

Association between occupational voice use and occurrence of voice disorders

Voice disorders and work

Asociación entre el uso ocupacional de la voz y la aparición de trastornos de la voz: un metanálisis



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Resumen

Purpose: This meta-analysis has two aims: 1) to determine whether being an occupational voice user (teacher, broadcaster, call-center worker, etc.) is associated with an increased occurrence of voice disorders, 2) and to provide a quantitative assessment of the occurrence of voice disorders among different occupational voice users. Method: A random-effect meta-analysis was conducted on the occurrence of voice disorders among occupational voice users. Comprehensive literature searches were conducted using two computerized databases: PubMed/MEDLINE, and Scielo. As a measure of association, the odds ratio (OR) with corresponding 95% confidence interval (95% CI) was used. Heterogeneity was assessed by chi-square and I² and draw in forest plots. Results: Voice disorders are related with occupational voice use independently of type of prevalence with a pool OR of 2.39 for current voice disorders, 1.88 for 12-months prevalence, and 2.43 for life-time and unspecified recall period. Studies that include just teachers as the group of occupational voice users (n=12) reported ORs ranging from 1.20 to 4.61. Studies that include telemarketers, newsreaders, and sellers as the group of occupational voice users (n=6) reported ORs ranging from 0.85 when future vocal professionals were compared future non-vocal professionals to 4.58 when newsreaders were compared with non-newsreaders. Conclusion: Occupational voice users have a higher likelihood of having voice disorders. Teachers had a slightly lower likelihood than telemarketers, broadcasters, and sellers to have a voice disorder regardless the type of prevalence. Nevertheless, due to the weak to moderate quality of the included studies, the results should be taken with caution.

Abstract

Purpose: This meta-analysis has two aims: 1) to determine whether being an occupational voice user (teacher, broadcaster, call-center worker, etc.) is associated with an increased occurrence of voice disorders, 2) and to provide a quantitative assessment of the occurrence of voice disorders among different occupational voice users. Method: A random-effect meta-analysis was conducted on the occurrence of voice disorders among occupational voice users. Comprehensive literature searches were conducted using two computerized databases: PubMed/MEDLINE, and Scielo. As a measure of association, the odds ratio (OR) with corresponding 95% confidence interval (95% CI) was used. Heterogeneity was assessed by chi-square and I² and draw in forest plots. Results: Voice disorders are related with occupational voice use independently of type of prevalence with a pool OR of 2.39 for current voice disorders, 1.88 for 12-months prevalence, and 2.43 for life-time and unspecified recall period. Studies that include just teachers as the group of occupational voice users (n=12) reported ORs ranging from 1.20 to 4.61. Studies that include telemarketers, newsreaders, and sellers as the group of occupational voice users (n=6) reported ORs ranging from 0.85 when future vocal professionals were compared future non-vocal professionals to 4.58 when newsreaders were compared with non-newsreaders. Conclusion: Occupational voice users have a higher likelihood of having voice disorders. Teachers had a slightly lower likelihood than telemarketers, broadcasters, and sellers to have a voice disorder regardless the type of prevalence. Nevertheless, due to the weak to moderate quality of the included studies, the results should be taken with caution.

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Association between occupational voice use and occurrence of voice disorders

a meta-analysis

Asociación entre el uso ocupacional de la voz y la aparición de trastornos de la voz: un metanálisis: un metanálisis

Lady Catherine **Cantor Cutiva**

Introduction

In our modern society, oral communication plays a very important role for social interactions. For many individuals, voice is not just a tool for communication but also a working tool. These group of workers, including teachers, singers, telemarketers, and broadcasters are considered “occupational voice users” because they rely on their voices to perform their occupational duties ([Fritzell, 2009](#)).

Previous research has reported that occupational voice users have an increased likelihood of presenting functional and organic changes in their phonatory system during their working life. It has also been suggested that the high vocal demands (vocal load) associated with occupations like teaching, singing or broadcasting may increase the risk for developing voice disorders among these workers ([Koszyła, Rogowski, Ruczaj , Pepiński, & Lobaczuk-Sitnik, 2004](#)). In addition to the vocal load associated with the occupational voice use, other studies have found that physical conditions of the workplaces, such as noise, reverberation time and temperature, also influence the occurrence of voice disorders among occupational voice users ([Cantor Cutiva, Vogel, & Burdorf, 2013](#); [Vilkman, 1996](#)). Although several publications have investigated the magnitude and associated factors of voice disorders among different occupational voice users; to date, there is not available meta-analysis concerning this relationship. Results of the present study may contribute to the second step in the process of evidence-based practice as advised by the American Speech-Language- Hearing Association ([American Speech-Language- Hearing Association, 2004](#)).

