Somatotype and Body Composition of Normal and Dysphonic Adult Speakers

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Summary: Objective. Voice quality provides information about the anatomical characteristics of the speaker. The patterns of somatotype and body composition can provide essential knowledge to characterize the individuality of voice quality. The aim of this study was to verify if there were significant differences in somatotype and body composition between normal and dysphonic speakers.

Study Design. Cross-sectional study.

Methods. Anthropometric measurements were taken of a sample of 72 adult participants (40 normal speakers and 32 dysphonic speakers) according to International Society for the Advancement of Kinanthropometry standards, which allowed the calculation of endomorphism, mesomorphism, ectomorphism components, body density, body mass index, fat mass, percentage fat, and fat-free mass. Perception and acoustic evaluations as well as nasoendoscopy were used to assign speakers into normal or dysphonic groups.

Results. There were no significant differences between normal and dysphonic speakers in the mean somatotype attitudinal distance and somatotype dispersion distance (in spite of marginally significant differences [$P < 0.10$] in somatotype attitudinal distance and somatotype dispersion distance between groups) and in the mean vector of the somatotype components. Furthermore, no significant differences were found between groups concerning the mean of percentage fat, fat mass, fat-free mass, body density, and body mass index after controlling by sex.

Conclusion. The findings suggested no significant differences in the somatotype and body composition variables, between normal and dysphonic speakers.

Key Words: somatotype–body composition–dysphonia–voice disorders–voice quality.

INTRODUCTION

The concept of voice quality is the result of a set of features constantly present in the speech production of a particular person.[1,2] These characteristics include not only the organic component (relative to the structures of the vocal tract) but also the phonetic or functional component (the use of those structures, that is, the performed function). The study of these features is fundamental to characterize the voice quality of a particular speaker, especially when the speaker has a voice disorder or dysphonia.

Some challenges in the clinical practice of a speech and language therapist have been motivating the study of speech production variability. Issues such as slow or ineffective evolution and relapses in the rehabilitation process of the pathological voice make research in the intrinsic physical characteristics of the speaker important. These intrinsic physical characteristics of the speakers can explain their vocal individuality. Additionally, in our opinion, the identification of biomarkers (a naturally occurring characteristic by which a particular pathological or physiological process or disease can be identified) for dysphonia is of extreme importance for clinical practice.[3,4]

The voice phenomenon can be better understood if we analyze the morphological condition of the speaker. Many of the factors that determine the quality of the voice are beyond the control of the speaker. Differences in the size, shape, and muscular tone of the laryngeal structures may play a major role. Voices of men, women, and children reflect mainly anatomical differences, although intrinsic, anatomy-based features may be enhanced or diminished, depending on the sociocultural context.[5] Also, family voice disorders have been suggested to be due to genetic effects rather than to environmental effects.[6,7] Actually, etiological factors of dysphonia are well known: poor postural habits, hypertonicity associated with psychological states, personality, tone associated with pharyngolaryngeal reflux, neuromuscular abnormalities, and mass lesions.[8,9] However, according to our knowledge, studies including body composition biomarkers have not been considered in the field of voice disorders until the present moment.

Biological patterns of voice production associated with physical body characteristics are not new concerns in the field of voice quality research; however, the results achieved are controversial and none of these studies included dysphonic speakers.[6,10–21] Body size has been related to vocal tract morphology.[10–14,16] Fitch and Giedd[10] found differences in vocal tract morphology both in male and in female speakers, including changes in vocal tract length and in the relative proportions of the oral and the pharyngeal cavities, with consequences in formant frequencies. These sex differences were part of the vocal remodeling process that occurs during puberty in males.[10] A deep male voice may be a predictor of body size (height and weight) and body shape (body configuration including measures of body circumferences and ratios derived from these measures).[11] On the contrary, Collins,[13]

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Künzel,[20] González,[14] and Hamdan et al[15,16] could not find any association between vocal and body characteristics. Table 1 brings together information about recent studies.

