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Smoking as Cause of Organic Dysphonia Secondary to Chronic Obstructive Pulmonary Disease: A Systematic Review

Tabaquismo como causa de disfonía orgánica secundaria a enfermedad pulmonar obstructiva crónica: Una revisión sistemática

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ABSTRACT

Objective: The objective of this systematic review is to determine whether smoking causes organic dysphonia in adults with chronic obstructive pulmonary disease (COPD).

Materials and methods: The review adheres to the PRISMA statement guidelines and involves database selection based on defined key terms. Studies were included or excluded based on specific criteria. The research question was constructed using the PIO model, and the quality of evidence and strength of recommendation were assessed using the GRADE pro GDT system.

Results: The review conducted searches in databases such as PUBMED, SPRINGER LINK, SCIENCEDIRECT, SCOPUS, and EBSCO, using variable crosses generated from DESC and MESH keywords. After applying filters, a final sample of 30 articles was used in this research. Smoking-induced changes in laryngeal anatomical structure can lead to functional problems and have a negative impact on voice production, resulting in voice disorders. In individuals with COPD, voice quality is further compromised by disease-related symptoms, leading to reduced and irregular voice quality.

Conclusions: Dysphonia is a prevalent finding in adults with COPD, and smoking emerges as one of the primary factors contributing to its occurrence. The review underscores the role of smoking as a causative factor in organic dysphonia among individuals with COPD.

Keywords: **Dysphonia**, vocal alterations, smoking, voice, COPD.

RESUMEN

Objetivo: El objetivo de esta revisión sistemática fue determinar si el tabaquismo causa disfonía orgánica en adultos con enfermedad pulmonar obstructiva crónica (EPOC).

Materiales y métodos: La revisión se adhiere a las directrices de la declaración PRISMA e implica la selección de bases de datos basada en términos clave definidos. Los estudios se incluyeron o excluyeron en función de criterios específicos. La pregunta de investigación se construyó utilizando el modelo PIO, y la calidad de la evidencia y la fuerza de la recomendación se evaluaron utilizando el sistema GRADE pro GDT.

Resultados: La revisión realizó búsquedas en bases de datos como PUBMED, SPRINGER LINK, SCIENCEDIRECT, SCOPUS y EBSCO, utilizando cruces variables generados a partir de palabras clave DESC y MESH. Tras aplicar filtros, se utilizó una muestra final de 30 artículos en esta investigación. Los cambios inducidos por el tabaquismo en la estructura anatómica laríngea pueden dar lugar a problemas funcionales y repercutir negativamente en la producción de la voz, causando trastornos vocales. En

los individuos con EPOC, la calidad de la voz se ve aún más comprometida por los síntomas relacionados con la enfermedad, lo que conduce a una calidad de voz reducida e irregular.

Conclusiones: La disfonía es un hallazgo prevalente en adultos con EPOC, y el tabaquismo aparece como uno de los principales factores que contribuyen a su aparición. La revisión subraya el papel del tabaquismo como factor causal de la disfonía orgánica entre los individuos con EPOC.

Palabras clave: Disfonía, alteraciones vocales, tabaquismo, voz, EPOC.

INTRODUCTION

The World Health Organization (WHO) has declared that smoking is a public health problem; this habit became popular in the last century and still persists today, smoking tobacco causes chemical and psychological addiction and can cause physiological changes (1). Thus, nicotine is one of the substances found in tobacco, producing addiction and significantly affecting the central nervous system, which is one of the most complex and important systems of the human body (2) (3). Therefore, tobacco smoking damages most of the organs and systems of the body, decreasing the overall health of the person, as well as causing cancer of the lung, esophagus, larynx, mouth, kidney, liver, stomach, among others; as well as respiratory tract infections, COPD, chronic bronchitis and pneumonia (4) (5).

Among the physiological changes caused by tobacco consumption are vocal alterations (6) and dysphonia, which is an alteration in vocal quality, where not only the acoustic qualities of the voice are affected, such as intensity, tone, timbre and duration, but also the anatomical part of the phonatory apparatus, causing an altered oral communication (7) (8). Consequently, people suffering from dysphonia and voice disorders are more prone to develop social and communication problems, causing a decrease in the quality of life and in their physical and/or mental state (7) (9) (10).

On the other hand, COPD is mainly caused by tobacco consumption (11) (12) (13), and is defined as a common respiratory condition, which is mainly characterized by airflow limitation (7), this limitation hinders the process of expelling air from the lungs, which triggers difficulties to breathe properly (14) (15). Dysphonia is a common finding in COPD (11) (16), as constant coughing

is a common symptom of this pathology, it can cause incomplete adduction of the vocal cords triggered by vocal fatigue, and it is usually perceived as shortness of breath (7).

Additionally, COPD can affect voice production directly, associated with respiratory impairment and decreased lung volume (17), and, indirectly, as a side effect of medication and associated with concurrent symptoms (16) (18). According to the American Speech-Language-Hearing Association, COPD symptoms such as shortness of breath, constant cough, and mucous, can cause alterations in the larynx and vocal cords causing voice problems (17).

In this context, people with COPD have a significantly higher rate of dysphonia (11) (19); not only because of poor respiratory support, but also because of the use of inhaled corticosteroids (ICS) (16), symptoms associated with these diseases, such as cough, history of previous or current smoking, and common comorbidities of lung disease (11) (20).

COPD is one of the 10 leading causes of morbidity and mortality in the adult population worldwide (21) (22), its global prevalence is 11.4% in people aged 30 years or more (23); in Europe it has a prevalence of 9%, 11% in Latin America, 14.1% in North America, 8.6% in Japan, 10% in Asia, and 6% in the United States (24) (25). In Mexico, it is also one of the 10 leading causes of morbidity and mortality; a review study found that 54-77% of patients with COPD of moderate severity were tobacco smokers, while 38-51% of those with very severe stages of the disease also smoked (2) (26).

Similarly, the epidemiology of voice disorders among the general population is variable and has a high recurrence rate, approximately, 30% of adults have experienced a voice disorder during their lifetime and almost 7% report a current voice problem (27) (28); in Sweden, 16.9% of adults experience a voice disorder, and 21.9% of adults in the United States also experience a voice disorder at some point in their lives (7) (29) (30). Likewise, the World Health Organization (WHO) reported that tobacco smoking causes the death of more than 5 million people each year and 70% of COPD deaths have smoking in common (2) (31) (32).

In accordance with the above and considering the arguments and findings previously revealed, the present paper aims to conduct a systematic review of the literature, thus, the following research question arises: Does smoking produce Organic Dysphonia in adults with COPD?

MATERIALS AND METHOD

This review was conducted following the parameters proposed by the PRISMA statement, a tool that allowed the systematic review of the scientific literature based on the search and selection of research articles, providing updated guidance on the presentation of systematic reviews (33) (34) (35). To this end, the databases were initially identified and the key terms in the search for information were defined. The studies were selected on the basis of inclusion and exclusion criteria, which facilitated the evaluation of their quality and reliability and thus made it possible to answer the research question posed.

