

Ambulatory Phonation Monitoring in a Sample of 92 Call Center Operators

*Giovanna Cantarella, *Elisabetta Iofrida, †Paola Boria, †Simone Giordano, †Oriana Binatti, *, ‡Lorenzo Pignataro, §Claudia Manfredi, ||Stella Forti, and ¶, #Philippe Dejonckere, *†‡||Milan, §Florence, Italy, and ¶||Leuven, #Brussels, Belgium

Summary: Objectives. The voice is a primary work tool for call center operators, but the main risk factors for voice disorders in this category have not yet been clarified. This study aimed to analyze the vocal behavior in call center operators and search for correlations between the daily voice dose and the self-perceived voice-related handicap.

Study Design. Prospective.

Subjects and Methods. Ninety-two call center operators (aged 24–50 years) underwent ambulatory phonation monitoring during a working day and were administered the Voice Handicap Index (VHI) questionnaire and a questionnaire concerning smoking habits, symptoms, and extrawork activities requiring intensive voice use.

Results. Mean percentage phonation time (PT) during work was 14.74% and ranged from 4% to 31%. There was a significant difference between the percentage PT in working time and in extrawork time; however, subjects with high percentage PT in working time maintained a high value also in extrawork time. The mean PT was 87.5 ± 35.8 minutes and was not correlated with age, gender, number of work hours, symptoms, extraprofessional voice use, and VHI scores. The mean amplitude was significantly higher in subjects with longer PT and higher pitch ($P < 0.001$). VHI score (median = 9) was slightly higher than in the general population but not related to the number of work hours, indicating that work time was not a critical factor in causing the perception of voice problems.

Conclusion. Our study provides data about the voice behavior of a large cohort of call center operators and demonstrates that the number of work hours and the percentage PT are not statistically related to the perception of voice disturbances in this working category.

Key Words: Phonation–Ambulatory phonation monitoring–Call center operators–Voice handicap index–Voice dosimetry.

INTRODUCTION

Currently, the voice is a major work tool for a wide range of occupations and it is a primary tool of trade for call center operators. Voice load is commonly considered to be a main risk factor for the development of voice disorders and this is an important issue in occupations requiring intensive voice use.

The safe limits of phonation time and intensity for persons working in a call center are not defined, and the main risk factors for voice disorders in this category have not yet been clarified. Therefore, it is desirable to gather data about the importance of voice dose and the phonation behaviors of call center operators.

Previous studies¹ have not yet demonstrated a relationship between voice load and vocal problems but they dealt with a limited amount of subjects. Voice load does not seem to clearly correlate with vocal fatigue, but there is no means to objectively and quantitatively measure vocal fatigue,² which is a subjective feeling. In a study that analyzed risk factors for voice disorders in teachers,³ physical and psycho-emotional factors were found to be more relevant than vocal dose and environmental characteristics.

Titze et al⁴ measured the distance traveled by the vocal folds during their phonatory vibrations and tried to identify the levels of vocal dose that can be tolerated without damage. They determined that when a woman reads a passage, her vocal folds travel approximately in average 0.5–0.7 m/s. To calculate a safe vocal dose, these authors applied the safety limits used for hand-transmitted vibrations in industry. They calculated a safe dose limit of 520 m, which would be reached at 17 minutes of continuous phonation. This method of calculation has two main limitations. First, the anatomic structure of the vocal folds is ideal for sustaining prolonged vibration, whereas other body tissues, such as the hand, are not. Second, this measurement does not consider pauses in phonation that represent rest breaks and recovery time. The authors themselves hypothesized that due to pauses and to the anatomic characteristics of the multilayered vocal fold structure, the vocal load safety limits could be significantly higher.

The aim of the present study was to quantify and analyze vocal behavior in a large number of call center operators. The study also aims to compare the voice doses with those of other occupational voice users as teachers and search for correlations between the daily voice dose and the self-perceived voice-related handicap, to assess whether the vocal dose has an impact on the subjects' quality of life. The intensity of voice use during working time is also compared with that in nonworking hours.

MATERIALS AND METHODS

Participants

The study included subjects who had been working as telephone operators in the Vodafone Call Center in Milano, Italy for at least three consecutive months at the time of the study. All of them worked in similar environmental conditions as far

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From the *Otolaryngology Department, Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico, Milan, Italy; †Occupational Medicine, Private Practice, Milan, Italy; ‡Dipartimento di Scienze Chirurgiche Specialistiche, Università degli Studi di Milano, Milan, Italy; §Department of Information Engineering, Università degli Studi di Firenze, Florence, Italy; ||Audiology Unit, Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico, Milan, Italy; ¶Department of Neurosciences, University of Leuven, Leuven, Belgium; and the #Federal Institute for Occupational Diseases, Brussels, Belgium.

Address correspondence and reprint requests to Giovanna Cantarella, Otolaryngology Department, Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico, Via F.Sforza 35, 20122 Milano, Italy. E-mail: g.cantarella@libero.it

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as noise and microenvironment. The only exclusion criterion was previous surgery of the neck, chest, or vocal folds.