Some vocal quality studies, which consider morphological variables and morphology, have been developed especially in the field of obesity and weight loss.[17–19,22–24] Body weight and body fat volume appear to influence objective measures of voice quality,[17,18,22] vocal aerodynamics,[17,18] and phonatory range performance.[17] The distribution pattern of fat mass (FM) is derived from factors such as age, sexual dimorphism, morphological type, and age of obesity development.[25] The FM parameter, in particular, is a body composition measure scarcely considered in voice research studies. Also, a comparison has never been made between dysphonic and normal speakers to verify the influence of the relative amount of body fat (percentage fat [Fat%]) on voice quality. However, body fat should be analyzed as it can compromise the upper airway and the vocal tract (uvula, soft palate, and the posterior region of the tongue),[26] can diminish lung function (because of adipose tissue presented around the rib cage, abdomen, and in the visceral cavity), and can reduce functional residual capacity.[27] Excessive fat accumulation in the larynx might also alter maximum phonation time, which would impair myoelastic and aerodynamic forces in the larynx adjustments, which are required for adequate phonation.[18] The amount of fat in an individual or a population can be related to diminished quality of life and with the emergence of certain diseases,[28,29] namely the incidence of laryngeal reflux, apnea syndrome, and obstructive sleep apnea, particularly in obese people.[18]

Despite the importance of this subject, previous literature has mostly focused on variables such as weight and body mass index (BMI),[10,13,14,17,19,23,24] which are not the most appropriate measures of body composition variability, and for that reason can condition the information that can be obtained and analyzed. In our opinion, body composition analysis must consider other morphological characteristics such as skull, neck, shoulder, chest, waist, and hip circumferences, shoulder-hip ratio, shoulder-waist ratio, waist-hip ratio,[11] muscle mass, fat weight, extremity fat,[15,16] trunk fat,[15] extremity fat-free mass (FFM), trunk FFM, and body FFM.[16]

Moreover, the morphological type that encloses a set of morphological traits or characteristics and integrates an individual into a certain category, often called morphotype or morphological type,[25,30] seems to be another biological feature to consider in the study of voice quality although it was possibly never studied in the field of voice disorders. Somatotype is synthetic information about body build and is normally associated with motor efficiency.[31] The dimensional and proportional characteristics of an individual are related to postural changes,[32] and for this reason, head and thorax characteristics, in particular, can possibly be related to voice quality,[33] but until the present moment they have not yet been studied.

Aforementioned studies, which tried to characterize voice production based on physical body aspects,[6,10–21] reached few sustainable results and even controversial ones (like the influence of body characteristics on the pitch or fundamental frequency [F0] parameters[12–16] or the vocal differences between obese and nonobese speakers[17–19,22–24]), which need clarification in the near future. In addition, understanding the features of the dysphonic speaker is particularly important to define appropriate treatment strategies and prevent recurrences.

Therefore, despite the relevance of previous studies and the implications of the anatomic and physiological characteristics of speakers on voice production and in the characterization of vocal pathologies, it is important to persist in the study of postural and morphological characteristics, especially of the dysphonic speakers, to obtain an integral understanding of the voice phenomena. The aim of this study is to verify if normal and dysphonic speakers have different morphological characteristics, using more precise anthropometric methods such as somatotype and body composition.

MATERIALS AND METHODS

Subjects

The potential participants were largely recruited during the Week of Screenings of World Voice Day, in the Department of Ear, Nose and Throat (ENT), Voice and Communication Disorders, of the Santa Maria Hospital, Faculty of Medicine, University of Lisbon. Thereafter, other participants were recruited from the School of Health Sciences, Polytechnic Institute of Leiria, and from the Faculty of Medicine, University of Lisbon. The inclusion criteria were (1) age between 20 and 50 years, (2) Caucasians, (3) European Portuguese as their first language, (4) absence of functional respiratory changes, and (5) signed informed consent. The age range chosen for our sample aimed to exclude all subjects that were in morphological growth and vocal maturation processes, in menopausal age, and with a clear decline in morphological and vocal abilities as a result of aging. To assess functional respiratory changes, all the recruited patients were submitted to a spirometry exam in the Pulmonology Department of Santa Maria Hospital. In turn, subjects with musculoskeletal disease, craniofacial malformations, orthopedic trauma, altered spirometry values, neurological diseases, neck scarring from surgery, radiation therapy or trauma, and previous history of larynx surgery were excluded.

Smoking was not included as an exclusion criterion because etiology was not the aim of this study and because all individuals had performed a spirometry, as an eligibility exam, and only those with no functional respiratory pathology were selected.

Among the 91 individuals assessed, only 72 met all the inclusion criteria and did not evidence any exclusion criterion. They were screened in the following sequence: body composition analysis and then voice quality evaluation. Our sample constituted 35 males (48.61%) and 37 females (51.39%). The male mean age was 32.43 years (standard deviation [*SD*] = 9.94) and the female mean age was 31.74 years (*SD* = 10.52). The individuals were classified into two groups: normal or dysphonic speakers. This classification was done on the basis of their voice quality. The normal speakers group consisted of 40 participants (22 male and 18 female) with a mean age of 31.12 ± 9.64 years; the dysphonic speakers group was composed of 32 participants (13 male and 19 female) with a mean age of 33.72 ± 10.92 years.