The PICO model was used to construct the research question, which constitutes a specialized format to develop the clinical question, describing the components that integrate it, allowing to improve the specificity and conceptual clarity of the clinical problems to be studied, as well as allowing the searches to have a higher quality and precision, which allows to collect pertinent and precise data to answer the problem question (36) (37).

The classification of the quality of the evidence and grading of the strength of recommendation was performed through the GRADE system; this system is highly specialized for the scientific analysis of the most relevant studies for the present research (38) (39). It is a web application for creating managing and sharing summaries of research evidence (called evidence profiles and summary of results table), such tables are often used to summarize evidence from systematic reviews, these tables present key information about the relevant outcomes for a given measured care question, such as the body of evidence, judgments about the underlying quality of evidence, key statistical findings, and a rating for the quality of evidence for each outcome (40) (41).

Research Question

In accordance with the topic posed for the research, the components of the PICO model shown in table 1 were established, resulting in the following research question: Does smoking produce Organic Dysphonia in adults with COPD?

Table 1. Research Question

Component	Description
P: Patient or problem of interest (Population)	Adults with COPD, smoking habit
I: Intervention	Organic dysphonia
C: Comparison	Not aplicable
O: Outcome	Risk factors, likelihood ratio

Source: own elaboration.

Inclusion and Exclusion Criteria

Table 2. Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Articles where subjects with COPD are found.	Articles where no subjects with COPD are present
Articles related to Smoking as a cause of Organic Dysphonia in adults with COPD	Articles unrelated to smoking as a cause of Organic Dysphonia in adults with COPD.
Full text articles	Articles without full text
Articles with a 10-year publication time window	Articles with a publication time window of more than 10 years
Articles	Literature such as these, research reports and projects, working papers, newsletters, technical reports, technical recommendations and standards, books, abstracts, academic courses and lecture notes.

Source: own elaboration.

Sources of Information

Key terms were selected from the Descriptors in Health Sciences (DESC) and Medical Subject Headings (MESH) (see table 3).

Table 3. DESC and MESH Descriptors

Source	Keyword	Related terms
DESC MESH	Dysphonia	Spastic Dysphonia, Phonation disorders
DESC MESH	Vocal Cord Dysfunction	No records found
DESC MESH	Voice	No records found
DESC MESH	Phonation	No records found
DESC MESH	Vocal Cords	True Vocal Cord, Vocal cords, vocal ligaments, vocal fold
DESC MESH	Voice Quality	No records found
DESC MESH	Voice Disorders	No records found
DESC MESH	Pulmonary Disease, Chronic Obstructive	COAD, COPD, EVOC, Chronic Obstructive Airway Disease, Chronic Obstructive Pulmonary Disease, Chronic Obstructive Lung Disease, Chronic Obstructive Pulmonary Diseases, Chronic Obstructive Pulmonary Disease, Chronic Airflow Obstruction, Chronic Airflow Obstruction
DESC MESH	Risk Factors	Health Correlations Risk factor, Social Risk Factors, Populations at Risk, Population at Risk, Risk Factor Scores, Risk Scores
DESC MESH	Cigarette Smoking	Smoking cigarette, Cigarette Smoking Habit
DESC MESH	Smoking	Smoking Action, Smoking Behavior, Smoking Behaviors, Smoking habit
DESC MESH	Nicotine	No records found
DESC MESH	Tobacco Smoking	Tobacco Smoking Habit, Smoking Habit, Tobacco habit
DESC MESH	Tobacco	Nicotiana, Nicotiana tabacum

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DESC MESH	Tobacco Use Disorder	Nicotine addiction, Nicotine dependence, Tobacco Unit, Nicotine Use Disorder, Tobacco Use Disorder
DESC MESH	Tobacco Products	Bidi, Cigarette, Bidi Cigarettes, Cigars Cigars, Kretek, Kreteks, Cigars, Bidi Tobacco, Kretek Tobacco, Kreteks Tobacco, Pipe tobacco, Túbanos

Source: Information obtained from DESC and MESH.

Search Strategies

A search strategy was developed with the help of databases, some of which are part of the digital library of the University of Pamplona, Colombia. Subsequently, search equations were designed with the terms found. These equations were created using logical AND/OR operators and symbols such as “” and (). The information search was carried out in PUBMED, SPRINGER LINK, SCIENCEDIRECT, SCOPUS and EBSCO, using the English language (see table 4).

Table 4. Search Equations

Database	Search Algorithm
PUBMED, SPRINGER LINK, SCIENCEDIRECT, SCOPUS, y EBSCO	(“Pulmonary disease, chronic obstructive”) AND (“Dysphonia”) AND (“Tobacco”)
	(“Pulmonary disease, chronic obstructive”) AND (“Vocal Cord Dysfunction”) AND (“Tobacco”)
	(“Pulmonary disease, chronic obstructive”) AND (“Dysphonia” OR “Voice”) AND (“Cigarette Smoking” OR “Tobacco”)
	(“Dysphonia” OR “Voice Disorders”) AND (“Pulmonary Disease, Chronic Obstructive”) AND (“Tobacco Use Disorder”)
	(“Voice Disorders”) AND (“Tobacco Smoking”) AND (“Pulmonary Disease, Chronic Obstructive”)
	(“Cigarette Smoking”) AND (“Voice Disorders” OR “Voice Quality”) AND (“Pulmonary Disease, Chronic Obstructive”)
	(“Pulmonary disease, chronic obstructive”) AND (“Dysphonia”) AND (“Risk Factors”) AND (“Tobacco”)
	(“Pulmonary disease, chronic obstructive”) AND (“Phonation” OR “Vocal Cords”) AND (“Tobacco Smoking” OR “Nicotine”)
	(“Pulmonary disease, chronic obstructive”) AND (“Voice Disorders” OR “Voice”) AND (“Smoking” OR “Tobacco Use Disorder”)

