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## **EFFECTS OF VOCAL FATIGUE ON VOICE PARAMETERS OF INDIAN TEACHERS**

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**ABSTRACT :** *Vocal fatigue is a frequently reported voice symptom among professional voice users. Indian school teachers teach continuously for many hours in adverse acoustical environments and are highly susceptible to vocal fatigue. The present study is the first to examine acoustic voice measures in teachers reporting naturally induced vocal fatigue. 40 female primary school teachers (mean age =36 years) with varying severity of vocal fatigue participated in this study. Voice measures of minimum and maximum fundamental frequency were obtained before and after one and a half hours of continuous teaching at the workplace. Maximum fundamental frequency was an important acoustic parameter in determining presence of vocal fatigue. Most common perceptual symptoms include throat dryness, discomfort and loss of voice. The role of vocal hygiene and warm-up in reducing vocal fatigue are considered.*

*Key Words : Vocal fatigue; voice; school teachers*

### **INTRODUCTION**

Professional voice users depend on effective vocal communication for their livelihood (Colton & Casper, 1996; Titze, Limke & Montequin, 1997). A healthy voice is critical to their professional, economic and mental well-being. A common voice disorder affecting such voice users is vocal fatigue (Cooper, 1977 ; Herrington-Hall, Lee, Stemple, et al., 1988 and Titze et al., 1997). Vocal fatigue refers to a voice problem that begins as the speaking day progresses and usually disappears after a period of voice rest (Gotaas & Starr, 1993).

Teachers have been especially identified as an at-risk population for developing vocal fatigue (Eustace, Stemple & Lee, 1996 ; Herrington-Hall et al., 1988 ; Smith, Gray, Dove et al., 1997). Teachers often speak loudly and continuously, in adverse acoustical environments such as noisy classrooms. High student-teacher ratio, extended teaching hours and poor classroom acoustics resulting in a large number of Indian school teachers reporting frequent episodes of vocal fatigue. At the primary school level, teachers

teach a variety of subjects and often have to complete a minimum criterion of 30 teaching hours per week resulting in prolonged voice use for up to 3 hours.

Vocal fatigue could lead to vocal hyperfunction and benign lesions such as nodules (Colton & Casper, 1996 ; Fawcus, 1991). Identifying vocal fatigue in its initial stage would facilitate timely intervention and prevention of voice disorders. While most individuals report some perceptual differences in their voice following fatigue, such changes are often difficult to identify by trained professionals. Acoustic measures of fundamental frequency (F0) allow for objective quantification of voice quality. If such acoustic measures are sensitive to voice changes following fatigue they could be used as objective criteria to identify at-risk populations for vocal fatigue, and facilitate intervention strategies to prevent voice disorders. The present study examined acoustic voice measures of minimum and maximum fundamental frequency (F0) in two groups of teachers reporting varying degrees of vocal fatigue.

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## MATERIAL & METHODS

Subjects :- Forty primary school teachers (ages 22-63 years, mean =35) with perceptually normal speech and voice participated in this study. All reported general good health and normal hearing. All teachers had morning teaching schedules. Teachers were assigned to two groups based on their responses to a questionnaire listing the symptoms of vocal fatigue (appended). Subjects in group - 1 ranged in age from 22-58 years (mean = 37 years), and had teaching experience between 8 months to 35 years. All these subjects reported more than 5 symptoms of vocal fatigue per week. Subjects in group -2 ranged in age from 23-63 years (mean =37 years), with teaching experience between 6 months to 35 years. These subjects reported 0-4 symptoms of vocal fatigue per week. Subjects were unaware of the group in which they were placed and were naive to the experimental hypothesis.

