theoretical and practical knowledge, as well as social responsibility, with a view to reintegrate these patients in society.

In light of the above, this study aims to describe the clinical and sociodemographic profile, as well as the outcome of speech-language rehabilitation of people with laryngeal cancer treated at the otolaryngology and speech-language therapy facility of a teaching hospital.

## METHODS

This study has been approved by the Research Ethics Committee of Faculdade de Medicina de São José do Rio Preto on August 14, 2002 under protocol number 66.463. Signing of the informed consent agreement was not required, as the research data has been collected from medical records.

This cross-sectional study was carried out by surveying data from the medical records of 204 patients with laryngeal cancer seen at a teaching hospital between 1989 and 2015.

The hospital is provided with a specialized speech-language therapy service. After medical consultation, the therapeutic procedures and referral to speech-language rehabilitation are planned by the multidisciplinary team.

The study included all of the patients with laryngeal cancer seen by the otolaryngology service—Head and Neck Cancer and referred for speech-language rehabilitation between 1989 and 2015. The study excluded patients with incomplete notes on their records.

The following variables were selected to describe the cases:

### Sociodemographic

Gender (male/female), age range (20-59 y.o. and 60+ y.o.), education level (no education, elementary school, high school, and college degree), occupation (agricultural, commercial worker, service provider, and others) and lifestyle (smoking/alcoholism).

## Clinics

The TNM Staging System, proposed by the Union for International Cancer Control (UICC), introduces a classification of tumor staging according to three parameters: tumor size (letter T), nearby lymph nodes involved (letter N), and distant metastasis (letter M). A number after the letter code indicates the disease's degree of progression (T, T0, T1, T2, T3, T4, N, N0, N1, N2, N3, M, M0, and M1)[12]. Thus, the following variables were selected: Tumor stage (T1, T2, T3, and T4); lymph nodes involved (yes or no); metastasis (yes or no); therapy (partial laryngectomy, complete laryngectomy, chemo-/radiotherapy).

## Speech-language rehabilitation

The following variables were assessed with regard to the patients' speech-language rehabilitation profile: alteration in the stomatognathic system's function (tongue) and alteration of neurovegetative system (speech/voice and speech/voice/swallowing) upon first assessment; whether oral communication has progressed, and the outcomes of speech-language therapy (development of written and gestural communication; development of gestural communication; improvement of dysphagia/dysphonia; improvement of dysphonia, development of oral communication with electrolarynx, and development of oral communication with esophageal speech by the end of the treatment.

The average period of patients' speech-language therapy was of three months, with weekly 60-min one-on-one sessions.

In order to describe the profile of the laryngeal cancer patients, the variables were presented in absolute (n) and percentage values (%). Association between the speech-language therapy outcome and the sociodemographic and clinical characterization variables was performed by uni- and multivariance techniques.

The multivariate approach, carried out by means of the Multiple Correspondence Analysis, allowed for the observation of relationships between the most important variables of the study. This approach is interesting as it presents outcomes that cannot be observed by the univariate approach (associative). In this context, the Multiple Correspondence Analysis was applied with the aim to observe the correspondence between the speech therapy outcomes and the other variables assessed.

The Multiple Correspondence Analysis indicates that the variables near one another are highly correspondent and significantly related. Distant variables are poorly related or not correspondent at all. The analyses are normally carried out by quadrants.

Comparisons, when relevant, were made by the chi-square test, where a p-value below or equal to 0.05 was considered significant. The Minitab 17 (Minitab Inc.®) and Statistica 10 (StatSoft Inc.®) software were used for analysis.

## RESULTS

The results showed that most patients assessed were male (194-95.10%), aged 60 or more (109-53.43%), had elementary schooling (106-77.37%), worked in services (90-44,12%), and were smokers and alcohol consumers (160-81.63%) (Table 1).

Table 2 shows that the majority of the patients assessed were stage 3-T3 (38-30.40%) and did not present lymph nodes (90-72.00%) nor metastasis (107-85.60%). In addition, the most common procedure in this patient population was laryngectomy (160-78.43%), where 139 (68.14%) were complete and 21 (10.29%), partial. Among the partial laryngectomy patients, 15 (7.35%) had the procedure associated with radiotherapy. Among the 139 patients who underwent complete laryngectomy, 126 (61.76%) had the procedure associated with radiotherapy and 9 (4.41%) with radio- and chemotherapy. Among the 44 patients treated with radio- and chemotherapy,34 (16.67%) received radiotherapy exclusively.