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PUBMED, SPRINGER LINK, SCIENCEDIRECT, SCOPUS, y EBSCO	("Dysphonia" OR "Vocal Cord Dysfunction" OR "Voice Disorders") AND ("Pulmonary Disease, Chronic Obstructive") AND ("Tobacco Use Disorder" OR "Smoking")
	("Pulmonary disease, chronic obstructive") AND ("Dysphonia" OR "Voice") AND ("Cigarette Smoking" OR "Tobacco") AND ("Risk Factors")
	("Dysphonia") AND ("Pulmonary Disease, Chronic Obstructive") AND ("Cigarette Smoking")
	("Vocal Cord Dysfunction" OR "Phonation") AND ("Pulmonary Disease, Chronic Obstructive") AND ("Smoking" OR "Tobacco Smoking")
	("Voice" OR "Voice Quality") AND ("Pulmonary Disease, Chronic Obstructive") AND ("Nicotine" OR "Tobacco Use Disorder")
	("Pulmonary Disease, Chronic Obstructive") AND ("Tobacco")
	("Pulmonary Disease, Chronic Obstructive") AND ("Dysphonia" OR "Vocal Cord Dysfunction") AND ("Cigarette Smoking" OR "Smoking")
	("Pulmonary Disease, Chronic Obstructive") AND ("Voice" OR "Phonation") AND ("Nicotine" OR "Tobacco Smoking")
	("Dysphonia" OR "Voice Disorders") AND ("Pulmonary Disease, Chronic Obstructive") AND ("Risk Factors") AND ("Tobacco Use Disorder")
	("Vocal Cords" OR "Voice Quality") AND ("Pulmonary Disease, Chronic Obstructive") AND ("Tobacco" OR "Tobacco Use Disorder")
	("Voice" OR "Voice Disorders") AND ("Pulmonary Disease, Chronic Obstructive") AND ("Tobacco Smoking" OR "Tobacco Products")
	("Dysphonia") AND ("Pulmonary Disease, Chronic Obstructive") AND ("Smoking" OR "Nicotine" OR "Tobacco Use Disorder")
	("Dysphonia") AND ("Pulmonary Disease, Chronic Obstructive") AND ("Tobacco Smoking" OR "Tobacco")
	("Vocal Cord Dysfunction") AND ("Pulmonary Disease, Chronic Obstructive") AND ("Cigarette Smoking" OR "Nicotine")
	("Pulmonary Disease, Chronic Obstructive") AND ("Smoking" OR "Tobacco Smoking")
	("Vocal Cord Dysfunction") AND ("Pulmonary Disease, Chronic Obstructive") AND ("Tobacco Smoking" OR "Tobacco")
	("Vocal Cord Dysfunction") AND ("Pulmonary Disease, Chronic Obstructive") AND ("Tobacco Use Disorder" OR "Tobacco Products")
	("Pulmonary Disease, Chronic Obstructive") AND ("Cigarette Smoking")
	("Voice") AND ("Pulmonary Disease, Chronic Obstructive") AND ("Cigarette Smoking" OR "Tobacco")
("Voice") AND ("Pulmonary Disease, Chronic Obstructive") AND ("Tobacco Smoking" OR "Smoking")	

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PUBMED, SPRINGER LINK, SCIENCEDIRECT, SCOPUS, y EBSCO	("Voice") AND ("Pulmonary Disease, Chronic Obstructive") AND ("Tobacco Use Disorder" OR "Tobacco Products")
	("Phonation") AND ("Pulmonary Disease, Chronic Obstructive") AND ("Cigarette Smoking" OR "Smoking")
	("Pulmonary Disease, Chronic Obstructive") AND ("Tobacco Use Disorder")
	("Phonation") AND ("Pulmonary Disease, Chronic Obstructive") AND ("Nicotine" OR "Tobacco" OR "Tobacco Use Disorder")
	("Vocal Cords") AND ("Pulmonary Disease, Chronic Obstructive") AND ("Cigarette Smoking" OR "Tobacco Products")
	("Vocal Cords") AND ("Pulmonary Disease, Chronic Obstructive") AND ("Tobacco Smoking" "Nicotine")
	("Pulmonary Disease, Chronic Obstructive") AND ("Nicotine")
	("Voice Quality") AND ("Risk Factors") AND ("Pulmonary Disease, Chronic Obstructive") AND ("Tobacco Smoking" OR "Tobacco")
	("Vocal Cords") AND ("Pulmonary Disease, Chronic Obstructive") AND ("Tobacco Use Disorder" OR "Smoking")
	("Pulmonary Disease, Chronic Obstructive") AND ("Smoking" OR "Tobacco Products")
	("Voice Quality") AND ("Pulmonary Disease, Chronic Obstructive") AND ("Cigarette Smoking" OR "Smoking" OR "Nicotine")
	("Voice Quality") AND ("Pulmonary Disease, Chronic Obstructive") AND ("Tobacco Smoking" OR "Tobacco")
	("Voice Disorders") AND ("Pulmonary Disease, Chronic Obstructive") AND ("Cigarette Smoking" OR "Smoking" OR "Tobacco Smoking")
("Voice Disorders") AND ("Pulmonary Disease, Chronic Obstructive") AND ("Tobacco" OR "Nicotine" OR "Tobacco Use Disorder")	

Source: own elaboration.

Characteristics of the Studies

Initially, we classified the studies that were characterized by including tobacco consumption in adults with COPD, additionally, articles where the characteristics and effects of tobacco consumption on the voice as a cause of Organic Dysphonia in adults with COPD were shown, it was taken into account that these studies had characteristics and aspects such as: adult population with COPD, smoking history, manifestations of the population with respect to vocal and respiratory problems or alterations and thus give development to the research topic.

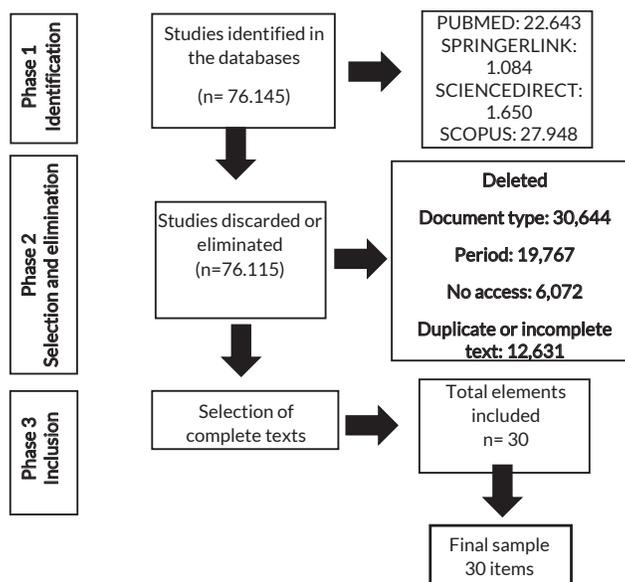
Selection and Analysis

A preliminary selection of studies was considered, based on the established inclusion criteria, population characteristics, type of study and year. Subsequently, a registration table in Excel, prepared by the authors, was filled in independently, in which the key elements of each of the selected studies were specified. Following the structure proposed by the PRISMA statement, the process used in the identification, screening, eligibility and inclusion of articles is briefly described.

GRADE pro GDT was used through the clinical management question, including in the analysis number of studies, study design, risk of bias, inconsistency, indirect evidence, imprecision and the degree of certainty of the study (42).

RESULTS

The eligibility criteria were determined following the order established in the methodology, through the development of each of the phases of the PRISMA flowchart (figure).



Source: own elaboration.

Figure. PRISMA Diagram

Identification Phase

The search was performed in the PUBMED, SPRINGER LINK, SCIENCEDIRECT, SCOPUS and EBSCO databases, according to the variable cross-references constructed from the DESC and MESH keywords. The following filters were then applied: document type, time window, full text or duplicate, and articles without access and non-compliance with criteria. Finally, articles were selected to obtain the final sample of 30 articles used in this research (see table 5).

Table 5. Filters Applied

Database	Total articles	Type of document	Period	Incomplete and/or duplicate texts	No access	Non-compliance with criteria	Selected articles
PUBMED	22.643	20.980	786	12	228	634	3
SPRINGER LINK	1.084	493	211	0	203	167	10
SCIENCEDIRECT	1.650	717	434	53	307	132	7
SCOPUS	27.948	7.652	7.863	3.875	3.871	4.679	8
EBSCO	22.820	802	10.473	2.132	8.022	1.389	2
Total	76.145	30.644	19.767	6.072	12.631	7.001	30

Source: own elaboration.

