VOCAL FATIGUE USING VOCAL FATIGUE INDEX (VFI): A COMPARISON AMONG DIFFERENT LEVELS OF SCHOOL TEACHERS

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May 2019

CERTIFICATE

This is to certify that this dissertation entitled **"Vocal fatigue using Vocal Fatigue Index (VFI): A comparison among different levels of school teachers"** is a bonafide work submitted in part fulfillment for the degree of Master of Science (Speech-Language Pathology) by the student holding Registration Number: 17SLP015. This has been carried out under the guidance of a faculty member of this institute and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

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CERTIFICATE

This is to certify that this dissertation entitled **"Vocal fatigue using Vocal Fatigue Index (VFI): A comparison among different levels of school teachers"** has been carried out under my supervision and guidance. It is also certified that this dissertation has not been submitted earlier to any other University for the award of any other Diploma or Degree.

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DECLARATION

This is to certify that this dissertation entitled **"Vocal fatigue using Vocal Fatigue Index (VFI): A comparison among different levels of school teachers"** is the result of my own study under the guidance of Dr K Yeshoda, Associate Professor in Speech Sciences, Department of Speech-Language Sciences, All India Institute of Speech and Hearing, Mysuru, and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

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CHAPTER 1

Introduction

“The Human Voice is the most perfect instrument of all” –Arvo Part

Voice is the result of regulation of air from the lungs by altering the configuration of the vocal tract. The process of voice production requires a complex and coordinated activity of the neuromuscular system (Michael & Wendahl, 1971). Voice is considered to be normal, when loudness, pitch and quality are appropriate to the age, gender and geo-culture (Aronson & Bless, 2009). Voice disorders are medical conditions involving abnormal pitch, loudness or quality of the sound produced by the larynx and thereby affecting speech production.

“It is increasingly being realized that a substantial section of our population vocalizes for a long period of time to earn their livelihood” (Titze & Sundberg, 1992). Professional Voice Users (PVUs) as individuals whose entire livelihood depends on vocal communication. This category includes teachers, actors, politicians, vendors, etc. Koufman and Issacson (1991) formulated a classification of PVUs based on their need and amount of vocal communication as depicted in Table 1 below.

Table 1: **Classification of PVUs (Koufman and Issacson, 1991)**

Levels	Description
Level 1: Elite vocal performers	People who fall under this category require maximum vocal performance (at all times). They need superior quality, pitch, range, and loudness (i.e., professional actors and singers).
Level 2: Professional voice users	At this level the voice is an integral part of these professionals. They require maximum vocal stamina over prolonged periods (i.e., lecturers, teachers, telemarketers, group fitness instructors).
Level 3: Non-vocal professionals	These individuals would be able to perform their jobs even if moderately dysphonic. However, severe dysphonia may prevent them fulfilling their professional commitments (i.e., doctors, lawyers, business executives).
Level 4: Non-vocal non-professionals	A voice disorder would be unlikely to affect their ability to carry out their job.

Teaching is one of the most vocally demanding occupations. Teaching profession is one among the occupations that requires medical help for voice difficulties (Fritzell, 1996). Research studies have shown that about fifty to eighty percentage of teachers have experienced voice problems at least once in their lifetime and, about one-fifth to one-third of teachers were reported to be absent from work owing to voice problems during a working year (Pekkarinen, Himberg & Pentti, 1992; Gotaas & Starr, 1993).

The most frequently cited symptoms in teachers were hoarseness, fatigued voice and discomfort when speaking loudly (Smith, Lemke, Taylor, Kirchner & Hoffman, 1998). It is known that school teachers generally have to work in an environment where the background noise from children is particularly high and requires voice use for a prolonged period. This manner of prolonged voice use is termed as 'vocal loading'. Vocal loading can be quantified by three vocal doses, namely, time dose (total voicing duration), distance dose (total distance travelled by the vocal fold tissue during phonation) and cycle dose (number of vocal fold oscillations). Among the three doses, time dose is considered as a bigger risk factor for vocal fatigue (Vilkman, 1998).