**Table 1.** Socio-demographic profile of individuals with laryngeal cancer

| Socio-demographic variables | n | % |
|---|---|---|
| **Gender** | 204 | 100 |
| Female | 10 | 4.90 |
| Male | 194 | 95.10 |
| **Age range** | 204 | 100 |
| 20 to 59 years old | 95 | 46.57 |
| Above 60 years old | 109 | 53.43 |
| **Education*** | 137 | 100 |
| No education | 16 | 11.68 |
| Elementary school | 106 | 77.37 |
| High school | 13 | 9.49 |
| College degree | 2 | 1.46 |
| **Occupation (industries)** | 204 | 100 |
| Agriculture | 34 | 16.67 |
| Commerce | 17 | 8.33 |
| Services | 90 | 44.12 |
| Others | 63 | 30.88 |
| **Habits*** | 196 | 100 |
| None | 4 | 2.04 |
| Smoking | 32 | 16.33 |
| Smoking/alcohol consumption | 160 | 81.63 |

*The n presented differs from the total due to unanswered variables

**Table 2.** Clinical profile of laryngeal cancer cases

| Clinical variables | n | % |
|---|---|---|
| **Tumor stage*** | 125 | 100 |
| T1 | 35 | 28.00 |
| T2 | 16 | 12.80 |
| T3 | 38 | 30.40 |
| T4 | 36 | 28.80 |
| **Presence of nodes*** | 125 | 100 |
| No | 90 | 72.00 |
| Yes | 35 | 28.00 |
| **Metastasis*** | 125 | 100 |
| No | 107 | 85.60 |
| Yes | 18 | 14.40 |
| **Therapeutic procedure*** | 204 | 100 |
| Partial laryngectomy | 21 | 10.29 |
| Complete laryngectomy | 139 | 68.14 |
| Chemotherapy/radiotherapy | 44 | 21.57 |

*The n presented differs from the total due to unanswered variables

**Table 3.** Speech-language rehabilitation profile of individuals with laryngeal cancer

| Speech-language rehabilitation variables | n | % |
|---|---|---|
| **Alterations in stomatognathic system function** | 204 | 100 |
| Alterations in the tongue | 47 | 23.04 |
| No alterations | 157 | 76.96 |
| **Alterations in neurovegetative system function** | 204 | 100 |
| Speech/voice | 154 | 75.49 |
| Speech/voice/swallowing | 50 | 24.51 |
| **Development of oral communication** | 204 | 100 |
| No | 73 | 35.78 |
| Yes | 131 | 64.22 |
| **Speech-language therapy outcome** | 204 | 100 |
| Development of written and gestural communication | 44 | 21.57 |
| Development of gestural communication | 29 | 14.22 |
| Improvement of dysphagia/dysphonia | 33 | 16.18 |
| Improvement of dysphonia | 32 | 15.69 |
| Development of oral communication with electrolarynx | 20 | 9.80 |
| Development of oral communication with esophageal voice | 46 | 22.55 |

Table 3 presents the speech-language rehabilitation profile of people with laryngeal cancer. The results have shown that most patients did not present alterations in stomatognathic system function (157-76.96%). As to the neurovegetative system, the most frequent outcomes for most patients undergoing partial laryngectomy was the development of speech and voice (154-75.49%) and/or oral communication (131-64.22%); people submitted to complete laryngectomy developed esophageal voice (46-22.55%) and written and gestural speech (44-21.57%). Among the latter, illiterate patients developed gestural communication alone.

Table 4 shows the association between the speech-language therapy outcome variables and the socio-demographic and clinical variables. A significant association was found between the speech-language therapy outcomes and education ($p<0.001$). The results suggest that gestural communication development is more frequent in patients with no schooling; dysphonia improvement is increased among patients who have completed elementary school; dysphagia/dysphonia improvement and electrolarynx speech is increased in patients who have completed high school. Moreover, three significant associations with the outcomes of speech-language therapy are observed: Tumor