Selection and Elimination Phase

The initial selection of the research articles was made by preliminary reading of the titles, abstracts, and, later, the introduction, which allowed the identification of the most relevant articles with respect to the topic under investigation, with a total of 30 articles selected. The results of each variable cross-checking in English are listed below (see table 6) for the five databases PUBMED, SPRINGER LINK, SCIENCEDIRECT, SCOPUS, and EBSCO.

Table 6. Results of Cross-referencing Variables in English in the Databases

Cruces	Data Base				
	Pubmed	Springer Link	Sciencedirect	Scopus	Ebsco
Pulmonary Disease, Chronic Obstructive + Cigarette Smoking	1	0	1	0	0
Pulmonary Disease, Chronic Obstructive + Nicotine	1	0	1	1	0
Pulmonary Disease, Chronic Obstructive + Tobacco Use Disorder	1	0	0	1	0
Pulmonary disease, chronic obstructive + Dysphonia + Tobacco	0	1	0	0	0
Cigarette Smoking + Voice Disorders + Voice Quality + Pulmonary Disease, Chronic Obstructive	0	2	0	0	0
Dysphonia + Vocal Cord Dysfunction + Voice Disorders + Pulmonary Disease, Chronic Obstructive + Tobacco Use Disorder + Smoking	0	1	0	1	0
Dysphonia + Pulmonary Disease, Chronic Obstructive + Cigarette Smoking	0	1	0	0	0
Vocal Cord Dysfunction + Phonation + Pulmonary Disease, Chronic Obstructive + Smoking + Tobacco Smoking	0	1	1	1	0
Voice + Voice Quality + Pulmonary Disease, Chronic Obstructive + Nicotine + Tobacco Use Disorder	0	1	0	0	0
Pulmonary Disease, Chronic Obstructive + Dysphonia + Vocal Cord Dysfunction + Cigarette Smoking + Smoking	0	1	0	2	0
Voice + Voice Disorders + Pulmonary Disease, Chronic Obstructive + Tobacco Smoking + Tobacco Products	0	1	0	0	0
Dysphonia + Pulmonary Disease, Chronic Obstructive + Tobacco Smoking + Tobacco	0	1	0	0	0
Pulmonary disease, chronic obstructive + Vocal Cord Dysfunction + Tobacco	0	0	1	0	0

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Pulmonary disease, chronic obstructive + Dysphonia + Voice + Cigarette Smoking + Tobacco	0	0	1	0	0
Pulmonary disease, chronic obstructive + Phonation + Vocal Cords + Tobacco Smoking + Nicotine	0	0	1	0	0
Pulmonary disease, chronic obstructive + Voice Disorders + Voice + Smoking + Tobacco Use Disorder	0	0	1	1	1
Dysphonia + Pulmonary Disease, Chronic Obstructive + Smoking + Nicotine + Tobacco Use Disorder	0	0	0	1	0
Pulmonary Disease, Chronic Obstructive + Tobacco Use Disorder	0	0	0	0	0
Voice + Pulmonary Disease, Chronic Obstructive + Tobacco Smoking + Smoking	0	0	0	0	1
Total	3	10	7	8	2

Source: own elaboration.

In the first search, 43 cross-references were made in English, among the different variables, resulting in 3 articles in PUBMED, 10 articles in SPRINGERLINK, 7 articles in SCIENCEDIRECT, 8 articles in SCOPUS and 2 articles in EBSCO, for a total of 30 articles.

Classification of the Quality of the Evidence

The classification of the quality of evidence and grading of the strength of recommendation was performed through the GRADE system, which was highly specialized for the scientific analysis of the studies included in this study. This resulted in a high level of moderate certainty (15 articles) and a high level of certainty (15 articles), thus demonstrating a high quality of evidence for each result and, in general, for the review carried out (see table 7).

Table 7. Classification of the Quality of Evidence

N° of studies	Study design	Risk of bias	Certainty assessment				Other considerations	N° of patients		Effect		Certainty	Importance
			Inconsistency	Indirect evidence	Imprecision			Smoking	Relative (95% CI)	Absolute (95% CI)			
Laryngeal irritation (evaluated with: Video-stroboscopic analysis)													
1	observational studies	not serious	not serious	not serious	not serious	strong association all possible residual confounding factors could reduce the demonstrated effect	109/109 (100.0%)	109/109 (100.0%)	not estimable		⊕⊕⊕⊕ High		
Laryngeal irritation (evaluated with: Second Harmonic Generation (SHG) imaging)													
1	observational studies	not serious	not serious	not serious	not serious	strong association	8/8 (100.0%)	8/8 (100.0%)	not estimable		⊕⊕⊕○ Moderate		
Laryngeal irritation (evaluated with: Voice Handicap Index (VHI))													
1	observational studies	not serious	not serious	not serious	not serious	strong association	130 male participants				⊕⊕⊕○ Moderate		
Vocal cord erythema (evaluated with: Video-stroboscopic analyses)													
1	observational studies	not serious	not serious	not serious	not serious	strong association all possible residual confounding factors could reduce the demonstrated effect	109 cases 0 Controls				⊕⊕⊕⊕ High		
							-	0.5%					
Vocal cord erythema (evaluated with: Electroglottographic examination)													
1	observational studies	not serious	not serious	not serious	not serious	strong association	100 cases 0 Controls				⊕⊕⊕○ Moderate		
							-	0.0%					
Vocal cord erythema (assessed by: Speech, Language and Voice Questionnaire)													
1	observational studies	not serious	not serious	not serious	not serious	strong association all possible residual confounding factors could reduce the demonstrated effect	1,728 subjects were surveyed, 68% women and 32% men. About 24% of the men and 22% of the women were smokers, presenting different symptoms and vocal alterations.				⊕⊕⊕⊕ High		
Deterioration of voice quality and various degrees of dysphonia (evaluated with: Videolaryngoscopy system)													
1	observational studies	not serious	not serious	not serious	not serious	strong association	60 cases 0 Controls		Not estimable	-	⊕⊕⊕○ Moderate		
							-	0.0%					
Deterioration of voice quality and various degrees of dysphonia (assessed by: Pulmonary Function Tests (PFTs))													
1	observational studies	not serious	not serious	not serious	not serious	strong association dose-response gradient	60 cases 25 Controls		not estimable	-	⊕⊕⊕⊕ High		
							-	0.0%					
Shortness of breath (time of exposure: range 2019 months to 2020 months; assessed with: Aerodynamic evaluation applied to phonation)													
1	observational studies	not serious	not serious	not serious	not serious	strong association all possible residual confounding factors could reduce the demonstrated effect	60 cases 20 Controls		not estimable	-	⊕⊕⊕⊕ High		
							-	0.0%					
Shortness of breath (assessed with: Pulmonary Function Tests (PFT))													
1	observational studies	not serious	not serious	not serious	not serious	strong association dose-response gradient	103 cases 50 Controls		not estimable	-	⊕⊕⊕⊕ High		
							-	0.0%					

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Shortness of breath (time of exposure: range February 2015 years to March 2016 years; assessed with: Spirometric test)											
1	observational studies	not serious	not serious	not serious	not serious	strong association	60 cases 35 Controls	not estimable	-	⊕⊕⊕○ Moderate	
							-	0.0%			
Abnormal laryngeal color (evaluated with: Endoscopic examination)											
1	observational studies	not serious	not serious	not serious	not serious	strong association dose-response gradient	50 cases 0 Controls	not estimable		⊕⊕⊕⊕ High	
							-	0.0%			
Constant cough (evaluated with: Pulmonary Function Test (PFT))											
1	observational studies	not serious	not serious	not serious	not serious	strong association	199 cases 0 Controls	not estimable		⊕⊕⊕○ Moderate	
							-	0.0%			
Deterioration of voice quality and various degrees of dysphonia (assessed with: Praat)											
1	observational studies	not serious	not serious	not serious	not serious	strong association	456/880 (51.8%)	0.0%	not estimable	⊕⊕⊕○ Moderate	
Voice quality impairment and various degrees of dysphonia (assessed with: Voice-Related Quality of Life Protocol (VRQL))											
1	observational studies	not serious	not serious	not serious	not serious	strong association	Thirty-seven people with a diagnosis of COPD were evaluated; the mean score of the subjects was found to be below the cut-off point.			⊕⊕⊕○ Moderate	
Shortness of breath (evaluated with: Pulmonary Function Tests)											
1	observational studies	not serious	not serious	not serious	not serious	strong association dose-response gradient	152/152 (100.0%)	152/152 (100.0%)	not estimable	⊕⊕⊕⊕ High	
Shortness of breath (evaluated with: Pulmonary Function Tests)											
1	observational studies	not serious	not serious	not serious	not serious	strong association	20/20 (100.0%)	20/20 (100.0%)	not estimable	⊕⊕⊕○ Moderate	
Changes in the quality and variation of the tone (evaluated with: Praat)											
1	observational studies	not serious	not serious	not serious	not serious	strong association all possible residual confounding factors could reduce the demonstrated effect	40 patients with a history of vocal difficulties and a history of smoking and 10 control subjects.			⊕⊕⊕⊕ High	
Acoustic parameters (evaluated with: Praat)											
1	observational studies	not serious	not serious	not serious	not serious	strong association all possible residual confounding factors could reduce the demonstrated effect	Thirty patients with a diagnosis of COPD and presenting alterations in the acoustic qualities of the voice were evaluated.			⊕⊕⊕⊕ High	
Shortness of breath (evaluated with: Pulmonary Function Tests)											
1	observational studies	not serious	not serious	not serious	not serious	strong association	91 cases 40 Controls	not estimable	-	⊕⊕⊕○ Moderate	
							-	0.0%			
Shortness of breath (assessed with: Pulmonary Function Test)											
1	observational studies	not serious	not serious	not serious	not serious	strong association any plausible residual confusion suggests spurious effect, while no effect was observed.	11 cases 11 Controls		not estimable	-	⊕⊕⊕⊕ High

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Expiratory airflow limitation (assessed with: COPD Clinical Questionnaire (CCQ))								
1	observational studies	not serious	not serious	not serious	not serious	strong association dose-response gradient	A total of 2269 patients with COPD were included, 58% male 42% current smokers.	⊕⊕⊕⊕ High
Expiratory airflow limitation (assessed with: COPD Screening Test)								
1	observational studies	not serious	not serious	not serious	not serious	strong association	727 patients included, more than half of these patients presented COPD symptoms during the 24 hours of the day, including shortness of breath	⊕⊕⊕○ Moderate
COPD and treatment								
1	observational studies	not serious	not serious	not serious	not serious	strong association	Not estimable	⊕⊕⊕○ Moderate
Changes in tone quality and pitch variation (assessed by: Voice Handicap Index)								
1	observational studies	not serious	not serious	not serious	not serious	strong association	90 men included in the study, all of whom had a smoking history of more than 10 years.	⊕⊕⊕○ Moderate
COPD and smoking								
1	observational studies	not serious	not serious	not serious	not serious	strong association	not estimable	⊕⊕⊕○ Moderate
Nicotine and COPD								
1	observational studies	not serious	not serious	not serious	not serious	strong association	not estimable	⊕⊕⊕○ Moderate
Effects of smoking on the voice								
1	observational studies	not serious	not serious	not serious	not serious	strong association all possible residual confounding factors could reduce the demonstrated effect	not estimable	⊕⊕⊕⊕ High
Smoking and voice functions								
1	observational studies	not serious	not serious	not serious	not serious	strong association any plausible residual confusion suggests spurious effect, while no effect was observed.	not estimable	⊕⊕⊕⊕ High
COPD and smoking								
1	observational studies	not serious	not serious	not serious	not serious	strong association all possible residual confounding factors could reduce the demonstrated effect	not estimable	⊕⊕⊕⊕ High

Source: own elaboration.

Inclusion Phase

The selection was made after reading the titles and abstracts of the articles and they were analyzed in their entirety with a complete reading, applying criteria that allowed a selection, thus obtaining those that gave an answer to the question posed. The selection corresponded to a final sample of 30 articles (see table 8).

Table 8. Selection of Studies

Nº	Database	Title	Author	Year	URL	Contribution
1	PUBMED	Pathogenesis of chronic obstructive pulmonary disease (COPD) induced by cigarette smoke	Mari Hikichi, Kenji Mizumura, Shuichiro Maruoka, Yasuhiro Gon	2019	(43) (Accessed May 12, 2023)	Tobacco smoke induces airway inflammation in COPD and affects vocal quality.
2	PUBMED	Implications of the Immune Landscape in COPD and Lung Cancer: Smoking Versus Other Causes	Elisabeth Taucher, Iurii Mykoliuk, Joerg Lindenmann and Freyja-Maria Smolle-Juettner	2022	(44) (Accessed May 12, 2023)	Respiratory infections such as COPD due to tobacco consumption, in turn causes laryngeal alterations.
3	PUBMED	Unravelling the many faces of COPD to optimize its care and outcomes	Patrick Mulhall and Gerard Criner	2016	(45) (Accessed May 12, 2023)	Progressive and irreversible narrowing of the airways mainly due to smoking.
4	SPRINGER LINK	Study of voice disorders in patients with bronchial asthma and chronic obstructive pulmonary disease	Adel M. Saeeda, Nermine M. Riada, Nehad M. Osmana Ahmed Nabil Khattabb, Shymaa E. Mohammeda	2018	(16) (Accessed May 15, 2023)	COPD causes adverse effects on the voice; all patients with COPD had dysphonia as the main cause of tobacco consumption.
5	SPRINGER LINK	Voice changes in patients with chronic obstructive pulmonary disease	Enas Elsayed Mohamed a, Riham Ali El maghraby	2014	(17) (Accessed May 15, 2023)	Many COPD patients experience voice changes; dysphonia was perceived in 50% of them.
6	SPRINGER LINK	The Utility of Pulmonary Function Testing in Patients Presenting with Dysphonia	Kirsten Meenan, Lisa Catanoso, Julien Aoyama, Stephen R. Stephan, Ridley Chauvin, and Robert T. Sataloff	2019	(11) (Accessed May 15, 2023)	In COPD, the voice can be affected by the symptoms of the disease, leading to a breathy voice quality.
7	SPRINGER LINK	Investigating the Effects of Smoking on Young Adult Male Voice by Using Multidimensional Methods	Dogan Pinar, Hakan Cincik, Evren Erkul, and Atilla Gungor, Istanbul, Turkey	2015	(12) (Consulted on May 16, 2023)	Tobacco smoking causes edema and erythema of the vocal cords, impairing the vibratory function of the vocal cords and is the main factor in COPD.
8	SPRINGER LINK	Enfermedad Pulmonar Obstructiva Crónica y Tabaquismo	Francisco Arancibia H.	2017	(13) (Accessed May 16, 2023)	The main risk factor for COPD is smoking, causing respiratory and vocal alterations.

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9	SPRINGER LINK	Evaluating the effects of smoking on the voice and subjective voice problems using a meta-analysis approach	Haewon Byeon & Seulki Cha	2020	(6) (Accessed May 16, 2023)	Smoking tobacco irritates and dries the mucosa of the vocal cords, causing laryngitis and Reinke's edema.
10	SPRINGER LINK	Objective and Subjective Evaluation of Larynx in Smokers and Nonsmokers: A Comparative Study	Hansa Banjara, Varsha Mungutwar, Digvijay Singh and Anuj Gupta	2014	(4) (Accessed May 16, 2023)	Tobacco smoking causes laryngeal alterations in the epithelium of the vocal cords, affecting the acoustic properties of the voice.
11	SPRINGER LINK	Collagen Microstructure in the Vocal Ligament: Initial Results on the Potential Effects of Smoking	Jordan E. Kelleher, PhD; Thomas Siegmund, PhD; Roger W. Chan, PhD	2014	(46) (Accessed May 17, 2023)	Tobacco smoking causes chronic irritation and increased vocal cord mass, in addition to affecting the acoustic properties of the voice.
12	SPRINGER LINK	Influence of smoking isolated and associated to multifactorial aspects in vocal acoustic parameters	Aline Gomes Lustosa Pintoa, Agrício Nubiato Crespob, Lucia Figueiredo Mourão	2014	(1) (Consulted on May 17, 2023)	In addition to affecting the voice, smoking triggers pulmonary difficulties such as COPD.
13	SPRINGER LINK	Multimodal Analysis of Dysphonia in Smokers: A Two-Year Comprehensive Study	Neha Raghuvanshi, Aparajita Mundra, Neeraj Kumar Dubey, Surbhi Godha, Rajkumar Mundra	2021	(47) (Accessed May 17, 2023)	Observable effects of smoking on vocal cord microanatomy, chief complaint dysphonia in tobacco smokers.
14	SCIENCE DIRECT	Towards the Objective Speech Assessment of Smoking Status based on Voice Features: A Review of the Literature	Zhizhong Ma, Chris Bullen, Joanna Ting Wai Chu, Ruili Wang, Yingchun Wang, and Satwinder Singh, y Auckland.	2023	(48) (Accessed May 17, 2023)	Smoking causes inflammation and malfunction of the vocal cords and affects the acoustic properties of the vocal cord.
15	SCIENCE DIRECT	Quality of Life Predictors in Voice of Individuals with Chronic Obstructive Pulmonary Disease	Gabriele dos Anjos Palagi da Silva, Thais Dias Feltrin, Fernanda dos Santos Pichini, Carla Aparecida Cielo, and Adriane Schmidt Pasqualoto, Santa Maria, and y Curitiba.	2022	(9) (Consulted on May 18, 2023)	People with COPD may present signs and symptoms such as vocal alterations due to respiratory and muscular damage.

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16	SCIENCE DIRECT	Multiple symptoms, functioning, and general health perception in people with severe COPD over time	Soo Kyung Park, PhD, RN a, Janet L. Larson, PhD, RN	2016	(49) (Accessed May 18, 2023)	People with COPD present vocal discomfort and its main etiology is tobacco consumption.
17	SCIENCE DIRECT	Goals of COPD treatment: Focus on symptoms and exacerbations	Claus F. Vogelmeier a, Miguel Roman-Rodríguez b, Dave Singh c, MeiLan K. Han d, Roberto Rodríguez-Roisin, Gary T. Ferguson	2020	(21) (Accessed May 18, 2023)	Smoking causes COPD and its symptoms include vocal alterations.
18	SCIENCE DIRECT	Gender Differences in the Prevalence of Vocal Symptoms in Smokers	Susanna Simberg, Hanna Udd, and Pekka Santtila, Abo	2015	(50) (Accessed May 18, 2023)	Smoking tobacco causes vocal and respiratory alterations.
19	SCIENCE DIRECT	The Effect of Smoking on the Fundamental Frequency of the Speaking Voice	Marie Reine Ayoub, Pauline Larrouy-Maestri, and Dominique Morsomme, Li ege, Belgium, and y Frankfurt.	2019	(51) (Accessed May 18, 2023)	Tobacco smoking significantly affects the vocal apparatus; tobacco smokers report vocal complaints.
20	SCIENCE DIRECT	Using Receiver Operating Characteristic Curve to Define the Cutoff Points of Voice Handicap Index Applied to Young Adult Male Smokers	Dionysios Tafiadis, Spyridon K. Chronopoulos, Evangelia I. Kosma, Louiza Voniati, Vasilis Raptis, Vasiliki Sifaka, and Nausica Zivara, Ioannina, Arta, and Larissa, Greece, and Nicosia.	2018	(52) (Accessed May 18, 2023)	Smoking causes changes in the larynx and alterations in the voice mechanism, as well as respiratory and pulmonary problems.
21	SCOPUS	Is insufficient pulmonary air support the cause of dysphonia in chronic obstructive pulmonary disease?	Megahed M. Hassan a, Mona T. Hussein b, Ahmed Mamdouh Emam a Usama M. Rashad c, Ibrahim Rezk c, Al Hussein Awad	2018	(14) (Accessed May 19, 2023)	Tobacco smokers have a high prevalence of dysphonia, COPD may include vocal abnormalities.

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22	SCOPUS	Respiratory Symptoms Items from the COPD Assessment Test Identify Ever-Smokers with Preserved Lung Function at Higher Risk for Poor Respiratory Outcomes	Martinez, C. H., Murray, S., Barr, R. G., Bleecker, E., Bowler, R. P., Christenson, S. A	2017	(53) (Accessed May 19, 2023)	Tobacco smokers present respiratory and pulmonary alterations, as well as vocal difficulties.
23	SCOPUS	Distinguishing between pre- and post-treatment in the speech of patients with chronic obstructive pulmonary disease	Andreas Triantafyllopoulos, Markus Fendler, Anton Batliner, Maurice Gerczuk, Shahin Amiriparian, Thomas M. Berghaus and Bjorn W. Schuller	2022	(54) (Accessed May 19, 2023)	The predominant cause of the voice is tobacco consumption and this affects the voice significantly.
24	SCOPUS	Speech-Based Support System to Supervise Chronic Obstructive Pulmonary Disease Patient Status	Mireia Farrús, Joan Codina-Filbà, Elisenda Reixach, Erik Andrés, Mireia Sans, Noemí Garcia 4 and Josep Vilaseca	2021	(55) (Accessed May 19, 2023)	COPD patients suffer voice changes, tobacco consumption influences voice quality alterations.
25	SCOPUS	Analysis of Acoustic Parameters from Respiratory Signal in COPD and Pneumonia patients	Neili Zakaria Fezari, Mohamed Abdeghani, Redjati	2019	(56) (Accessed May 20, 2023)	COPD is caused by tobacco use and affects the respiratory signal and phonation.
26	SCOPUS	Assessment of Chronic Pulmonary Disease Patients Using Biomarkers from Natural Speech Recorded by Mobile Devices	Viswam Nathan, Korosh Vatanparvar, Md Mahbubur Rahman, Ebrahim Nemati, Jilong Kuang	2019	(57) (Accessed May 20, 2023)	Lung conditions such as COPD affect voice production and speech patterns.
27	SCOPUS	Morning and night symptoms in primary care COPD patients: a cross-sectional and longitudinal study. An UNLOCK study from the IPCRG	Ioanna Tsiligianni, Esther Metting, Thys van der Molen, Niels Chavannes and Janwillem Kocks	2016	(58) (Accessed May 20, 2023)	Tobacco smokers present poor pulmonary function, with a hoarse voice and constant throat clearing.

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28	SCOPUS	Observational study to characterise 24-hour COPD symptoms and their relationship with patient-reported outcomes: results from the ASSESS study	Marc Miravittles, Heinrich Worth, Juan José Soler Cataluña, David Price, Fernando De Benedetto, Nicolas Roche, Nina Skavlan Godtfredsen, Thys van der Molen, Claes-Göran Löfdahl, Laura Padullés and Anna Ribera	2014	(59) (Accessed May 20, 2023)	Among the characteristic symptoms of COPD are respiratory and vocal disturbances.
29	EBSCO	Self-Perceived Handicap Associated With Dysphonia and Health-Related Quality of Life of Asthma and Chronic Obstructive Pulmonary Disease Patients: A Case-Control Study	Rafael Hurtado-Ruzza, a, Óscar Álvarez-Calderón Iglesias, Ricardo Becerro-de-Bengoa-Vallejo, C César Calvo-Lobo, c Marta San-Antolín, d Marta Elena Losa-Iglesias, e Carlos Romero-Morales, f and Daniel López-López	2021	(7) (Accessed May 20, 2023)	People with COPD show higher prevalence of dysphonia and higher levels of vocal fatigue, contributing to changes in vocal quality and pitch variation.
30	EBSCO	Role of Genetic Susceptibility in Nicotine Addiction and Chronic Obstructive Pulmonary Disease	Gloria Pérez-Rubio ¹ , Elizabeth Córdoba-Lanús, Paula Cupertino, Francisco Cartujano-Barrera, Michael A. Campos ⁴ and Ramcés Falfán-Valencia	2019	(2) (Accessed on May 20, 2023)	All tobacco smokers develop some level of lung inflammation, but in people with COPD, the inflammation is denser and damaging.

Source: own elaboration.

Table 9 shows the effects caused and structures affected corresponding to Organic Dysphonia produced by tobacco consumption in adults with COPD.

**Table 9. Effects and Structures Affected in Organic Dysphonia
Caused by Smoking in Adults with COPD**

Effect	Structure
<ul style="list-style-type: none"> ○ Enlarged laryngeal mucosa (7) (16) (51) ○ Acute laryngitis caused by an infection of the upper respiratory tract (17) (11) (6) ○ Cancer of the larynx (17) (12) (50) ○ Laryngeal irritation (12) (4) (46) (52) ○ Smoking produces anatomical changes in the larynx (6) ○ Laryngospasm (1) ○ Abnormal laryngeal color (50) ○ Benign and malignant tumors (52) 	Larynx
<ul style="list-style-type: none"> ○ Incomplete adduction of the vocal folds (7) ○ Diffuse congestion, unhealthy mucosa and edema of the vocal folds (16) (4) ○ Bilateral edema of the vocal folds (16) ○ Reinke's edema (17) (6) (50) (52) ○ Increase of the vascularization of the vocal cords (16) -Nódulos en las cuerdas vocales (11) (58) ○ Vocal cord polyps (11) (47) ○ Vocal cord erythema (12) (4) (50) ○ Abnormal edge of the vocal cords (4) (4) 	Vocal cords
○ Tos constant (7) (16) (17) (11) (2) (6) (1) (9)	Lungs
○ Glottic edema due to smoking (16)	Glottis
○ Inflammation, irritation and dryness (14) (6)	Vocal tract
○ Thickening, aberrations and carcinomas (46)	Epithelium of the Vocal Cords
○ Idiopathic subglottic stenosis (1)	Subglottis
<ul style="list-style-type: none"> ○ Chest tightness (7) (59) ○ Pulmonary disorders (17) (13) (9) ○ Decreased pulmonary function (11) ○ Smoking leads to lung disease, which can cause dysphonia (11) ○ Expectoration (2) (6) (1) (59) ○ Pulmonary hypersecretion (9) ○ Lung cancer (44) 	Lungs
<ul style="list-style-type: none"> ○ Inflammation of the respiratory tract (7) (43) (51) ○ Progressive and irreversible narrowing of the airways (45) 	Respiratory tract

Source: own elaboration.

Table 10 shows the effects caused and functions affected corresponding to Organic Dysphonia produced by tobacco consumption in adults with COPD.

Table 10. Effects and Affected Functions in Organic Dysphonia Caused by Tobacco use in Adults with COPD

Effect	Function
<ul style="list-style-type: none"> ○ Vocal fatigue (7) ○ Strained voice (16) (14) (14) (21) (50) ○ Slurred voice (16) ○ Clearing (44) (1) (1) (52) ○ Vocal alterations due to smoking (17) (9) (9) ○ Increased mucus production, leading to a clipped or raspy voice quality (11) ○ Vocal weakness and aphonia (11) ○ Deterioration of voice quality and various degrees of dysphonia (16) (11) (14) ○ Hoarseness (46) (1) (47) 	Voice
<ul style="list-style-type: none"> ○ Prosodic characteristics (55) (57) 	Speak to
<ul style="list-style-type: none"> ○ Laryngeal hypersensitivity (7) 	Hypersensitivity
<ul style="list-style-type: none"> ○ Changes in the quality and variation of the tone (7) (16) (1) (9) 	Quality and tone of voice
<ul style="list-style-type: none"> ○ Insufficient glottic closure leading to a decrease in the duration of phonation time (7) (6) (4) (50) 	Maximum Phonation Time
<ul style="list-style-type: none"> ○ Decrease of the fundamental frequency (6) (4) (46) (48) (57) (50) (51) ○ Jitter variation (6) (4) (4) (57) (51) 	Fundamental frequency
<ul style="list-style-type: none"> ○ Variation of shimmer (6) (4) (57) 	Voice amplitude
<ul style="list-style-type: none"> ○ Harmonic Noise Ratio (HNR) impairment (4) (48) 	Harmonic
<ul style="list-style-type: none"> ○ Altered phonatory physiology (12) (4) (46) (52) 	Phonation
<ul style="list-style-type: none"> ○ Limitation of respiratory support which causes difficulties in speech and loss of speech volume (17) ○ Wheezing (2) (49) (49) (57) (58) (59) ○ Respiratory infections (21) ○ Difficulty in breathing (7) (11) (17) (2) (9) (49) (21) (59) (7) (11) (17) (2) (9) (49) (21) (59) -Limited expiratory airflow (7) (54) (53) ○ Shortness of breath (7) (11) (11) (17) (2) (9) (49) (21) (59) 	Breathing

Source: own elaboration.

ANALYSIS AND DISCUSSION

Smoking is the leading cause of preventable death worldwide, and it is considered a public health problem. Tobacco smoke is made up of different toxic and carcinogenic compounds, including nicotine, nitrogen oxides and carbon monoxide (9).

Once nicotine is inhaled, it is absorbed and transmitted to the brain, where it acts on specialized receptors that cause the release of neurotransmitters, especially dopamine. The pleasurable effects of this neurotransmitter result in positive feedback that leads to addiction. (45) Continuing to smoke tobacco produces neuroadaptive tolerance, while quitting causes withdrawal symptoms, as well as irritability, anxiety and depression; in addition, the conditioned behaviors, i.e., the pleasure after a meal, developed by a smoker over the year serve as reinforcement to continue smoking tobacco. (45)

Smoking is also an important factor that has a deleterious effect on vocal health (9), and it is considered one of the main causes of vocal disorders, (50) likewise, according to the International Union Against Cancer, tobacco smoking is considered the most important risk factor in the etiology of laryngeal cancer (12).

Changes in the anatomical structure of the larynx can cause functional problems and as a result, can adversely affect voice production and lead to voice disorders. (6) From a clinical/acoustic voice perspective, tobacco smoking has been shown to induce acoustic changes in characteristics such as fundamental frequency (FO), jitter, shimmer, harmonic-to-noise ratio (HNR), (48) (57) (7) brightness, maximum phonation time, pitch variation and sound quality, tense voice, throat clearing, changes in pitch quality and pitch variation, deterioration of voice quality and various degrees of dysphonia, (16) (6) (4) increased mucus production, leading to a choppy or raspy voice quality, vocal weakness and aphonia, (11) (21) resulting in impaired oral communication.

It is widely known that voice disorders have a very high recurrence rate worldwide. Particularly, even if voice rehabilitation is performed after the onset of a disorder or disturbance, the risk of recurrence is even higher unless the risk factor that adversely affects it and causes its etiology is eliminated (6).

Regarding the structure of the vocal folds, it is stated that smoking tobacco causes chronic irritation and abnormal texture (46), edema, mainly in the superficial layers, presence of erythema, nodules and polyps in the vocal folds, (11) (47) abnormalities in flexibility or stiffness, abnormalities of the size of the glottic space, resulting in microscopic alterations identified in the epithelium, and abnormal and swollen border (4), as well as Rheinke's edema, leukoplakia, glottic edema, abnormalities in flexibility or stiffness due to prolonged edema, increased vascularization of the vocal folds (16) (46), inflammation, irritation and dryness in the vocal tract, (14) (6) enlarged laryngeal mucosa, incomplete adduction of the vocal folds, (7) thickening, aberrations and carcinomas in the vocal fold epithelium, (46) acute laryngitis caused by an upper respiratory tract infection, laryngeal cancer, (17) (11) (12) (6) likewise, tobacco favors the increase in the production of cells and change in the shape of the vocal folds, contributing to the appearance of vocal fold cancer. (1)

Prolonged exposure of the laryngeal mucosa to tobacco compromises its mucocondulatory movement, chronic inflammation or irritation, benign and malignant tumors, (52) mucosal edema or interaritenoid thickening and modifies voice quality causing burning sensation, throat clearing and presence of secretions and laryngitis. (1) Likewise, a relationship between tobacco smoke exposure and different types of cancer, respiratory, cardiovascular, infectious and neurological diseases has been demonstrated (44).

Since voice production results from complex interactions between the respiratory and phonatory systems, tobacco smoking can result in a much more drastic loss of pulmonary function and dysphonia (17), which is characterized by respiratory as well as systemic and extrapulmonary manifestations that may be accompanied by various comorbidities such as heart failure, cardiac arrhythmias, anemia, weight loss, anxiety, depression, diabetes, increased muscle pain, wheezing, frequent coughing. (13)

In addition to typical pulmonary symptoms such as dyspnea, increased mucus production, cough and decreased exercise capacity, in COPD, the voice can be affected by various symptoms of the disease, leading to diminished and choppy voice quality further affecting an individual's quality of life. (11) (2) According to the American Speech-Language-Hearing Association, these and other symptoms of COPD can wreak havoc on the larynx and vocal cords, causing problems such as voice and communication disorders (17).

COPD can affect voice quality and production, both directly, associated with respiratory impairment, and indirectly, as a side effect of medication and associated with concurrent symptoms, contributing to dysphonia. (16) Similarly, individuals show limited ventilatory capacity and respiratory infections (21) (58) (59) (43) (51) with the consequent increase in respiratory frequency, which can compromise communication and decrease the Maximum Phonation Time, (49) causing COPD subjects to need numerous air refills to maintain and finish the sentence during conversation (9).

This being the case, pulmonary disorders cause limitation of vital capacity, which in turn will limit the respiratory support and control needed to speak effectively. (54) Adequate prevention of controllable diseases such as COPD through early smoking cessation and early intervention for patients who develop these diseases will play an important role in maintaining vocal strength and efficiency (17). Dysphonia can be directly related to alterations in airflow volume and velocity, so the decreased lung volume associated with COPD (55) and common dyspnea contribute to dysphonia and reduce message duration, resulting in decreased vocalization efficiency (17).

In contrast to other controversial interventions for the treatment of COPD, tobacco smoking cessation may be the most effective therapeutic intervention. It has been estimated that nearly one in five deaths can be attributed to the effects of smoking, and smoking remains the greatest risk factor for developing COPD. Quitting tobacco smoking is difficult, both, because of the addictive properties of nicotine, and the psychological dependence it causes (45).

CONCLUSIONS

Dysphonia is a common finding in adults with COPD, smoking being the main cause of their appearance.

Smoking affects the larynx and vocal cords causing notable alterations, such as irritation and enlargement of the laryngeal mucosa, benign and malignant tumors, increased vascularization, inflammation and dryness, edema, nodules, polyps and erythema in the vocal cords. Each of these manifestations affects not only the structures involved in the voice process, but also the acoustic characteristics of the voice, causing changes in tone quality and pitch variation, deterioration of voice quality, and various degrees of dysphonia.

Similarly, COPD can affect the quality and production of the voice, associated with respiratory impairment, these people may present difficulties in the voice, since phonation requires considerable respiratory capacity and as one of the main symptoms of COPD is the limitation and obstruction of expiratory airflow, leading to an imbalance between breathing and phonation, as well as decreased lung volume and dyspnea, contributing to dysphonia and reduce the duration of the message, resulting in a decrease in the efficiency of vocalization.

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