According to the American Speech-Language-Hearing Association the “*term evidence-based practice refers to an approach in which current, high-quality research evidence is integrated with practitioner expertise and client preferences and values into the process of making clinical decisions*”. A meta-analysis of the current scientific literature in the relationship between occupational voice use and occurrence of voice

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disorders, will help with two of the activities that a speech and language pathologist need when making clinical practice evidence-based: 1) acquire the knowledge that are necessary to provide high quality professional services; and 2) evaluate the quality of evidence appearing in journal articles.

Therefore, a meta-analysis of the available scientific literature was conducted with two aims: 1) to determine whether being an occupational voice user (teacher, broadcaster, call-center worker, etc.) is associated with an increased occurrence of voice disorders, 2) and to provide a quantitative assessment of the occurrence of voice disorders among different occupational voice users.

Methods

Literature search

Comprehensive literature searches were conducted using two computerized databases: PubMed/MEDLINE (National Library of Medicine, Bethesda, Maryland) beginning in 1966, and Scielo (Scientific Electronic Library Online, Sao Paulo, Brazil) from 1997. All literature searches were conducted through May 2018. The following search strings were used on PubMed/MEDLINE: ((vocal fatigue) AND ((occupation) OR (work-related))). The “user” search string was translated by PubMed in the search string: (“voice disorders”[MeSH Terms] OR (“voice”[All Fields] AND “disorders”[All Fields]) OR “voice disorders”[All Fields] OR (“vocal”[All Fields] AND “fatigue”[All Fields]) OR “vocal fatigue”[All Fields]) AND ((“occupations”[MeSH Terms] OR “occupations”[All Fields] OR “occupation”[All Fields]) OR work-related[All Fields]). In Scielo, the string was: ((vocal fatigue) AND ((occupation) OR (work-related))). Originally, this meta-analysis was aimed to include publications on vocal fatigue (as one of the most common symptoms among occupational voice users). However, the search resulted in studies on voice disorders in general, and due to the reduce number of studies on vocal fatigue, this meta-analysis focused on voice disorders. The search was extended by screening the reference lists of all relevant publications identified as described below.

Study Selection

Initially, titles and abstracts of all papers identified were screened. For final inclusion in this meta-analysis, publications had to fulfil all the following criteria: 1) report empirical data on the association between occupational voice use and voice disorders, 2) include a comparison group in their sampling, and 3) be published in peer-reviewed scientific journals written in English, Spanish, or Portuguese.

Data extraction and analysis

First, relevant data was extracted from the included publications. The extracted information included: year of publication, study

population, sample size, instrument used to identify voice disorders, definition of voice disorders. The prevalence of voice disorders reported in 18 publications was classified in four categories: point identified by questionnaire (currently present), point identified by laryngoscopy (currently present), 12-month (present in the past year), and life-time (life-time and no specific time period reported).

As measure of association between voice disorders and occupation, the odds ratio (OR) with a corresponding 95% confidence interval (95% CI) was used. The OR is the ratio of the odds of the event of interest (i.e. voice disorders) occurring in one group to the odds of it occurring in another group (Bland & Altman, 2000). ORs were calculated based on the raw data provided in all the included publications (Behlau, Zambon, Guerrieri, & Roy, 2012; Brinca et al., 2015; Cantor Cutiva & Burdorf, 2015; De Jong et al., 2006; Gunasekaran, Boominathan, & Seethapathy, 2016; Jones et al., 2002; Loiola-Barreiro & Silva, 2016; Pekkarinen, Himberg, & Pentti, 1992; Rechenberg, Goulart, & Roithmann, 2011; Roy, Merrill, Thibeault, Gray, & Smith, 2004; Roy et al., 2004; Sala, Laine, Simberg, Pentti, & Suonpaa, 2001; Sales et al., 2010; Sliwinska-Kowalska et al., 2006; Smith, Gray, Dove, Kirchner, & Heras, 1997; Smith, Lemke, Taylor, Kirchner, & Hoffman, 1998; Thomas, Kooijman, Cremers, & De Jong, 2006; Timmermans et al., 2002).

Publication bias and methodological quality assessment

The 18 publications selected for this meta-analysis were assessed for methodological quality. The assessment was based on criteria from the quality assessment tool for quantitative studies (Effective Public Health Practice Project, 1998), distinguishing 6 topics: selection bias, study design, confounders, blinding, data collection methods, and withdrawals and drop-outs. The scale also assesses the intervention integrity and the analysis, but these two aspects are not considered for the final quality score. Linear regression analysis was conducted to evaluate whether the quality score was associated with odds ratio in order to identify possible biased findings.

Meta-analysis

A random-effect meta-analysis was conducted to evaluate whether being an occupational voice user (teacher, singer, call-center worker, etc.) was associated with an increased occurrence of voice disorders. Random-effect method assumes that there is a variation on population parameters from study to study. Therefore, the variance between studies is calculated and used to modify the weights used to calculate the summary estimate (Deeks, 2002).

Heterogeneity was assessed by chi-square and I^2 . Heterogeneity is defined as differences in methodology or study populations used by the studies under examination (Monroe, 2007). Values of I^2 statistic range from 0% to 100% and show the proportion of total variation across studies not due to chance. Thresholds for the interpretation of I^2 can be misleading, since the importance of inconsistency depends on several factors. The importance of the observed value of I^2 depends on (1) magnitude and direction of effects and (2) strength of evidence for heterogeneity (e.g. p-value from the chi-squared test, or a confidence interval for I^2) (Ryan, 2014).

Results

Occurrence of voice disorders

A total of 420 relevant papers on the relation between voice disorders and occupational voice use were identified. Of the relevant publications, 18 were included in this meta-analysis (Figure 1), all reporting on cross-sectional studies (Table 1). Table 2 summarizes the reported prevalence of the included studies. Most studies based their results on questionnaires with point prevalence of voice disorders among occupational voice users ranging from 11% (Roy, Merrill, Thibeault, Gray, & Smith, 2004) to 18% (de Jong , y otros, 2006). Five publications presented a clinically verified prevalence of voice disorders, ranging from 7% (Timmermans, y otros, 2002) to 53% (Sales, y otros, 2010)The 12-month prevalence ranged from 54% (Thomas, Kooijman, Cremers, & de Jong, 2006) to 80% (Pekkarinen, Himberg, & Pentti, 2009).

Association between occupational voice use and voice disorders

This meta-analysis showed a statistically significant association between being an occupational voice user and having a voice disorder across different types of prevalence. Three forest plots were drawn to illustrate the strength of the relationship between occupational voice use and voice disorders according to three different types of prevalence (point, 12-months, and life-time and unspecified recall period). As shown in figure 2, voice disorders are related with occupational voice use independently of type of prevalence with a pool OR of 2.39 for current voice disorders, 1.88 for 12-months prevalence, and 2.43 for life-time and unspecified recall period. Among articles that reported point prevalence, the OR ranged from 0.85 when comparing future vocal professionals (radio-directors and TV journalists) with future non-vocal professionals (theatre directors) (Timmermans, y otros, 2002) to 4.61 when teachers were compared with non-teachers (Sliwinska-Kowalska, y otros, 2006). With respect to 12-months prevalence, the OR ranged from 1.66 (Pekkarinen, Himberg, & Pentti, 2009) to 2.03 (Cutiva & Burdorf, 2015). Among papers that reported life-time prevalence or unspecified recall period prevalence, OR ranged from 1.85 when comparing telemarketers with administrative workers (Rechenberg, Goulart, & Roithmann, 2011) to 4.58 when newsreaders where compared with non-newsreaders (Gunasekaran, Boominathan , & Seethapathy, 2016).

Heterogeneity tests (I^2) among these articles was 68% for current voice disorders, 0% for 12-months voice disorders, and 66% for life-time and unspecified recall period. The I^2 values for current voice disorders and life-time and unspecified recall period represent substantial heterogeneity across the studies, whereas the I^2 value for 12-months voice disorders suggest heterogeneity was not an important factor across the studies.

Although around 70% of the total number of included publications assessed the occurrence of voice disorders among teachers as occupational voice users, an analysis per occupation was performed. The objective was to identify the possible influence of occupation in the occurrence of voice disorders. Figure 3 shows the forest plot of the studies that include just teachers as the group of occupational voice users (n=12). As Figure 3 shows, the OR ranged from 1.20 (Brinca, et al., 2015) to 4.61 (Sliwinska-Kowalska, et al., 2006). Heterogeneity test (I^2) among these articles is 17%, meaning that heterogeneity was not important across the studies. Therefore, results are comparable.

Figure 4 shows the forest plot of the studies with telemarketers,

newsreaders, and sellers as the group of occupational voice users (n=6). Among these studies, the OR ranged from 0.85 when future vocal professionals were compared to future non-vocal professionals (Timmermans, y otros, 2002) to 4.58 when newsreaders were compared with non-newsreaders (Gunasekaran, Boominathan , & Seethapathy, 2016) Heterogeneity test (I^2) among these articles is 40%, which indicate that heterogeneity was not important across the studies.

Publication bias

Linear regression analysis showed that the quality score was not influencing the results on the associations between occupational voice use and voice disorders ($R^2=0.004$; p-value 0.797). Studies of moderate quality did not present different findings than studies of low quality.

Methodological quality assessment

Table 3 presents the methodological quality assessment of the included publications. Methodological quality scores of the included publications ranged from weak to moderate. Thirteen out of 18 publications were scored with moderate quality, whereas 5 publications got a low-quality score. All included publications contained cross-sectional studies. None of the publications scored “strong quality” on the items ‘study design’ and ‘blinding’.

Discussion

The results of this meta-analysis showed that occupational voice users have up to 4 times more likelihood of having a voice disorder than non-occupational voice users. Nevertheless, like in previous publications (Cantor Cutiva, et al., 2013; Verdolini & Ramig, 2001; Williams, 2003), a large variation in prevalence of voice disorders was observed.

As previously mentioned by Cantor et al (2013), two possible reasons may explain this large variation. First, publications with longer recall period (12-months, life-time) resulted in a higher prevalence of voice disorders, up to 94% (Roy, Merrill, Thibeault, Gray, & Smith, 2004) than publications with a short recall period with prevalence of current voice disorders as low as 11% (Roy, Merrill, Thibeault, Gray, & Smith, 2004). Second, the assessment method to identify a voice disorder seems to play a role in this large variation too. Publications that based their results on clinical examination (videolaryngoscopy, stroboscopy) reported higher prevalence of current voice disorders (53%) (Sales, y otros, 2010), whereas publications that based their results on questionnaires report lower values of prevalence of current voice disorders (18%) (de Jong , y otros, 2006). Among studies that reported current prevalence, analysis of heterogeneity stratified by assessment method (data not shown) suggests that although prevalence varied considerably, heterogeneity is lower compared with the pool analysis ($I^2=0\%$ for clinical assessment methods, $I^2=26\%$ for current voice disorders identified by questionnaire, $I^2=68\%$ for all the studies that reported current prevalence). These results suggest that an increase of precision in the assessment method used to identify a voice disorder may be associated with the decrease of the heterogeneity in the analysis in this group. Therefore, it could be assumed that all studies using similar assessment methods were evaluating the same effect.

This meta-analysis showed a statistically significant association

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between being an occupational voice user and having a voice disorder across different occupations and different types of prevalence. In general, occupational voice users had twice more risk of voice disorders than non-occupational voice users. These results confirm the need of implementing strategies to prevent voice disorders and promote vocal health at the workplaces. The analysis of voice disorders across different groups of occupational voice users showed that teachers had a pool OR=1.95 for having a voice disorder regardless the type of prevalence. Telemarketers, broadcasters, and sellers had a higher likelihood compared with teachers, with an OR=2.75. These results highlight the importance of providing voice training to these workers prior to the start of their work life (Fritzell, 1996). Another strategy to decrease the occurrence of voice disorders among occupational voice users is the implementation of occupational safety and health recommendations that reduce risk factors at work (Vilkman, 2000). These actions may include intervention to the physical conditions of the workplaces and adjustments in the work organization and employment conditions. In the case of teachers, previous studies have shown that topic of teaching is an important factor associated with voice disorders (physical education and music teachers have higher prevalence of voice disorders than other teachers) (Cantor Cutiva, et al., 2013; Verdolini & Ramig, 2001). Therefore, schools should take this aspect into consideration during the planning of classes to prevent an overload of occupational voice use. Among other occupational voice users (singers and broadcasters), non-fixed employment contracts may cause these workers to work in more than one organization, which can increase their vocal load. As a consequence, voice disorders may appear.

The analysis of the included occupations showed that studies including teachers (as the occupational voice user group) were overrepresented in this meta-analysis (around 70% of studies were on teachers). Therefore, studies that investigate the magnitude and associated factors of voice disorders among other occupational groups (telemarketers, broadcasters, singers, among others) are required to extend our knowledge about the nature of voice disorders and their work-related factors among occupational voice users.

This meta-analysis has several limitations. First, although linear regression analysis showed that the quality score was not related with associations between occupational voice use and voice disorders, publication bias cannot be disproved, whereby publications with statistically significant results are more easily published than other publications (Egger, Davey Smith, Schneider, & Minder, 1997).

Second, none of the included publications scored high in the quality assessment. Although the quality of the studies did not influence the reported findings, the overall weak to moderate quality demonstrates that studies of better quality are highly needed. Third, since voice production is a multidimensional phenomenon, there are other individual and environmental factors that may influence the occurrence of voice disorders. Nevertheless, since this meta-analysis was focused on the relationship between occupational voice use and occurrence of voice disorders, those factors were not considered. Future research is advised to include important individual and environmental factors in meta-analysis of the relationship between occupational voice use and occurrence of voice disorders.

In conclusion, occupational voice users have a higher likelihood of having voice disorders. Results of this meta-analysis show that teachers had a slightly lower likelihood (pool OR=1.95) than telemarketers, broadcasters, and sellers (pool OR=2.75) for having a voice disorder regardless the type of prevalence. Nevertheless, due to the weak to moderate quality of the included studies, the results should be taken with caution. Moreover, better quality studies among all the different groups of occupational voice users are required to better understand the natural variation of voice disorders among occupational voice users. This information is needed to design effective programs for preventing voice disorders and promoting vocal health at workplaces.