**Table 4.** Association between the outcome of speech-language therapy and the socio-demographic and clinical variables

| Socio-demographic and clinical variables | Speech-language therapy outcome | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Written and gestural communication | | Gestural communication | | Improvement of dysphagia and dysphonia | | Improvement of dysphonia | | Electrolarynx | | Esophageal voice | |
| | n | % | n | % | n | % | n | % | n | % | n | % |
| **Age range (p=0.445)**[1] | | | | | | | | | | | | |
| 20 to 59 years old | 22 | 23.16 | 9 | 9.47 | 16 | 16.84 | 13 | 13.68 | 11 | 11.58 | 24 | 25.26 |
| Above 60 years old | 22 | 20.18 | 20 | 18.35 | 17 | 15.60 | 19 | 17.43 | 9 | 8.26 | 22 | 20.18 |
| **Education**[2] **(p<0.001)1** | | | | | | | | | | | | |
| No education | 0 | 0.00 | **9** | **56.25** | 2 | 12.50 | 3 | 18.75 | 1 | 6.25 | 1 | 6.25 |
| Elementary school | 23 | 21.70 | 7 | 6.60 | 21 | 19.81 | **24** | **22.64** | 10 | 9.43 | 21 | 19.81 |
| High school | 2 | 15.38 | 1 | 7.69 | **4** | **30.77** | 0 | 0.00 | **4** | **30.77** | 2 | 15.38 |
| **Occupation (p=0.801)1** | | | | | | | | | | | | |
| Agriculture | 8 | 23.53 | 6 | 17.65 | 4 | 11.76 | 5 | 14.71 | 2 | 5.88 | 9 | 26.47 |
| Commerce | 4 | 23.53 | 2 | 11.76 | 3 | 17.65 | 1 | 5.88 | 1 | 5.88 | 6 | 35.29 |
| Services | 22 | 24.44 | 9 | 10.00 | 17 | 18.89 | 15 | 16.67 | 11 | 12.22 | 16 | 17.78 |
| Other | 10 | 15.87 | 12 | 19.05 | 9 | 14.29 | 11 | 17.46 | 6 | 9.52 | 15 | 23.81 |
| **Tumor stage (p<0.001)1** | | | | | | | | | | | | |
| Grade I tumor - T1 | 2 | 5.71 | 1 | 2.86 | 12 | 34.29 | **17** | **48.57** | 2 | 5.71 | 1 | 2.86 |
| Grade II tumor - T2 | 1 | 6.25 | 3 | 18.75 | **7** | **43.75** | 2 | 12.50 | 2 | 12.50 | 1 | 6.25 |
| Grade III tumor - T3 | 12 | 31.58 | 6 | 15.79 | 1 | 2.63 | 2 | 5.26 | 3 | 7.89 | **14** | **36.84** |
| Grade IV tumor - T4 | 6 | 16.67 | 6 | 16.67 | **10** | **27.78** | 3 | 8.33 | 7 | 19.44 | 4 | 11.11 |
| **Presence of nodes (p=0.274)1** | | | | | | | | | | | | |
| No | 12 | 13.33 | 11 | 12.22 | 23 | 25.56 | 21 | 23.33 | 10 | 11.11 | 13 | 14.44 |
| Yes | 9 | 25.71 | 5 | 14.29 | 7 | 20.00 | 3 | 8.57 | 4 | 11.43 | 7 | 20.00 |
| **Metastasis (p=0.137)1** | | | | | | | | | | | | |
| No | 18 | 16.82 | 11 | 10.28 | 28 | 26.17 | 23 | 21.50 | 11 | 10.28 | 16 | 14.95 |
| Yes | 3 | 16.67 | 5 | 27.78 | 2 | 11.11 | 1 | 5.56 | 3 | 16.67 | 4 | 22.22 |
| **Habits**[3] **(p=0.019)1** | | | | | | | | | | | | |
| Smoking | 6 | 18.75 | 2 | 6.25 | **9** | **28.13** | 8 | 25.00 | 4 | 12.50 | 3 | 9.38 |
| Smoking/alcohol consumption | 38 | 23.75 | 26 | 16.25 | 21 | 13.13 | 17 | 10.63 | 16 | 10.00 | **42** | **26.25** |
| **Therapeutic procedure (p<0.001)1** | | | | | | | | | | | | |
| Partial laryngectomy | 0 | 0.00 | 0 | 0.00 | 7 | 38.89 | **11** | **61.11** | 0 | 0.00 | 0 | 0.00 |
| Complete laryngectomy | **44** | **30.99** | 29 | 20.42 | 1 | 0.70 | 2 | 1.41 | 20 | 14.08 | **46** | **32.39** |
| Chemo- and radiotherapy | 0 | 0.00 | 0 | 0.00 | **25** | **56.82** | 19 | 43.18 | 0 | 0.00 | 0 | 0.00 |

[1]The p-value refers to the chi-square test; [2]Two patients with a college degree have been excluded from the association analysis due to a lack of sample representativeness; [3]Four patients who did not present any of the habits included in the analysis have been excluded from the association analysis due to a lack of sample representativeness

staging (p<0.001), habits (p=0.019), and therapeutic procedure (p<0.001).

Most patients with tumor stage T2 and T4 presented improvement in dysphagia and dysphonia; T1 patients presented improvement of dysphonia, and T3 patients developed esophageal voice. Most patients who had been only smokers presented improvement in dysphagia and dysphonia, whereas most smokers and alcohol consumers developed esophageal voice. The patients submitted to cordectomy presented improvement of dysphonia, whereas most patients submitted to chemo- or radiotherapy presented improvement of dysphagia and dysphonia.

The patients submitted to laryngectomy showed strong association with the development of esophageal voice and written and gestural communication. However, it is worth noting that among the 142 laryngectomies performed, 139 (97.88) were complete. The patients submitted to partial laryngectomy achieved an improvement in dysphagia and dysphonia during rehabilitation.

Figure 1 shows the two-dimensional chart of the Multiple Correspondence analysis (MCA), indicating the location of the variables studied. The results suggest that the patients treated with chemo- or radiotherapy, smokers or non-smokers/alcohol consumers, with elementary schooling and tumors stage T1 developed esophageal voice and presented dysphagia/dysphonia improvement. The patients who developed electrolarynx voice were those working in commerce or services, between 20 and 59 years old, with a high school degree, lymph nodes, metastasis, and tumor stage T4.

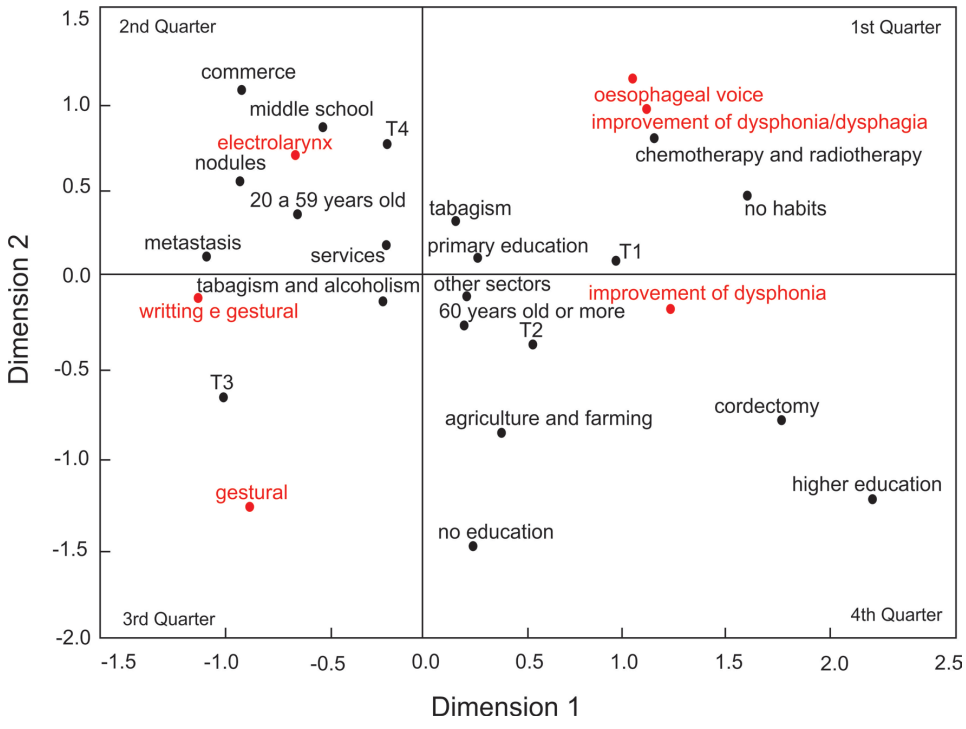
Gestural and written and gestural development was more frequent in patients with the habit of smoking and consuming alcohol with tumors stage T3. Patients who presented improvement of dysphonia presented correspondence with cordectomy, were 60 or more years old, used to work in agriculture or other industries, had either no schooling or an undergraduate degree, and tumor stage T2.

## DISCUSSION

As in this study, the literature points out that laryngeal cancer is prevalent among men. A study carried out in the Northeastern region of Brazil demonstrated prevalence of the condition in male patients between 2008 and 2012[14]. In Germany, between 1998 and 2011, 14,847 cases of laryngeal cancer were recorded. Among them, 13,195 occurred in men and 1,652, in women[15].

In Brazil, in 2016, the risk of incidence of the disease was almost seven times greater in men than in women (6.43 cases per 100,000 men and 0.94 cases per 100,000 women)[1]. This situation may be related to male health, less healthy habits and lack of self-care, which jeopardizes their health[16]. One may also consider the fact that men are exposed to environmental factors, alcohol and tobacco consumption, which is considered the main risk factor for laryngeal cancer[17].

The age range above 60 years was prevalent. These findings are corroborated by the literature, which shows that laryngeal cancer occurs mostly in individuals above 40 years old and its incidence increases with age[6]. The profile of patients studied was of poor schooling, low socio-economic level, and manual occupations (construction and rural workers, among others). This profile may be related to the fact that the study population was treated by the national public health care system, SUS. Although this system is available for all citizens, it is mostly used by patients who cannot afford private health insurance[18].




**Caption:** T1: grade I tumor; T2: grade II tumor; T3: grade III tumor; T4: grade IV tumor
**Figure 1.** Two-dimensional chart of the Multiple Correspondence Analysis

The occupational factor is classified within the risk range. Exposure to cement dust in civil construction work poses a risk of laryngeal cancer regardless of smoking and alcohol consumption[19]. As to rural workers, exposure to chemicals used in animal raising, micro-organisms carried by these animals, and endotoxins present in their living environment impact carcinogenesis[20].

Alcohol consumption and smoking, two habits observed in the vast majority of the patients in this study, are pointed out in the literature as the most established risk factors for laryngeal cancer, where alcohol consumption increases the risk of the disease by 1.5 to 2 times. As to smoking, the risk is 15 times higher for active smokers and five times higher for former smokers compared to non-smokers[6]. The carcinogenic risk increases when alcohol is associated with smoking[6,21].

As to the clinical variables, the most advanced stages, T3 and T4, were prevalent. However, the majority did not present lymph nodes or metastasis at the time, which reduced prognostics and treatment compromise. It is worth noting that difficulty of access to health care may increase the number of advanced-stage diagnoses and thus compromise prognosis and hinder treatment. In addition, the literature also points out that factors such as the initial location of the tumor in the larynx and stages N0-N1 are related to good prognosis, whereas more advanced stages, in patients submitted to complete laryngectomy, to poorer prognosis[22].

Stages T1 and T2 present more favorable prognoses, with global survival rates of five years in 65% to 70% of patients and treatment compatible to rehabilitation and cure. The T1 and T2 patients in the study were submitted to radio- and/or chemotherapy. Contrarily, those in more advanced stages were submitted to multimodal treatment (surgery associated with radio-and/or chemotherapy), as recommended by the literature[19,23].

The choice of treatment can be influenced by factors such as: age, professional use of voice, heavy smoking and alcoholism, as well as some socio-economic and clinical factors[23]. The medical conduct, whether surgical or not, adds emotional alterations to the patients' physical symptoms. This requires a multidisciplinary support which involves, in addition to the medical team, nurses, psychologists, and speech-language therapists qualified to meet the needs of these patients and their families[14,24]. With regard to the rehabilitation outcomes, improvement of dysphonia in T1 tumors and patients submitted to cordectomy may be explained by the lower severity of this stage, which requires a lower dose of radiation for tumor control[16].

In the specialized facility where the study was carried out, in case of partial vertical laryngectomy—among them, cordectomy—patients are assessed by means of videostroboscopy and maximum phonation time. With regard to dysphagia, a protocol named functional assessment of swallowing is put in place. Thus, vocal speech-language therapy focuses on the over-adduction of the remaining vocal fold, with exercises that favor coaptation, glottal support, vibration, nasal sounds, speech over-articulation, and chewing technique[25].

In this study, stage T2 and T4 patients submitted to chemo-/radiotherapy improved dysphagia and dysphonia, possibly because there have not been submitted to surgery. Currently, the primary protocols of chemoradiation, also known as preservation protocols, have been favored, since many T4 patients do not tolerate surgery due to the advanced stage of the disease[26]. The improvement of dysphagia/dysphonia presented by smokers and non-alcoholics is related to a better disease prognostics when it is not associated to alcohol or, if they are in a more advanced stage, to the preservation protocol.

T3 patients submitted to complete laryngectomy developed esophageal voice and written and gestural communication in the same proportion. Success of therapy with esophageal voice varied. The development of written and gestural communication - as opposed to esophageal voice - probably occurred due to the surgery type and scope, the patients' emotional state, their socio-economic and cultural status, correct learning, radiotherapy, and alterations in their esophagus. Thus, the therapy process must take into account the different causes impacting vocal rehabilitation of completely laryngectomized patients[27,28].

In the cases of complete laryngectomy, speech-language therapy intervention at the specialized facility is more complex and ranges from immediate pre- and post-operative guidance to rehabilitation per se. Post-operative speech-language rehabilitation begins between days 10 and 15, or after a couple of months, by virtue of surgical complications - fistulas, flap necrosis, RxT/Ch - or other complications related to the patients' general health. Therefore, assessment is carried out according to stomatognathic structures and functions (muscular sensitivity and mobility and symmetry of face, lips, tongue, and palate; sensitivity/tenderness), shoulder girdle mobility; the presence of facial edema, trismus, teeth, or partial or full prostheses; neurovegetative function (breathing, size of stoma and presence of respiratory sounds; swallowing, in different consistencies; chewing), presence of auditory impairment. At a later stage, the individual's ability to use the different means of communication proposed will be assessed[29].

Esophageal voice is the most widely used method in Brazil, because of both its lower cost and the fact it is more physiological and natural than the others[29]. There are three different methods to produce this type of alaryngeal communication: swallowing, aspiration, and air injection into the esophagus. The way in which air enters the esophagus is different in each of these methods. However, the vibration and voice production mechanisms are the same[30]. Vocal speech-language rehabilitation at the facility where this study was conducted began with the vocal production with open vowels "a" and "ó" (pronounced \ȯ\, as in "saw"), through other associated vowels, long vowels, two-syllable words, three-syllable words, sentences and refining of esophageal voice. The process lasts throughout a period of four to six months, until the patient is able to take part in a spontaneous conversation.

Individuals with T4 tumors with lymph nodes and metastasis who have also been submitted to complete laryngectomy and rehabilitated with electrolarynx were at a more advanced stage with worse prognosis and in working age. It is believed that the advanced stage of the disease may be associated with professional responsibilities and factors such as beliefs and attitudes towards their health, which delay their search for medical assistance and, consequently, hinder early diagnosis[23].

The patients who have undergone complete laryngectomy who did not develop oral communication with esophageal voice or the use of electrolarynx are encouraged to develop written or gestural communication using over-articulation (silent) associated with facial mimicry and gestures.

The results of this study point to the importance of speech-language therapy intervention in multidisciplinary assistance of individuals with head and neck cancer, evincing that assessment and intervention by speech-language therapists are of the essence in these patients' treatment planning and rehabilitation. Furthermore, they strengthen the treatment managed by speech-language therapy related to oncological treatments [the field of *fononcologia*] in Brazil with a view to improve the quality of life of laryngectomized patients and enable their social reintegration as speakers.

Limitations to the study included incomplete personal identification information in medical records, particularly those related to patients' education and occupation, as well as the change in recording method (manual to electronic format), which entailed loss of information. Capabilities worthy of note include the team's clinical notes on the medical records, from anamnesis to discharge, and the records kept by the speech-language therapist who has followed up the patients since the establishment of the facility.

## CONCLUSION

The majority of the laryngeal cancer patients seen at the otolaryngology and speech-language therapy facility of the hospital where the study was carried out is male, above 60 years old and with elementary school education. They worked in the service industry, are smokers and alcohol consumers.

A prevalence of T3 tumors without lymph nodes and metastasis was found. Most of these patients has been submitted to complete or partial laryngectomy.

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## Author contributions

*ICF and SHFV participated in the idealization of the study, data collection, analysis and interpretation, and article writing; LGL, NSGMSS, JVM, JAPJ, and LSR participated in the article writing and critical review of the intellectual content; MLSGS participated in the idealization of the study, analysis, data interpretation, and article writing, in the condition of guide.*