Ninety-two subjects volunteered to participate in the study. Twenty-five were males aged 25–42 years (mean 35.5 ± 4.9), and 67 were females aged 24–50 years (mean 36.6 ± 4.2). Subjects belonged to three different working categories: Frontline team (62 subjects) who spent approximately 70% of time receiving phone calls to give information and 30% making calls offering services; Corporate Service (22 subjects) who spent about 55% of time receiving phone calls, 20% to perform phone calls, and 25% answering e-mails; Technical team (eight subjects) spending about 6% of time answering calls, 38% making calls to offer services, and the remaining 56% answering e-mails. The population considered represents the distribution of working categories in the call center under study. None of the recruited subjects was currently in the treatment for voice problems.

The daily work time ranged from 4 to 10 hours/day, but main operators worked either 6 or 8 hours; the distribution can be seen in Figure 1. All the study documents including recordings and submitted questionnaires were anonymous and marked with numbers. The institutional review board of Ospedale Policlinico di Milano approved the study protocol.

General questionnaire

A questionnaire was administered to gather information about the participants' age, gender, smoking habits, and the presence of upper airway symptoms or pathologies, such as respiratory allergies, bronchial asthma, or gastroesophageal reflux. Questions were also asked about involvement in extrawork activities requiring systematic intensive voice use such as teaching, singing, or theater acting.

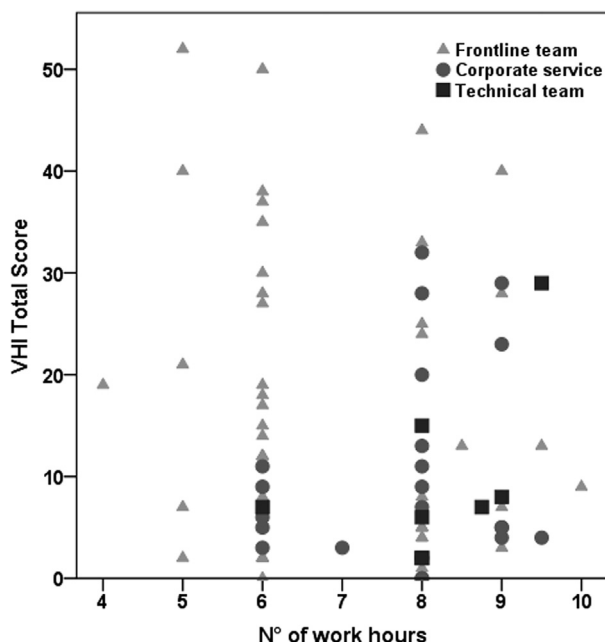


FIGURE 1. Distribution of the number of work hours respect to VHI total scores and the categories of work type.

Evaluation of voice-related disability

The Voice Handicap Index (VHI) questionnaire⁵ was administered for the self-assessment of perceived voice-related disability (in terms of reduction in quality of life). This is a validated and widely used 30-item test divided into three subscales that measure the functional, physical, and emotional aspects of the eventual handicap caused by voice impairment. The subscale scores range from 0 to 40, and the total ranges from 0 to 120; a higher score indicates a greater degree of handicap. A score of 12 (calculated as mean + 1 standard deviation) resulted to be the cutoff value in an Italian general population without voice problems⁶; this cutoff was according to the findings of Behrman et al⁷ Maertens and de Jong report that 95% of the normal population has a score lower than 32.8, and the median value in the normal population is 6.⁸

Ambulatory phonation monitoring equipment and procedure

The ambulatory phonation monitoring (APM) equipment used in this study was the APM model 3200 by KayPENTAX (Lincoln Park, NJ).^{9,10} It consists of an accelerometer that is attached at the anterior base of the neck of the subject under study. The accelerometer gathers acoustic voice raw data at a rate of 20 samples per second; the data are transferred to a microprocessor unit worn in a waist pack. Before starting each new recording, a sound pressure level (SPL) calibration was performed using a microphone positioned 15 cm from the subject's mouth.

The acquired data include:

- ✓ Phonation time: expresses the duration of time during which the vocal folds actually have been in phonatory vibration.
- ✓ Percentage phonation time: is the percentage of the recording time during which the vocal folds have been in phonatory vibration.
- ✓ Fundamental frequency (F_0) average: is the mean frequency at which the vocal folds vibrate, measured in Hertz.
- ✓ F_0 mode: is the F_0 value at which most phonation occurs during the recording.
- ✓ Mean amplitude (SPL, dB): is the mean value of the amount of energy of the voice sound wave (SPL). The greater the intensity of voice, the greater the amplitude value.
- ✓ Total cycles of vibration: represent the number of vibratory cycles of the vocal folds during the recording time.
- ✓ Total distance dose (m): is the estimated distance traveled by the vocal folds during their vibratory cycle; the formula to obtain this measure takes into account total phonation time, F_0 , and amplitude.

The total duration of data sampling was 21.50 hours, which corresponds to the maximum battery activity of the APM equipment. Data for work hours and extrawork hours were separated. Sleeping time was excluded.

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