Vocal Fatigue (VF) as a term is often confusing in nature because it lacks an accurate definition or generally agreed upon description. Solomon (2008) described VF to be "the self-report of an increased sense of effort with prolonged phonation". The symptoms include "(1) increased vocal effort and discomfort, (2) reduced pitch range and flexibility, (3) reduced vocal projection or power, (4) reduced control of voice quality, (5) an increase in symptoms across the speaking day, and (6) improvement after resting" (Colton, Casper, & Leonard, 2006; Gotaas & Starr, 1993; Kitch & Oates, 1994; Stemple, Glaze, & Klaben, 2000). Vilkman (2004) defined VF as "a subjective term, which refers to negative sensations related to voicing''. This statement highlights that VF is a relatively subjective measure. Hence, a self-report method may be considered

to be a more useful measure in identification of vocal fatigue. McCabe and Titze (2002) defined fatigue as a ‘‘progressive increase in phonatory effort accompanied by a progressive decrease in phonatory capabilities.’’ Solomon (2008) proposed that such fatigue could be defined as a ‘‘perception by the voice user, manifested primarily as a sense of increased vocal effort that increases over time with voice use, and subsides with voice rest”. Along these lines, the author incorporated the concept of rest in her characterization of vocal fatigue.

Symptoms of VF are a forerunner and early determinants of developing voice disorders in the future. These symptoms can be studied for prevention of voice problems in teacher. However, VF has always been difficult to identify and characterize. Tools such as Voice Related Quality Of Life (V-RQOL) developed by Hogikyan and Sethuraman (1999) and Voice Handicap Index given by Jacobson, Johnson, Grywalski, Silbergleit, Jacobson, Benninger and Newman (1997) were used to describe self-reported symptoms of voice problems.

Voice Handicap Index (VHI) (Jacobson et al, 1997) was developed and validated in over three phases. In the first phase, based on past interviews of patients with voice disorder, an 85-item questionnaire was developed with three domains (functional, emotional and physical) and administered on a clinical group (65 patients). After the administration the number of questions was subsequently reduced to 30 items having 10 items per domain in this phase. The second phase involved checking test-retest reliability of the questionnaire on 63 patients which was found to be strong for all 3 domains. In the third phase, the authors attempted to check the correlation of VHI scores with self-rated voice disorder severity, and moderate correlation was found between the two measures. Thus, the authors concluded that VHI could potentially be used to measure self-percept of voice problem in a population and its effect on their daily life. However, VHI does not provide a measure of vocal fatigue.

In an attempt to resolve this concern, Nanjundeswaran, Jacobson, Gartner-Schmidt and Abbott (2015) developed and validated Vocal Fatigue Index (VFI), which could be used to identify VF and to document the symptoms. However, Hunter and Banks (2017) stated that "VFI has not been tested specifically on occupational voice users, the population of speakers whose vocal load puts them at high risk for vocal fatigue and other more severe issues". One category among this population of speakers is teachers (Hunter & Banks, 2017). According to the authors, teachers were likely to report three times more VF using VFI than normal population. Hence VFI can be considered as a useful determinant in identifying vocal fatigue in different categories of teachers.

Need for the study

Prolonged voice use is a common characteristic in school teachers which makes them more prone to develop VF, which can subsequently lead to the development of voice disorders in this population. The amount of voice use in school teachers varies amongst teachers of different levels. A kindergarten teacher's amount of voice use differs from that of a high school teacher. Moreover, the vocal demands of non-academic teachers like physical education teachers vary greatly when compared to classroom teachers. There is limited research done on VF using VFI in teachers and no studies have compared VF across different levels of teachers. Therefore, it would be informative to investigate the VF in different levels of academic teachers as well as physical education teachers. Hence, the present study was planned to explore the self-reported VF symptoms among different levels of school teachers using VFI-version 2.

CHAPTER 2

Review of Literature

Vocal fatigue

Prevention of a problem has always been better than cure. Prevention of voice problems starts with early identification of the symptoms. Symptoms of vocal fatigue help in identifying probable voice problems. The most distinguishing factor of vocal fatigue is that it improves as a result of voice rest. “Vocal fatigue may occur in relative isolation, and thus be considered a ‘pure’ condition. In addition, it can be, and frequently is, reported as a component of other voice disorders” (Solomon, 2008).

Vocal fatigue has been described symptomatically by many authors (Vilkman, 2004; Enoka and Stuart, 1992; McCabe and Titze, 2002; Solomon, 2008). Few of the symptoms are “hoarse/husky vocal quality, breathy vocal quality, loss of voice, pitch breaks, inability to maintain typical pitch, reduced pitch range, lack of vocal carrying power, reduced loudness range, need to use greater vocal effort, running out of breath while talking, tension in neck/shoulders, throat/neck pain, throat fatigue, throat tightness/constriction, increased need to cough/throat clear and discomfort in chest, cars, or back of neck” (Kostyk and Rochet,1998).

Solomon (2008) reviewed 100 articles relating to VF in the literature and discussed how it may be related to vocal hyperfunction. She also described possible methods to study VF experimentally, including selection of subjects, design, and measurement. The difficulty posed in the general understanding of the term due to the subjective nature of the phenomenon was described, and VF was operationally defined as “the self-report of an increased sense of effort with prolonged phonation, whether or not there are observable or measurable decrements in phonatory function.” Further, the definition of VF was given by different authors (Welham & Maclagan, 2003; Vilkman,

2004; McCabe and Titze, 2002), in which each of them emphasized on changes in physiology of voice production, self-perception of fatigue and self-perceptual as well as observable-behavioural consequences of prolonged physical activity respectively. She then postulated different mechanisms that may contribute to vocal fatigue, including neuromuscular fatigue (Titze, Hunter & Svec, 2007), non-muscular tissue fatigue and viscosity, sense of effort (Chang & Karnell, 2004; Solomon & DiMattia, 2000; Stemple, Stanley, & Lee, 1995; Vilkman, 2004) and vocal rest and recovery (Titze et al., 2007). Models of vocal fatigue given by different authors were described. In one model, VF was viewed as a continuum which started with warm up and continued till VF was attained (Vilkman, 2004). McCabe and Titze (2002) described a model in which phonation led to glycogen depletion, increased blood flow, increased viscosity and muscle stiffness. These change caused the voice user to make hyperfunctional compensations which lead to further neuromuscular changes. Welham and Maclagan (2003) extended this model to include a "threshold of soft tissue changes in the lamina propria". Solomon hypothesized that vocal hyperfunction could either be a predecessor to or a consequence of VF. She described different populations in which VF has been studied, which have been healthy vocally normally subjects in which VF was induced or more recently, those who were at risk of developing vocal fatigue based on their occupations such as teachers (Bovo, Galceran, Tetruccelli & Hatzopoulos, 2007; Roy, Merrill, Thibeault, Parsa, Gray & Smith, 2004; Russell, Oates & Greenwood, 1998; Sala, et al., 2002; Smith et al., 1998; Vilkman, 2004). In terms of study design, the author discussed the different settings from laboratory to field settings. She also delineated different measurement variables including self-perception and ratings, auditory perceptual and acoustic characteristics of voice, aerodynamic measures, laryngeal appearance and other indicators such as electroglottographic analysis.

Vocal fatigue in teachers

In a study designed to simulate the timings of a typical teaching day, Vintturi, Alku, Sala, Sihvo and Vilkman (2003) assessed self-perceptions of central fatigue in forty male teachers and forty female teachers using two items on a 17-item questionnaire. Other questions addressed muscular and postural symptoms, dryness, sensations in the throat, and vocal symptoms. Responses to all topic areas increased after three consecutive 45-minute sessions, separated by 15-minute breaks, of continuous talking (i.e., before the lunch break). Subsequently, two additional sessions were conducted, after which there was a slight reduction in all areas except for the questions related to central fatigue (Vintturi et al., 2003; Vilkman, 2004). This indicates that their dislike for the task and feeling of tiredness did not recover as readily as other symptoms after a break.

Vocal Fatigue Index (VFI)

Nanjundeswaran et al (2015) developed and validated Vocal Fatigue Index (VFI-2) in two stages, to aid the identification of VF and document the symptoms related to it. The authors aligned with the clinical view that VF is a self-perceived set of symptoms. Hence the need for developing the self-report tool emerged. Initially a beta version of VFI-1 was generated that had 21 questions. Later, 2 items were removed from it (VFI-1) due to poor item to total correlation to construct VFI-2 with 19 questions. The same questionnaire was administered to the groups of clinical population (105 participants) and 70 normal participants. The VFI-2 was characterized into three factors: (1) related to tiredness of voice and voice avoidance (11 questions), (2) related to physical discomfort associated with voicing (5 questions), and (3) improvement of symptoms with rest (3 questions). The responses for VFI-2 are rated on a 5-point Likert scale in which the subjects indicate “never”, “almost never”, “sometimes”, “almost

always" and "always" from 0-4 respectively. The scale had sensitivity and specificity of 0.91 which made it a good way to differentiate people with and without VF. VFI-2 was validated and verified in dysphonic and healthy controls and the results suggested that the underlying symptom for many voice problems is VF. Hence, VFI-2 may be used efficiently in identifying individuals with VF.

Factors in VFI-2

As discussed in the previous section, VFI-2 was characterised into three factors: tiredness of voice, physical discomfort during voice use, and improvement after rest. Recent studies relating to one of these factors are discussed under the same headings below.

Tiredness of voice: Bottalico, Graetzer, and Hunter (2016) investigated the effect of speech styles, room acoustics and vocal fatigue on the vocal effort for males and females. Twenty participants were considered in the study, in which they were asked to read a text in various situations such as anechoic, semi-reverberant and reverberant rooms and in different vocal intensities including normal and loud volumes. Following each task, the subjects answered questions in which they were required to rate effort, clarity of voice and comfort of voice for each reading situation. The results revealed that sound pressure measurements and self-reported ratings increased at louder volumes and decreased when reflective panels were present. Females reported more vocal effort in general compared to males in all the tasks.

VFI in teachers:

Hunter and Banks (2017) examined the reporting of vocal fatigue in teachers using VFI-2 and compared their results with the normative given by Nanjundeswaran et al (2015). The participants were 518 female teachers and 122 male teachers. The gender distribution was considered to be similar to the national average of the country's population in which the study was carried out. The average age for the female teachers

in the sample was 43.0 years (SD=12.2) and the average age for the male teachers was 48.4 years (SD=11.5). The total average age was 43.5 years. Data was collected by mode of internet survey. The authors changed the wording for factor 3 in order to maintain the same type of scoring pattern as in factors 1 and 2. The results indicated that female teachers had higher mean values for all the 3 factors compared to male teachers. On comparison with normative given by Nanjundeswaran et al (2015), teachers were found to be 3 times more likely to report vocal fatigue.

From the above studies, it was evident that teachers are at a potential risk of developing voice problems. Most of the studies conducted on teachers are mainly of primary and secondary school teachers. The vocal demand also varies according to the grades taught by them. A high school teacher would require teaching more hours and taking extra classes when compared to primary and secondary school teachers, while a kinder-garden teacher would have a higher vocal demand compared to secondary or higher secondary school teachers. A physical education teacher would have vocal abuse due to shouting compared to a teacher who teaches academic subjects. Hence, tasks of different levels of teachers vary significantly. Their vocal usage, the usage of voice amplifying aids in teaching and academic subjects also play an important role. VHI used to describe vocal fatigue (VF) symptoms is common in many studies but is not sensitive to it (VF). Only a single study (Hunter & Banks, 2017) has investigated VFI in teachers. Hence, the current study was planned to find the extent of vocal fatigue exhibited by the teachers, the differences between the levels and also the gender difference in reporting vocal fatigue.

Aim

The aim of the present study was to explore the self-reported vocal fatigue symptoms among different levels of school teachers: Physical education teachers, Kinder-garden teachers, Primary school teachers, Secondary school teachers, Higher Secondary teachers using Vocal Fatigue Index (VFI)-Version 2.

Objectives

a) To estimate the extent of vocal fatigue exhibited by school teachers teaching different levels of classes using Vocal Fatigue Index (VFI)-version 2.

b) To compare the VFI scores among school teachers who teach different Categories: Physical education teachers, Kinder-garden teachers (LKG & UKG), Primary school teachers (1st standard to 5th standard), Secondary school teachers (6th standard to 8th standard) and Senior Secondary teachers (9th to12th standard) [Statistics of school education, 2011].

c) To check for gender differences, if any, in the VFI scores across different categories of school teachers.

CHAPTER 3

Method

Participants

A total of 100 teachers participated in the study. They were divided into five categories: Kindergarten teachers (Lower Kindergarten and Upper Kindergarten), Primary teachers (1st standard to 5th standard), Secondary teachers (6th standard to 10th standard), Higher Secondary teachers (11th standard and 12th standard) and Physical Education teachers. Each group consisted of 20 participants. Different levels of teachers were coded as follows:

- Kindergarten as KG
- Primary as PRI
- Secondary as SEC
- Higher Secondary as HSEC
- Physical Education as PE

The participants were recruited from 19 English medium private schools from Chennai, Tamil Nadu. All the schools followed Tamil Nadu state syllabus and teaching guidelines from Department of School Education, Government of Tamil Nadu. Each participating teacher had a minimum of 5 years of teaching experience.

Participants having history of voice problems, respiratory diseases, neurological diseases, or any other communication impairment were excluded from the study. Chronic smokers and excessive alcohol consumers were also excluded from the study. The PE teachers who have had used any form of amplifying devices such as microphones for their classes were also excluded from the study. Tables 2-6 depict the details of participants in different categories. Since most of the kindergarten and primary teachers are females, only females were considered to represent the population in KG and PRI categories.

Table 2: **Demographic details and experience for KG teachers**

Participant ID	Age (years) (Mean= 38.95/ SD=5.69)	Gender	Teaching experience (years) (Mean=18.59/SD=5.74)
KG1	38	Female	5
KG2	32	Female	7
KG3	33	Female	9
KG4	42	Female	23
KG5	45	Female	23
KG6	38	Female	8
KG7	32	Female	12
KG8	36	Female	9
KG9	46	Female	14
KG10	43	Female	12
KG11	44	Female	18
KG12	38	Female	15
KG13	38	Female	18
KG14	38	Female	10
KG15	30	Female	5
KG16	46	Female	21
KG17	30	Female	11
KG18	40	Female	19
KG19	50	Female	12
KG20	40	Female	7

Table 3: **Demographic details and experience for PRI teachers**

Participant ID	Age (years) (Mean=40.85/ SD=3.57)	Gender	Teaching experience (years) (Mean=12.95/SD=5.94)
PRI1	36	Female	5
PRI2	39	Female	17
PRI3	41	Female	7
PRI4	41	Female	17
PRI5	46	Female	20
PRI6	38	Female	18
PRI7	44	Female	20
PRI8	42	Female	20
PRI9	47	Female	22
PRI10	37	Female	10
PRI11	40	Female	10
PRI12	40	Female	5
PRI13	46	Female	19
PRI14	39	Female	10
PRI15	40	Female	18
PRI16	36	Female	5
PRI17	44	Female	9
PRI18	45	Female	8
PRI19	35	Female	8
PRI20	41	Female	11

Table 4: **Demographic details and experience for SEC teachers**

Participant ID	Age (years) (Mean=40.4/ SD=6.39)	Gender	Teaching experience (years) (Mean=11.95/SD=5.65)
SEC1	44	Male	20
SEC2	36	Male	10
SEC3	49	Male	20
SEC4	50	Male	15
SEC5	45	Male	20
SEC6	50	Male	25
SEC7	40	Male	6
SEC8	50	Male	6
SEC9	41	Male	10
SEC10	44	Male	17
SEC11	31	Female	6
SEC12	37	Female	9
SEC13	34	Female	11
SEC14	32	Female	6
SEC15	36	Female	5
SEC16	45	Female	10
SEC17	40	Female	10
SEC18	34	Female	15
SEC19	33	Female	8
SEC20	37	Female	10

Table 5: **Demographic details and experience for HSEC teachers**

Participant ID	Age (years) (Mean=40.9/ SD=5.65)	Gender	Teaching experience (years) (Mean=13.55/SD=4.90)
HSEC1	31	Male	7
HSEC2	44	Male	17
HSEC3	42	Male	15
HSEC4	35	Male	14
HSEC5	40	Male	17
HSEC6	36	Male	9
HSEC7	39	Male	18
HSEC8	47	Male	13
HSEC9	46	Male	17
HSEC10	40	Male	6
HSEC11	36	Female	7
HSEC12	30	Female	7
HSEC13	41	Female	15
HSEC14	50	Female	25
HSEC15	50	Female	15
HSEC16	40	Female	10
HSEC17	45	Female	15
HSEC18	38	Female	9
HSEC19	47	Female	20
HSEC20	41	Female	15

Table 6: **Demographic details and experience for PE teachers**

Participant ID	Age (years) (Mean=40.5/ SD=6.7)	Gender	Teaching experience (years) (Mean=13.15/SD=6.01)
PE1	35	Male	7
PE2	34	Male	5
PE3	45	Male	19
PE4	49	Male	21
PE5	35	Male	13
PE6	41	Male	13
PE7	45	Male	12
PE8	32	Male	9
PE9	34	Male	9
PE10	50	Male	20
PE11	44	Female	21
PE12	44	Female	20
PE13	46	Female	9
PE14	49	Female	21
PE15	38	Female	13
PE16	40	Female	12
PE17	41	Female	6
PE18	38	Female	6
PE19	24	Female	6
PE20	46	Female	21

Test Material

The instrument used to evaluate the VF symptoms was Vocal Fatigue Index version 2 (VFI-2; given in Appendix 1) developed by Nanjundeswaran et al (2015), which contained a total of 19 questions. The questions were categorized into 3 factors, with Factor 1 related to tiredness of voice and avoidance of voice use, Factor 2 related to physical discomfort of voice use, and Factor 3 related to improvement in symptoms with rest. Each question was to be rated on a 5 point Likert scale in which 0 represented 'never', 1 represented 'almost never', 2 represented 'sometimes', 3 represented 'almost always' and 4 represented 'always'.

Factor 1 contained questions which were worded negatively so a higher score indicated vocal fatigue. Factor 2 contained questions related to the physical discomfort due to voice use and were also worded negatively so a greater score indicated vocal fatigue. Factor 3 was related to the improvement of vocal symptoms with rest, and contained questions which were worded positively, so a lesser score indicated vocal

fatigue. Since each factor was conceptually different, a total score was not calculated. Table 7 shows the number of questions and cut-off scores for each factor.

Table 7: **VFI factors, number of questions, maximum scores and cut-off scores**

Factor number	Number of questions	Maximum score	Cut-off score for VF
1	11	44	≥24
2	5	20	≥7
3	3	12	≤7

Procedure

Initially, a permission letter for data collection was sent to 27 English medium private schools in Chennai. Of these, 19 schools responded positively and they were contacted in order to fix a date for data collection. The present study adhered to the bio behavioural ethical research guideline of the Institute. The participants were explained about the aim and procedure of the study, and a dated written consent was obtained from every teacher who participated.

Printed copies of VFI-2 were used to administer the questionnaire with prior permission obtained from the author of the instrument. The following instructions were provided to each participant prior to the administration of VFI-2: "These are some of the symptoms usually associated with voice problems. Circle the response that indicate how frequently you experience the same symptoms" (Nanjundeswaran et al., 2015).

A total of 100 completed VFI-2 response sheets were obtained from the participants and these sheets were scored for each factor separately. Each of the individual question scores as well as the total factor scores were tabulated.

Statistical analysis

The scores obtained were collected and compiled and were subjected to descriptive and inferential statistics. Statistical Package for Social Sciences (SPSS) version 20.0 was used. The following statistical analyses were carried out:

- Shapiro-Wilk's test was used to check the normality of the data.

- Descriptive statistics was carried out for the factor-wise VFI-2 scores in all the categories of teachers.
- Independent 2 sample t-test was carried out to check the gender effects in the categories SEC, HSEC, and PE.
- One way MANOVA was carried out to check the significance between the categories (KG versus PRI versus SEC versus HSEC versus PE) and within each factor of VFI-2.
- Bonferroni test was used for Post Hoc analysis.

CHAPTER 4

Results

The present study aimed to explore the self-reported VF symptoms among different levels of school teachers using VFI-2. A total of 100 teachers were considered, who were divided into 5 categories, with each category having 20 teachers. KG and PRI had 20 females each, and SEC, HSEC and PE had 10 males and 10 females each. The SPSS data sheet was prepared with the scores of Factor 1, Factor 2, and Factor 3 separately.

Results of normality

The data was subjected to Shapiro Wilk's test of normality and the results revealed normal distribution of the data ($p>0.05$) after the removal of an outlier (one female participant from PE).

The results of the study are presented under the following sub-headings:

- Extent of VF exhibited by different categories of teachers
- Comparing the VFI scores for each factor across KG, PRI, SEC, HSEC and PE
- Comparison of gender difference in the categories SEC, HSEC, and PE

Extent of VF exhibited by different categories of teachers

Based on the individual responses for VFI-2, the participants were categorized into VF group and non VF group for each factor according to the cut off scores given by Nanjundeswaran et al. (2015). Number of participants in VF and non VF groups for all levels of teachers for factor1, factor 2 and factor 3, respectively are depicted in Table 8 to Table 10.

From Table 8, totally 35% of teachers had VF. Among the 20 participants of KG, PRI, SEC and HSEC, 60%, 35%, 10% and 55%, respectively, had VF. Among the 19 participants of PE, 16% were observed to have VF. The KG teacher category had a highest percentage of individuals with VF, followed by HSEC, PRI, SEC and PE.

Table 8: **Number of participants in VF and Non VF group for factor 1**

Categories	No. of participants in VF group	No. of participants in non VF group
KG (n=20)	12	8
PRI (n=20)	7	13
SEC (n=20)	2	18
HSEC (n=20)	11	9
PE (n=19)	3	16
Total	35	64

From Table 9, totally 71% of total teachers were indicated to have VF, and in each category, 75% of KG, 85% of PRI, 55% of SEC, 16% of HSEC and 63% of PE were considered to have VF. The PRI category had a highest number of individuals with VF, followed by HSEC, KG, PE and SEC.

Table 9: **Number of participants in VF and Non VF group for factor 2**

Categories	No. of participants in VF group	No. of participants in non VF group
KG (n=20)	15	5
PRI (n=20)	17	3
SEC (n=20)	11	9
HSEC (n=20)	16	4
PE (n=19)	12	7
Total	71	28

From Table 10, totally 46% of teachers had VF, among which, 15% of KG, 50% of PRI, 60% of SEC, 55% of HSEC and 52% of PE were considered to have VF. SEC had the highest number of individuals with VF, followed by HSEC, PE, PRI and KG teachers.

Table 10: **The number of participants in VF and Non VF group for factor 3**

Categories	No. of participants in VF group	No. of participants in non VF group
KG (n=20)	3	17
PRI (n=20)	10	10
SEC (n=20)	12	8
HSEC (n=20)	11	9
PE (n=19)	10	9
Total	46	53

Comparing the VFI scores for each factor across KG, PRI, SEC, HSEC and PE

Descriptive statistics of factor wise VFI scores for each category of school teachers are depicted in Table 11. From Table 11, it was observed that mean scores of factor 1 was higher for KG, followed by HSEC, PRI, PE and SEC. The mean scores of factor 2 was higher for KG followed by PRI, HSEC, SEC and PE. The means scores for factor 3 was lower for SEC, followed by PE, HSEC, PRI and KG.

Table 11: **Mean and SD of factor wise VFI scores for all the categories**

Category	Mean and SD	Factor 1	Factor 2	Factor 3
KG	Mean	25.30	11.85	9.95
	SD	10.579	5.163	2.58
PRI	Mean	19.60	11.55	7.90
	SD	6.004	4.839	2.55
SEC	Mean	17.45	8.70	6.50
	SD	7.388	4.857	3.22
HSEC	Mean	21.75	10.95	7.45
	SD	9.613	998	3.17
PE	Mean	17.89	7.00	7.36
	SD	6.341	3.801	2.19

One way MANOVA was carried out to find the significant difference between the categories KG versus PRI versus SEC versus HSEC versus PE for each factor. The results of the analysis revealed a significant main effect of category ($F(12, 243) = 2.72$, $p < 0.05$). Hence, Bonferroni Post hoc analysis was carried out to check for between category differences for each factor. The results of the Bonferroni Post hoc analysis for

between category difference for factor 1, factor 2 and factor 3 are given in the table 12, 13, and 14 respectively. The p-values marked with an asterisk (*) indicate significance for the respective category pairs.

From the Table 12, significantly higher factor 1 scores were obtained for KG when compared to SEC. The other pairs did not reveal any significant difference.

Table 12: **Results of Bonferroni Post hoc analysis for factor 1**

Category	Category	Mean Difference	p-values
KG	PRI	5.70	.305
	SEC	7.85	**.032***
	HSEC	3.55	1.00
	PE	7.41	.059
PRI	KG	-5.70	.305
	SEC	2.15	1.00
	HSEC	-2.15	1.00
	PE	1.71	1.00
SEC	KG	-7.85	.302
	PRI	-2.15	1.00
	HSEC	-100	1.00
	PE	-.44	1.00
HSEC	KG	-3.55	1.00
	PRI	2.15	1.00
	SEC	100	1.00
	PE	3.86	1.00
PE	KG	-7.41	.059
	PRI	-1.71	1.00
	SEC	.44	1.00
	HSEC	-3.86	1.00

Note: *p>0.05 indicates no significant difference*

From the Table 13, KG had significantly higher factor 2 scores compared to PE. Similarly, PRI had significantly higher factor 2 scores compared to PE. The other pairs of teachers did not reveal any significant difference.

Table 13: **Results of Bonferroni Post hoc analysis for factor 2**

Category	Category	Mean Difference	Significance
KG	PRI	0.30	1.46
	SEC	3.15	0.338
	HSEC	0.90	1.00
	PE	4.85	**0.015***
PRI	KG	-0.30	1.00
	SEC	2.85	0.543
	HSEC	0.60	1.00
	PE	4.55	**0.028***
SEC	KG	-3.15	0.338
	PRI	-2.85	0.543
	HSEC	-2.25	1.00
	PE	1.70	1.00
HSEC	KG	-0.90	1.00
	PRI	-0.60	1.00
	SEC	2.25	1.00
	PE	3.95	0.090
PE	KG	-4.85	**0.015***
	PRI	-4.55	**0.028***
	SEC	-1.70	1.00
	HSEC	-3.95	0.090

Note: *p>0.05 indicates no significant difference*

From the Table 14, KG had significantly lower factor 3 scores compared to SEC, HSEC and PE. The other pairs of categories did not any reveal significant difference.

Table 14: ***Results of Bonferroni Post hoc analysis for factor 3***

Category	Category	Mean Difference	Significance
KG	PRI	-2.15	0.131
	SEC	-3.35	**0.002***
	HSEC	-2.55	**0.035***
	PE	-3.21	**0.003***
PRI	KG	2.15	0.131
	SEC	-1.20	1.00
	HSEC	-.40	1.00
	PE	-1.06	1.00
SEC	KG	3.35	**0.002***
	PRI	1.20	1.00
	HSEC	.80	1.00
	PE	.14	1.00
HSEC	KG	2.55	**0.035***
	PRI	.40	1.00
	SEC	-.80	1.00
	PE	-.66	1.00
PE	KG	3.21	**0.003***
	PRI	1.06	1.00
	SEC	.14	1.00
	HSEC	.66	1.00

Note: *p>0.05 indicates no significant difference*

Comparison of gender difference in the categories SEC, HSEC and PE

Independent two sample 't' test was performed to check for significant gender difference for each factor score. The results of the independent two sample 't' test for SEC, HSEC and PE teachers are depicted in the table 15, table 16, and table 17, respectively.

From Table 15, it was observed that for the factor 1 and factor 2, the mean scores were higher for female when compared to male. While for the factor 3, the mean scores are lower for females when compared to male. However, there was no significant gender difference observed for all of the factors.

Table 15: **Results of independent two sample 't' test for SEC**

Factor	Gender	N	Mean (M)	Standard Deviation (SD)	t value	p value
1	Male	10	16.70	8.36	- 0.444	0.662
	Female	10	18.20	6.63		
2	Male	10	8.40	5.42	- 0.269	0.791
	Female	10	9.00	4.49		
3	Male	10	5.60	3.25	0.408	0.688
	Female	10	5.10	2.13		

Note: *p>0.05 indicates no significant difference*

From Table 16, it was observed that for factor 1 and factor 2, the mean scores were higher for females when compared to males, while for the factor 3, the mean scores were lower for females when compared to males. However, there was no significant gender difference observed for either of the factors.

Table 16: **Results of independent two sample 't' test for HSEC**

Factor	Gender	N	Mean (M)	Standard Deviation (SD)	t value	p value
1	Male	10	16.00	8.96	- 3.29	0.064
	Female	10	27.50	6.41		
2	Male	10	9.40	4.06	- 1.69	0.108
	Female	10	12.50	84		
3	Male	10	6.20	2.61	2.68	**0.015***
	Female	10	2.90	2.88		

Note: *p>0.05 indicates no significant difference*

From Table 17, it was observed that, for factor 1 and factor 2, the mean scores were higher for females when compared to males, while for factor 3, the mean scores were lower for females when compared to males. Gender difference was significant only for factor 3.

Table 17 ***Results of Independent two sample 't' test for PE***

Factor	Gender	N	Mean (M)	Standard Deviation (SD)	t value	p value
1	Male	10	16.00	5.12	- 1.410	0.177
	Female	9	20.00	7.17		
2	Male	10	5.70	4.00	- 1.64	0.118
	Female	9	8.44	3.16		
3	Male	10	5.80	2.25	1.129	0.275
	Female	9	4.56	2.25		

Note: *p>0.05 indicates no significant difference*

From the results of the present study, the following salient findings were revealed for each of the sub-headings.

- Extent of VF exhibited by different categories of teachers: KG was seen to have highest extent of VF among all the categories.
- Comparing the VFI scores for each factor across KG, PRI, SEC, HSEC and PE:
    - Factor 1: KG revealed significantly higher scores than SEC
    - Factor 2: KG and PRI revealed significantly scores than PE
    - Factor 3: SEC, HSEC and PE revealed significantly higher scores than KG
- Comparison of gender difference in the categories SEC, HSEC, and PE: Factor 3 scores revealed significantly higher scores for males than females in HSEC.

CHAPTER 5

Discussion

The present study revealed some relevant results, which are discussed along with the possible reasons and supporting and contradicting studies below.

Comparing the VFI scores for each factor across KG, PRI, SEC, HSEC and PE

In factor 1, KG had significantly greater scores compared to SEC. In factor 2, KG and PRI had significantly greater score compared to PE. In factor 3, KG had significantly lesser score compared to SEC, HSEC and PE. Hence, for all the 3 factors, teachers of the category KG were more likely to experience various symptoms of VF, while the trend varied significantly between other categories.

Kindergarten teachers tend to have more vocally demanding activities like singing rhymes, group play activities, etc. Also, kindergarten children are in the transition period of attending regular school in which each child reacts differently and requires special attention. This in turn could increase the psychological stress of the teacher which may increase the probability of voice problems.

Comparison of gender difference in the categories SEC, HSEC and PE

There was significant gender difference for particularly factor 3 in the category HSEC, while in other categories there was no significant gender difference observed for any of the factors. Also, the mean scores of factors 1 and 2 were generally higher in females compared to males and for factor 3, the mean scores for females were lower compared to males, although both of these findings were not statistically significant. These results indicated more VF in females compared to males. This is similar to the finding by Hunter and Banks (2017) who also reported the same general trend of results.

Females indicated elevated scores compared to males in VFI-2 in all the 3 factors. Increase score in factor 1 was an indicator of increased tiredness of voice. Bottalico et al (2016) also reported similar findings in which female subjects rated vocal

effort to be significantly higher than males. