

Prevalence of voice disorders in the elderly: a systematic review of population-based studies

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Abstract Voice disorders can occur in the elderly as a result of natural anatomical and physiological changes or greater exposure to pathological conditions in the aging, affecting communication and quality of life. Nevertheless, data about the prevalence of voice disorders in this phase of life are not well known in a population-based perspective. The aim of the present systematic review was to identify the prevalence of vocal disorders in persons aged 60 years or more in population-based studies. A systematic review was undertaken in eleven electronic databases based on preferred reporting items for systematic reviews and meta-analysis statement (PRISMA) criteria. The methodological quality of the studies was analyzed with strengthening the reporting of observational studies in epidemiology (STROBE) directives. The search was conducted independently by two

researchers. Four articles satisfied the criteria of eligibility. The prevalence of vocal disorders in the general population aged 60 years or more ranged from 4.8 to 29.1 %. The studies were different in terms of the methodological procedures and the STROBE directives were not completely satisfied by any of the articles selected. The prevalence of vocal disorders in the general elderly population ranged from low to moderate in population-based studies. The methodological discrepancies of the studies compromised the reliability of the estimated data. Upgrading the methodological quality of studies and designing a short, valid and easy-to-use functional voice-related instrument are urgently required in health surveys to determine the prevalence of vocal disorders among elderly individuals.

Keywords Voice · Voice disorders · Epidemiology · Cross-sectional studies · Aged · Aging

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Introduction

With the number of elderly growing rapidly around the world, disorders that involve the quality of communication in this population are becoming more common, including voice-related issues [1, 2]. During the aging process, the voice goes through perceptual and acoustic transformations [3] that can affect the communication process [4]. These transformations can be the product of anatomical and physiological changes that occur naturally or because some pathological conditions are more common in this phase of life [5–7]. Some vocal symptoms in elderly persons include hoarseness, breathiness, vocal fatigue, strain, instability, decreased loudness and changes in vocal pitch [3, 4, 7, 8]. These symptoms could be correlated to the anatomic and physiologic changes that occur in the larynx with aging, such as calcification and ossification of cartilages, muscle atrophy, fragile bloody supply and histological impairments of vocal folds [5–8]. Most common laryngeal diagnoses associated with voice complaints in the elderly included polyps, laryngopharyngeal reflux, muscle tension dysphonia, vocal fold paresis or paralysis, vocal fold mass, glottic insufficiency, functional dysphonia, malignant lesions and those related to neurologic conditions [7, 8].

These transformations in the elderly voice can have a negative impact on their quality of life, independence, integration and effective social participation [8, 9]. They can also affect physical, emotional and social skills, increasing the risk of functional disability, dependence, social isolation, a lack of productivity, illness and general worsening of health conditions [8, 10–12]. Studies have also shown that advancing age increases the expenditure of health systems in terms of assessing the management of laryngeal disorders associated with the voice such as vocal fold paralysis, cancer of the larynx and functional dysphonia [13, 14].

Nevertheless, the prevalence of voice disorders in the elderly is still referred to in an incipient and controversial manner [15, 16]. North American studies [15, 17] have suggested a greater prevalence than that found in the general population [18]. However, estimates are generally based on non-representative population samples. In addition, the available instruments to evaluate voice conditions are clinical, such as consensus auditory-perceptual evaluation of voice (CAPE-V) and GRBAS [19] or related to quality of life such as voice-related quality of life (V-RQOL) or voice handicap index (VHI) [20]. Thus, these instruments were not designed to specific voice conditions in the elderly.

The absence of instruments that capture this measure from an epidemiological perspective restricts access to more consistent data [15, 17, 21–23]. Epidemiological information on prevalence of voice disorders helps to know

the dimension of their effects on the communication skills and general health of the population, to estimate impact of expenses, to delineate the associate factors, and to develop early screening procedures to detect those at risk [21–24]. Therefore, the aim of the present review was to identify the prevalence of vocal disorders in elderly people in population-based studies.

Materials and methods

A review of the literature between January 1 1900 and September 1 2013 was made and the search included the electronic databases MEDLINE/PubMed, EMBASE, Scopus, Web of Science, CINAHL, Cochrane, PsycInfo, PAHO, WHOLIS, SciELO and Lilacs/BIREME. The search strategy involved the following combinations of research descriptors based on Medical Subjects Headings (MeSH): (voice OR voice disorders) AND (aging OR aged) AND (prevalence OR cross-sectional studies). The same combinations were used in Portuguese when searching the SciELO and Lilacs/BIREME electronic databases.

The following inclusion criteria were applied: original articles published or accepted for publication in English, Spanish or Portuguese; population-based cross-sectional design; the sample included people aged 60 years or more for developing countries and 65 years or more for developed countries, according the World Health Organization criteria. The following exclusion criteria were applied: articles that considered elderly individuals as part of the sample, but did not explicitly share the result with the group; articles with a population formed exclusively by people who sought health services because they already had a vocal complaint or needed to treat a laryngeal or voice disorder; studies with a sample composed only of individuals with a diagnosis of laryngeal or vocal disorder.

The studies were independently assessed by two different researchers. Afterwards, they compared their analysis and solved divergences by consensus. After identifying the articles in the databases, they were passed through the screening phase, in which the respective titles and abstracts were read and those that did not satisfy the abovementioned inclusion criteria were excluded. In the eligibility phase, the remaining articles that potentially dealt with the subject were submitted to a full text review. Also in this phase, the lists of references in the articles were checked manually and studies that were not previously identified by the search strategy were investigated.

Articles that satisfied the eligibility criteria were submitted to the extraction of the following data: location of the study; sample size; participant age and gender (minimum, maximum and mean); definition of the construct (voice disorder); diagnostic instruments; prevalence and

possible biases/comments. The construction of this systematic review was guided by the criteria of the preferred reporting items for systematic reviews and meta-analysis (PRISMA statement) [25]. The assessment of the methodological quality followed the strengthening the reporting of observational studies in epidemiology (STROBE) directives [26].

Results

Among the initial 1.610 studies identified by the search strategy, 49 were selected for full text review. Among these, four satisfied the inclusion criteria. Figure 1 displays the fluxogram of the search strategy and Table 1 displays the characteristics of the studies that satisfied the criteria of eligibility. The included articles were published between 2004 and 2012 and were conducted in the USA [11, 27], Brazil [28] and Scotland [29].

Only one study exclusively assessed the elderly and described the distribution based on age and gender [11]. The identification and recruitment of volunteers were different in each of the four studies. The definition of what the authors considered as voice disorders was similar in three of the studies [11, 27, 28]. To obtain the data, the authors of the oldest article [27] adapted a previous instrument [18] to the needs of an elderly population. The same instrument was translated into Brazilian Portuguese for another study [28]. In these last two studies, the instrument was applied using a face to face interview.

In the three articles cited above, the prevalence of vocal disorders was analyzed based on two endpoints: current voice disorders and lifetime voice disorders. In the Scottish article [29] the prevalence of vocal disorders was analyzed based on two specific aspects: “croakiness” and “loss or weakness of voice” (expressions used by the authors). Table 1 displays the studies outcomes, which were so different that limited direct comparisons.

The prevalence of vocal disorders in the elderly throughout their lives varied from 47 % in the American study [11] to 52.4 % in the Brazilian study [28]. The prevalence of vocal disorders at the time of data collection was 29.1 % in the American study [11]. In the other American study [27], prevalence rates of 11.1 and 7.3 % were found for elderly teachers and non-teachers, respectively. In the Scottish study [29], the prevalence of “croakiness” and loss or weakness of voice in the elderly was given using approximate values according to gender. However, the prevalence in the group of individuals aged 75 years or more was greater in both results (“croakiness”: men 60–74 years = 5.5 %/75 years or more = 8.5 %, women 60–74 years = 6.0 %/75 years or more = 8.8 %, loss or weakness: men 60–74 years = 4.8 %/75 years or

more = 9.5 %, women 60–74 years = 5.6 %/75 years or more = 9.1 %).

None of the four studies satisfied all of the STROBE criteria (Table 2) in the assessment of methodological quality. Eight STROBE items (4, 9, 12c, 12d, 13c, 14b, 16a and 16c) were not satisfied by any of the four articles. In addition, another three items (10, 11 and 8) were only partially satisfied or the data were not clear in the four articles. There were methodological discrepancies between the studies, so it was not possible to analyze the results using meta-analysis.

Discussion

According to the four studies selected for the present review, the prevalence of vocal disorders in the elderly population ranged from 4.8 to 29.1 %, reaching 52.4 % when referring to vocal disorders throughout the individual’s life, including old age. This result was close to the prevalence ranging from 6.6 to 7.4 % found in the general population [21, 22] in two studies with samples containing individuals of mixed ages [31, 33], but was above the value when the sample was made up exclusively of elderly individuals [11].

The great variability of the prevalence estimates published until now reflects a great limitation in terms of the quantity of articles about this topic with adequate methodological quality. Most studies are conducted with samples obtained by convenience in specific locations or health services [15] and generally contain individuals who are already sick [23, 30] or have a vocal disorder complaint [7, 35]. From an epidemiological perspective, results of this type do not dimension the problem on a population level. They reflect the situation of a service and exclude individuals who do not seek treatment. An epidemiological recent study evaluated the prevalence of laryngeal diseases in South Korea, but did not mention specific data on voice disorders [24].

In the selected studies, the form of identification and the recruitment criteria were quite different. These two aspects were even different in studies that had a similar design [27, 28]. It is also important to note that the elderly individuals who refused to participate in the research could have affected the final results since they were part of the sample. Another methodological limitation refers to the extensive instruments which were used to obtain the data. They took a long time to complete and provided no validity evidences, thereby compromising the reliability and trustworthiness of the results of the instrument in relation to what it proposed to assess [32].

With regards to the definition of the most common vocal disorders in the articles selected for the present review

Table 1 Characteristics of the studies included, with the methodological quality assessed according to the STROBE criteria for sectional studies

Reference	Location	Population	Sample	Gender	Age	Definition of the endpoint	Instrument	Prevalence of vocal abnormalities in the elderly individuals
Behlau et al. [28]	Brazil (all 27 federal states)	Teachers and general population	3,265 volunteers in total 149 elderly in total 60 teachers aged 60+ years 89 non-teachers aged 60+ years	Not given	Not given	“Any time your voice does not work, or perform, or sound as it normally should, so that it interferes with communication”	Face to face interview with 35 questions from the instrument used in a previous study (Roy, Merrill, Thibeault, Parsa, Gray & Smith, 2004), translated to Brazilian Portuguese by the authors	Prevalence only for Lifetime voice disorders Elderly teachers = 71.70 % (60.3–83) Elderly non-teachers = 43.80 % (33.5–54.1) Teachers and non-teachers: 52.4 % (44.5–60)
Roy et al. [11]	Utah and Kentucky/USA	Elderly individuals who lived in senior citizen centers or personal contacts	117 elderly aged 65+ years 78 (66.7 % female)	39 (33.3 % male, 66.7 % female)	Mean: 76.1 ± 8.5 Minimum–Maximum: 65–94	“Any time the voice did not work, or perform, or sound as it normally should so that it interfered with communication”	Face to face interview based on an adaptation of an instrument used in a previous study (Roy, Merrill, Thibeault, Parsa, Gray & Smith, 2004)	Lifetime voice disorders 47 % (37.9–56.0) Current voice disorders 29.1 % (21.2–37.3)
Hannaford et al. [29]	Scotland	General population, inhabitants of different regions of Scotland	15,140 volunteers in total 3,413 elderly in total 60–74: 2548 (16.8 %) 75 or +: 865 (5.7 %)	Not given	Quantitative distribution of the elderly according to age not given; categorized in two groups (60–74 years and 75 + years)	“Croakiness” or Loss of weakness (Every day for more than 14 days)	Questionnaire completed independently and sent by mail	“Croakiness” Men 60–74: 5.5 % 75+ : 8.5 % Women 60–74: 6.0 % 75+ : 8.8 % Loss or weakness Men 60–74: 4.8 % 75+ : 9.5 % Women 60–74: 5.6 % 75+ : 9.1 %

Table 1 continued

Reference	Location	Population	Sample	Gender	Age	Definition of the endpoint	Instrument	Prevalence of vocal abnormalities in the elderly individuals
Roy et al. [27]	Utah and Iowa/USA	General population using the Waksberg method and teachers for the data of the respective state education organs	2,531 volunteers in total 274 elderly in total 137 teachers of 60+ years 137 non-teachers of 60+ years	Not given	Not given, but it is known that the maximum age was 66 years	“Any time the voice does not work, perform, or sound as it normally should so that it interferes with communication”	Telephone interview	Elderly teachers = 11.1 % (6.1–16.1) Elderly non-teachers = 7.3 % (3.0–11.6)

(“any time the voice does not work, perform, or sound as it normally should so that it interferes with communication”), it is notable that the response could have been affected by the communicative demands of each respondent and the individual interpretation of what “interferes with communication”, particularly considering that elderly populations have special communicative needs, which are different to younger people [22].

Careful analysis should be performed in relation to results showing a higher prevalence of “lifetime voice disorders” in articles that consider this one as the endpoint to determine the prevalence of vocal disorders in the elderly. This result reflects the fact that through a full lifetime, elderly individuals exhibit a determined occurrence of vocal disorders, which does not mean estimating the currently prevalence of this condition. The highest or lowest frequency of vocal disorders throughout a lifetime could even be investigated as a factor associated with the current vocal condition of the elderly individual and should be interpreted in this manner. Furthermore, recall bias could have affected the reliability of these results [22]. Questions that refer to events that happened more than 6 months prior to questioning are usually unreliable, even in younger people [33]. Therefore, temporal questions should be avoided with elderly individuals and answers given should be interpreted with caution.

The Scottish study [29] involved the largest population (3,413 elderly individuals). However, the result in relation to the voice is limited to only two specific aspects (“croakiness” and loss or weak voice) and thus, the estimates of prevalence could have been negatively affected by the fact that other vocal disorders may not have been captured. It is notable that the stated aim of this Scottish study was to investigate the prevalence of ear, nose and throat disorders in the Scottish community aged 14 years or more. Thus, it was not exclusively focused on the voice or the elderly.

It is important to note that the authors of the Scottish study reported a trend of increased prevalence with increasing age, which is similar to the results of another study composed entirely of individuals who sought treatment and were medically diagnosed [23] but differs from the results of a study with a sample of people who were interviewed at the time of the consultation with the primary healthcare professional [22]. These differences may be due to the different methodologies of the studies, including the cultural patterns and different lifestyles of the populations involved, the selection process, sample size, the instruments used to obtain the data and the source of the data.

In a study of elderly individuals [7], an increase in age did not lead to statistically significant differences between the groups. The authors attributed this result to an

Table 2 Classification of the methodological quality of studies following the strengthening the reporting of observational studies in epidemiology (STROBE) criteria for sectional studies

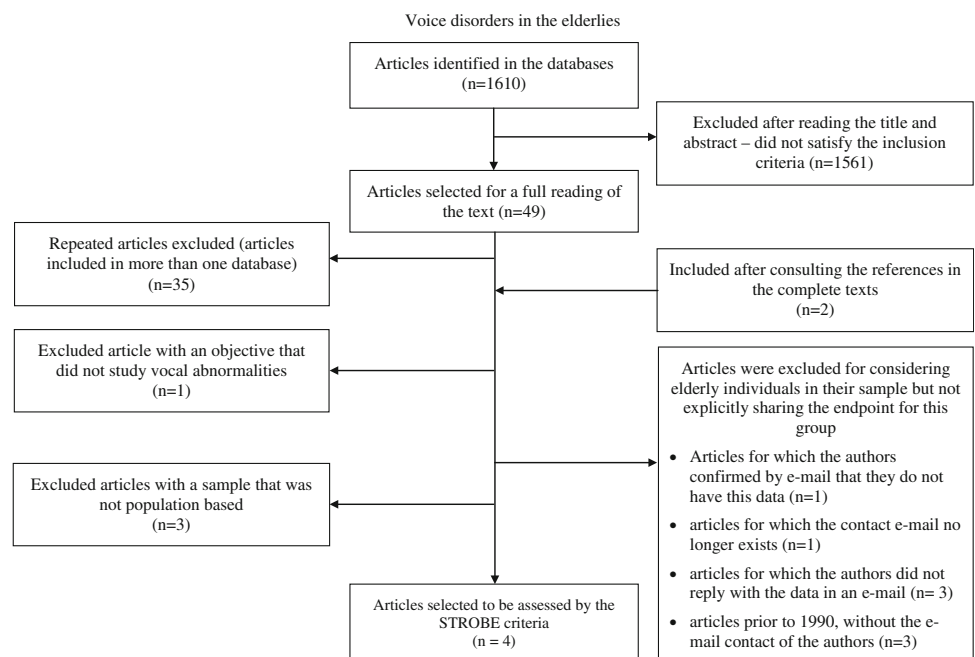
STROBE items	Behlau et al.[28]	Roy et al. [11]	Hannaforde et al.[29]	Roy et al. [18]
Title and abstract				
1a Indicate the study's design with 1 a commonly used term in the title or the abstract	+	+	+	+
1b Provide in the abstract an informative and balanced summary of what was done and what was found	+	+	+	+
Introduction				
2 Explain the scientific background and rationale for the investigation being reported	+	+	+	+
3 State specific objectives, including any prespecified hypotheses	+	+	?	+
Methods				
4 Present key elements of study design early in the paper	–	–	–	–
5 Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	+	+	+	+
6a Give the eligibility criteria, and the sources and methods of selection of participants	?	+	?	?
7 Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	+	?	–	+
8 For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	?	?	?	?
9 Describe any efforts to address potential sources of bias	–	–	–	–
10 Explain how the study size was arrived at	?	?	?	?
11 Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	?	?	?	?
12a Describe all statistical methods, including those used to control for confounding	+	+	?	+
12b Describe any methods used to examine subgroups and interactions	+	+	–	+
12c Explain how missing data were addressed	–	–	–	–
12d If applicable, describe analytical methods taking account of sampling strategy	–	–	–	–
12e Describe any sensitivity analyses	+	+	–	+
Results				
13a Report numbers of individuals at each stage of study—e.g. numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analyzed	?	?	+	+
13b Give reasons for non-participation at each stage	–	–	+	–
13c Consider use of a flow diagram	–	–	–	–
14a Give characteristics of study participants (e.g. demographic, clinical, social) and information on exposures and potential confounders	+	+	+	+
14b Indicate number of participants with missing data for each variable of interest	–	–	–	–
15 Report numbers of outcome events or summary measures	+	+	+	+
16a Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g. 95 % confidence interval). Make clear which confounders were adjusted for and why they were included	–	–	–	–
16b Report category boundaries when continuous variables were categorized	+	+	+	+

Table 2 continued

STROBE items	Behlau et al.[28]	Roy et al. [11]	Hannaford et al.[29]	Roy et al. [18]
16c If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	–	–	–	–
17 Report other analyses done—e.g. analyses of subgroups and interactions, and sensitivity analyses	+	+	+	+
Discussion				
18 Summarize key results with reference to study objectives	–	+	+	+
19 Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	+	–	?	?
20 Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	+	+	+	+
21 Discuss the generalizability (external validity) of the study results	+	+	+	+
Other information				
22 Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	–	–	+	+

+ meets the requirements of the item, – does not meet the requirements of the item, ? partially meets the requirements of the item or unclear data

Fig. 1 Fluxogram for the selection of articles



imbalance in the distribution of the groups, reiterating that the rates are lower in younger people and a larger epidemiological study would be required to confirm this result. Unlike the variability existing in relation to the effects of aging on the prevalence of vocal disorders, the occupation aspect did influence the estimates, particularly in relation to higher values for elderly teachers [27, 28]. The literature indicates that teachers are more susceptible to manifesting vocal signs and symptoms, including roughness,

discomfort, excessive vocal strength, vocal fatigue, difficulty in projecting the voice and modified vocal quality after a short time of use [18]. These signs and symptoms limit the ability to perform certain types of activities, increasing absenteeism, and are associated with a vocal overload, as well as the ergonomic and environmental conditions of the job [18, 34].

One relevant fact related to the voice that must be considered by epidemiological studies is that significant

parts of the elderly population who exhibit vocal disorders do not seek treatment or underestimate the problem and seek assistance too late [21, 22]. A number of authors [12, 15, 17, 22] attribute this behavior to the acceptance on behalf of the elderly that vocal abnormalities are a part of the natural aging process and the fact that they are not aware of the intervention possibilities and believe that the problem can be solved without treatment. Added to this, primary health care professionals admit that it is difficult to identify this type of disorders [22, 35].

The high frequency of denial or non-recognition of vocal disorders by elderly individuals and health professionals evokes a reflection about how to question the elderly about the presence or absence of vocal disorders. Therefore, it is essential to obtain validity evidence and reliability of the instruments used to identify who needs greater attention from the health team [17]. Educating the general public and health professionals about the symptoms that indicate the possible presence of voice disorders and stimulating more active participation from primary healthcare professionals in the early identification and management of vocal disorders would help to reduce the number of people who are not receiving adequate attention and to minimize the possible social and individual consequences of this condition [17, 22].

There are limitations to the present review. Eight articles contained a sample that was not exclusively composed of elderly individuals and could potentially have been included in this study. However, they did not explicitly present the endpoint for this population and they could not be included for the reasons described in Fig. 1. The inclusion of these studies could have altered the results. In addition, the studies selected for this review exhibited methodological biases in relation to sample selection, the analysis of results and the instruments used to collect data, reflected in the great heterogeneity of the studies design.

Conclusions

This systematic review of population-based studies in elderly individuals revealed that the prevalence of vocal disorders ranged from low to moderate. The methodological discrepancies among the studies, particularly in relation to sampling selection and instruments used, implies a large variability and low reliability of the prevalence estimates found. Upgrading the methodological quality of studies and designing a short, reliable, valid and easy-to-use functional voice-related instrument specific for aged people are urgently required in health surveys to determine the true prevalence of vocal disorders among the elderly in an epidemiological perspective.

Conflict of interest The authors do not have a financial relationship with the organization that sponsored the research.

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