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Figure 2. Forest plot showing heterogeneity among publications according to prevalence type

Figure 3. Forest plot, including just teachers, showing heterogeneity among publications according to prevalence time

Figure 4. Forest plot, including telemarketers – sellers – broadcasters, showing heterogeneity among publications according to prevalence time

Figure 1. Flowchart of the process for identification of the included publications

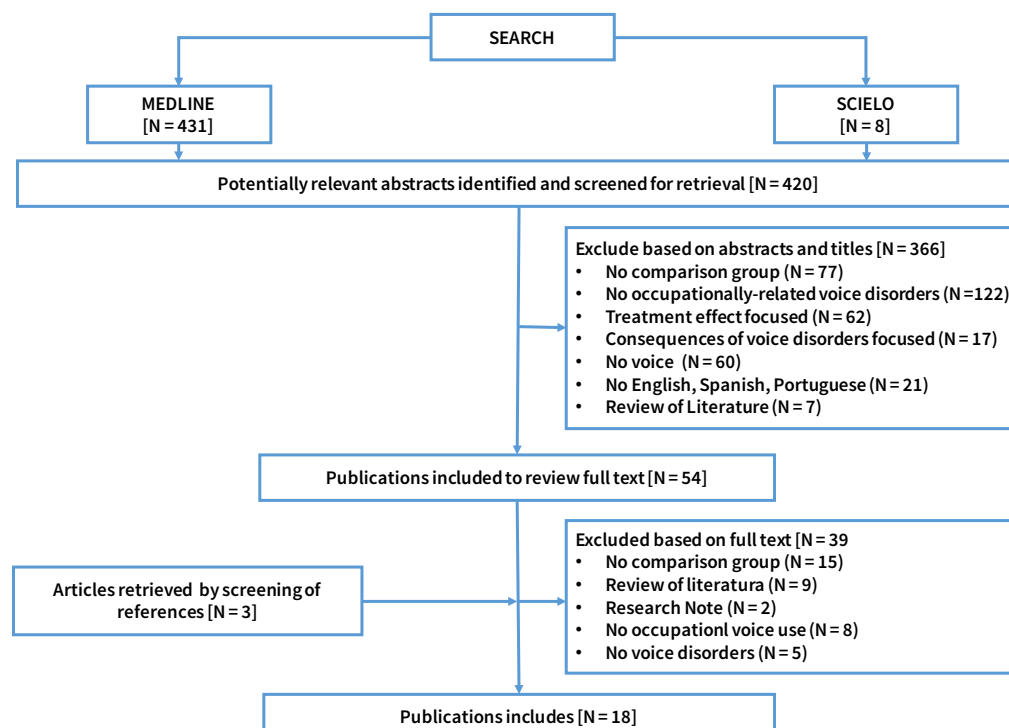


Figure 2. Forest plot showing heterogeneity among publications according to prevalence type

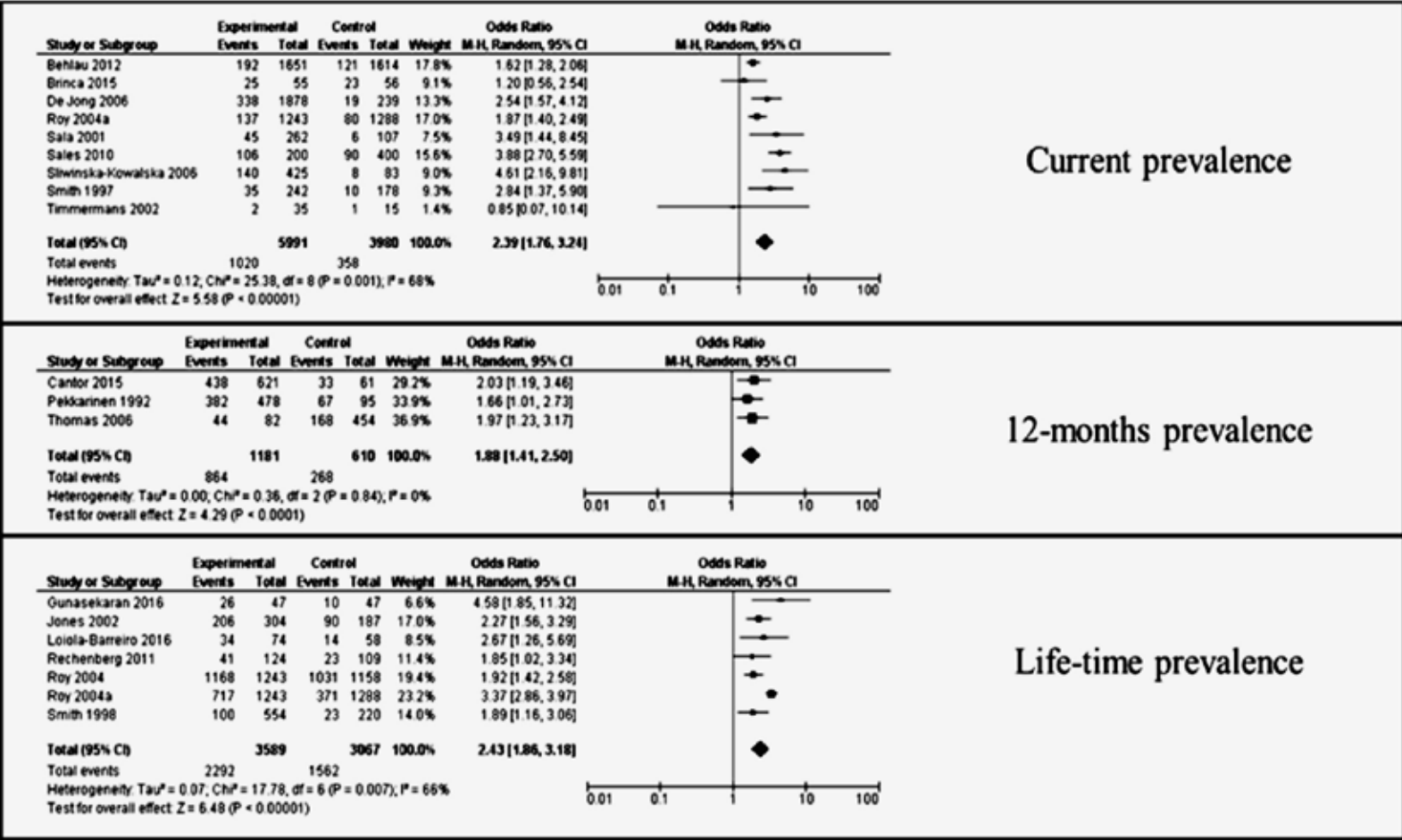


Figure 3. Forest plot, including just teachers, showing heterogeneity among publications according to prevalence time

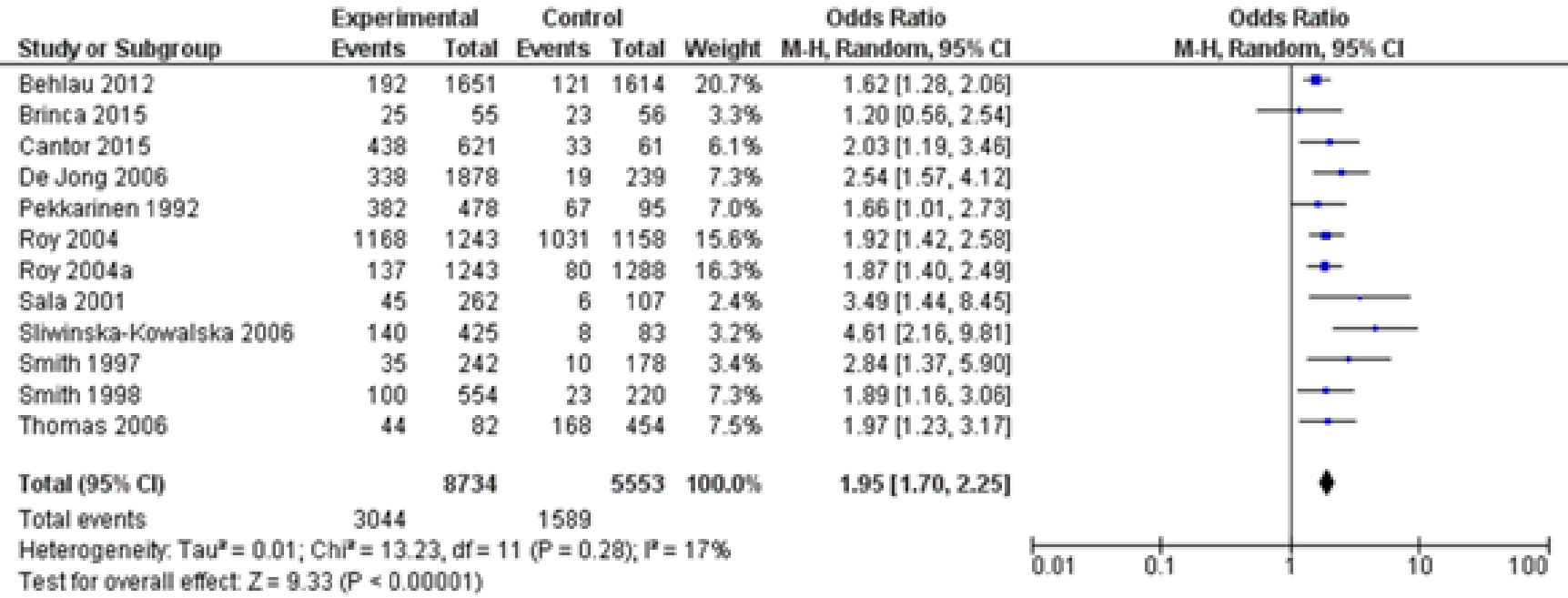
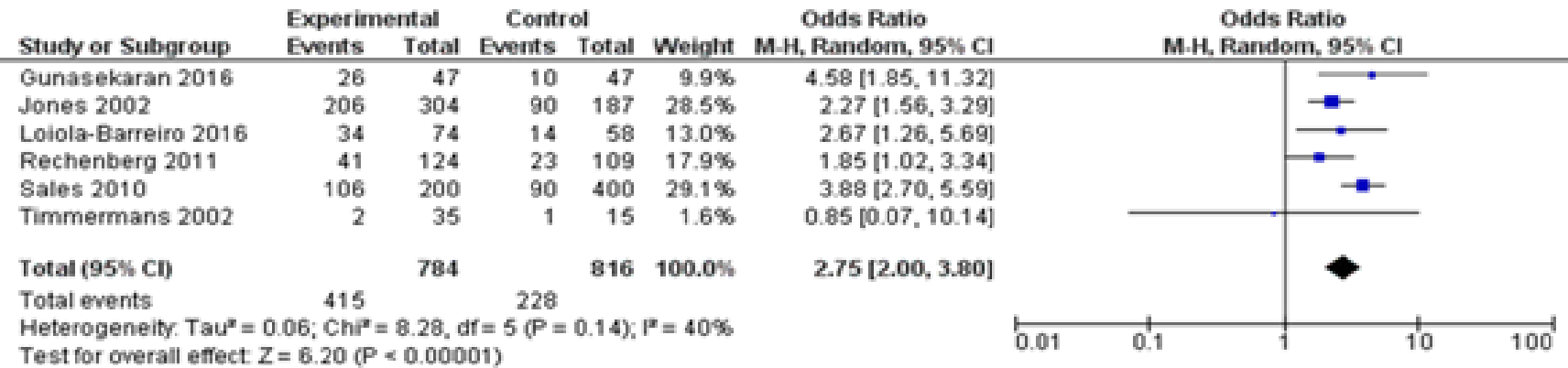


Figure 4. Forest plot, including telemarketers – sellers - broadcasters, showing heterogeneity among publications according to prevalence time



Fuente: Elaboración propia

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Table 1. Relevant data from the included publications

Study (first author /year/country)	Study Population		Sample Size		Voice Disorders	Instrument
	Occupational Voice Users (OVU)	Non-Occupational Voice Users (Non-OVU)	OVU	Non-OVU	Definition	of assessment
Behlau, 2011 (Brazil)	Teachers	Nonteachers	1651	1614	Current voice disorders	Questionnaire
Brinca, 2014 (Portugal)	Teachers	Nonteachers	55	56	Laryngeal pathology	Videolaryngoscopy
Cantor-Cutiva, 2015 (Netherlands)	Teachers	Nonteachers	621	61	Voice disorders in the past month	Questionnaire
De Jong, 2006 (Netherlands)	Teachers	Nonteachers	1878	239	Current voice disorders	Questionnaire
Gunasekaran, 2015 (Sri Lanka)	Newsreaders	Non-newsreaders	47	47	Vocal fatigue	Questionnaire
Jones, 2002 (USA)	Telemarketers	Community college students	304	187	Vocal attrition	Questionnaire
Loiola-Barreiro, 2015 (Brazil)	Popular singers	Erudite singers	74	58	Vocal complaint	Questionnaire
Pekkarinen, 1992 (Finland)	Teachers	Nonteachers	478	95	Voice disorders in the last year	Questionnaire
Rechenberg, 2011 (USA)	Telemarketers	Administrative workers	124	109	Vocal symptoms	Questionnaire
Roy, 2004 (USA)a	Teachers	Nonteachers	1243	1158	Life-time prevalence voice symptom:	Questionnaire
Roy, 2004 (USA)b	Teachers	Nonteachers	1243	1288	Life-time prevalence voice symptom:	Questionnaire
	Teachers	Nonteachers	1243	1288	Current voice disorders	Questionnaire
Sala, 2001 (Finland)	Teachers	Nonteachers	262	107	Laryngitis	Videolaryngoscopy
Sales, 2008 (Brazil)	School-children street sellers	School children no street sellers	200	400	Laryngeal pathology	Videolaryngoscopy
Sliwiska-Kowalska, 2006 (Poland)	Teachers	Nonteachers	425	83	Laryngeal pathology	Videolaryngoscopy
Smith, 1997 (USA)	Teachers	Nonteachers	242	178	Current voice disorders	Questionnaire
Smith, 1998 (USA)	Teachers	Nonteachers	554	220	Tired voice	Questionnaire
Thomas, 2006 (Netherlands)	Teachers	Nonteachers	82	454	Voice disorders in the last year	Questionnaire
Timmermans, 2002 (Belgium)	Future vocal professionals	Future theater directors	35	15	Organic lesions	Stroboscopic evaluation
Future vocal professionals= radiodirectos and TV journalists						

Table 2. Prevalence of voice disorders from the included publications

Study (first author /year/country)	Study Population		Prevalence VD (n, (%))		Instrument
	Occupational Voice Users (OVU)	Non-Occupational Voice Users (Non-OVU)	OVU	Non-OVU	
Current Voice Disorders					
Behlau, 2011 (Brazil)	Teachers	Nonteachers	192 (12%)	121 (8%)	Questionnaire
De Jong, 2006 (Netherlands)	Teachers	Nonteachers	338 (18%)	19 (8%)	Questionnaire
Roy, 2004 (USA)b	Teachers	Nonteachers	137 (11%)	80 (6%)	Questionnaire
Smith, 1997 (USA)	Teachers	Nonteachers	35 (15%)	10 (6%)	Questionnaire
Brinca, 2014 (Portugal)	Teachers	Nonteachers	25 (52%)	23 (48%)	Videolaryngoscopy
Sala, 2001 (Finland)	Teachers	Nonteachers	45 (17%)	6 (6%)	Videolaryngoscopy
Sales, 2008 (Brazil)	School-children street sellers	School children no street sellers	106 (53%)	90 (23%)	Videolaryngoscopy
Sliwiska-Kowalska, 2006 (Poland)	Teachers	Nonteachers	140 (33%)	8 (10%)	Videolaryngoscopy
Timmermans, 2002 (Belgium)	Future vocal professionals	Future theater directors	2 (7%)	1 (9%)	Stroboscopic evaluation
Voice Disorders in the last year					
Thomas, 2006 (Netherlands)	Teachers	Nonteachers	44 (54%)	168 (37%)	Questionnaire
Pekkarinen, 1992 (Finland)	Teachers	Nonteachers	382 (80%)	67 (71%)	Questionnaire
Cantor-Cutiva, 2015 (Netherlands)	Teachers	Nonteachers	438 (71%)	33 (54%)	Questionnaire
Life-time and unspecified recall period Voice Disorders					
Roy, 2004 (USA)a	Teachers	Nonteachers	1168 (94%)	1031 (89%)	Questionnaire
Roy, 2004 (USA)b	Teachers	Nonteachers	717 (58%)	371 (29%)	Questionnaire
Smith, 1998 (USA)	Teachers	Nonteachers	100 (18%)	23 (11%)	Questionnaire
Jones, 2002 (USA)	Telemarketers	Community college students	206 (68%)	90 (48%)	Questionnaire
Loiola-Barreiro, 2015 (Brazil)	Popular singers	Erudite singers	34 (46%)	14 (24%)	Questionnaire
Rechenberg, 2011 (USA)	Telemarketers	Administrative workers	41 (33%)	23 (21%)	Questionnaire
Gunasekaran, 2015 (Sri Lanka)	Newsreaders	Non-newsreaders	26 (55%)	10 (22%)	Questionnaire
VD= Voice Disorders OVU= Occupational Voice Users Non-OVU= Non-Occupational Voice Users Future vocal professionals= radiodirectos and TV journalists					

Table 3. Quality assessment of included studies (Quality assessment tool for quantitative studies, Effective Public Health Practice Project)

Study ID	SELECTION	STUDY DESIGN	CONFOUNDERS	BLINDING	DATA COLLECTION	WITHDRAWALS AND DROP-OUTS	GLOBAL RATING
Behlau, 2011 (Brazil)	Moderate	Moderate	Strong	Weak	Strong	NA	Moderate
Jones, 2002 (USA)	Strong	Moderate	Strong	Weak	Strong	NA	Moderate
Loiola-Barreiro, 2015 (Brazil)	Moderate	Moderate	Strong	Weak	Strong	NA	Moderate
Rechenberg, 2011 (USA)	Moderate	Moderate	Strong	Weak	Strong	NA	Moderate
Roy, 2004 (USA)a	Moderate	Moderate	Strong	Weak	Strong	NA	Moderate
Roy, 2004 (USA)b	Moderate	Moderate	Strong	Weak	Strong	NA	Moderate
Sala, 2001 (Finland)	Strong	Moderate	Strong	Weak	Strong	NA	Moderate
Sales, 2008 (Brazil)	Strong	Moderate	Strong	Weak	Strong	NA	Moderate
Sliwinska-Kowalska, 2006 (Poland)	Strong	Moderate	Strong	Weak	Strong	NA	Moderate
Smith, 1997 (USA)	Strong	Moderate	Strong	Weak	Strong	NA	Moderate
Smith, 1998 (USA)	Strong	Moderate	Strong	Weak	Strong	NA	Moderate
Thomas, 2006 (Netherlands)	Moderate	Moderate	Strong	Weak	Strong	NA	Moderate
Timmermans, 2002 (Belgium)	Moderate	Moderate	Strong	Weak	Strong	NA	Moderate
Brinca, 2014 (Portugal)	Weak	Moderate	Weak	Weak	Strong	NA	Weak
Cantor-Cutiva, 2015 (Netherlands)	Weak	Moderate	Strong	Weak	Strong	NA	Weak
De Jong, 2006 (Netherlands)	Weak	Moderate	Strong	Weak	Strong	NA	Weak
Gunasekaran, 2015 (Sri Lanka)	Moderate	Moderate	Weak	Weak	Strong	NA	Weak
Pekkarinen, 1992 (Finland)	Strong	Moderate	Weak	Weak	Strong	NA	Weak

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