Protocols :- Voice recordings were obtained in the mornings, in a quiet room at the workplace, prior to, and immediately after one and a half hours of continuous teaching. Subjects were seated at a constant distance of 4 inches from the microphone of a Digital Analog Tape Recorder (Sony TCD-D07). Dependent variables of maximum F0 and minimum F0 were obtained. To estimate maximum F0, subjects glided up from their comfortable speaking pitch on "i" to their maximum pitch which could be sustained for 2 seconds. Similarly, to obtain minimum pitch, subjects glided down from the comfortable pitch to the minimum pitch on "i". The experimenter provided a model to the subjects. The same measures were repeated after one and a half hours of continuous teaching. Recorded data were transferred to VAGHMI software and associated support hardware (Voice and Speech Systems, Bangalore). Off-line analysis was carried out on voice module of VAGHMI software.

Statistical Analysis :- Data were summarized as Means  $\pm$  SDs. Raw data were inspected for normality. Unpaired t-tests were employed to determine if the two groups differed on maximum and minimum F0 prior to and following continuous teaching.

## RESULTS AND DISCUSSION

Subjects in the two groups differed on maximum F0 prior to the teaching task ( $p < 0.01$ ,  $t = 3.88$ ). The maximum F0 values were higher for teachers in group -1 (reporting more symptoms of vocal fatigue) than in group-2. following one

and a half hours of continuous teaching, F0 max decreased for subjects in group - 1 (more symptoms of fatigue), but increased for subjects in group -2 (less symptoms of fatigue). Subjects in both groups did not differ on measures of minimum F0 before and after teaching.

The present study is the first to provide evidence for higher fundamental frequencies in subjects reporting symptoms of vocal fatigue, prior to a natural fatiguing task. Subjects experiencing more episodes of vocal fatigue started the day with higher fundamental frequency, which reduced after teaching. Conversely, subjects in group -2 (less symptoms of vocal fatigue) started the day with lower fundamental frequency, which increased after teaching. For these subjects, the teaching task could serve as vocal warm up. Conversely, for teachers with more symptoms of fatigue (group-1), the non-teaching period between the end of the previous day's teaching, and the start of the new day, may not suffice to provide complete vocal rest, reflected in their higher F0 prior to teaching. Increased vocal activity from this point onwards could serve as the fatiguing task, manifesting as reduced F0 max compared to pre-teaching values.

A subjective analysis of responses to the questionnaire revealed that both groups of teachers reported similar symptoms of fatigue with differing frequency of occurrence. The most commonly reported symptoms of vocal fatigue included dryness in the throat, voice breaks, throat discomfort and rough sounding voice. The symptoms reported by subjects in this study are similar to those reported by other professional voice users (Eustace et al., 1996 ; Stemple et al., 1995).

The present study is the first to assess voice change following vocal fatigue, in a natural environment in Indian school teachers, a population likely to report symptoms of laryngeal pathology. The findings have important implications for identification and prevention of vocal fatigue and thereby voice disorders. Maximum F0 appears to be an important variable in distinguishing individuals with varying severity of vocal fatigue. Awareness of the most common subjective symptoms of vocal fatigue could lead to better identification in the early stages, thereby preventing the adverse long-term effects of laryngeal fatigue. This study also highlights the importance of vocal warm-up prior to voice use and the need to emphasize vocal hygiene in the curriculum of school teachers and other professional voice users.

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**Appendix****Questionnaire of Vocal Fatigue**

Name : \_\_\_\_\_ Date : \_\_\_\_\_

Age :

Years of teaching :

Hours of teaching per day :

Hours of teaching per week :

Do you get periods of rest between teaching- please describe :

Do You engage in other vocal activities ; such as singing, acting etc. ?

Have you ever had a voice problem- please describe :  
Did you consult a doctor or speech pathologist for the same ?

Do you report any of the following vocal symptoms during and / or after teaching ?

**SYMPTOMS****RESPONSE**

Dryness in throat

Scratchy sensation in throat

Rough voice

Throat discomfort (itching sensation)

Effort to talk

Voice breaking

Tightness in the throat

Shortness of breath

Pain in the throat

Not wanting to talk

Loss of voice at the beginning of the sentence

Loss of voice at the end of the sentence

Worsening of voice at the end of the sentence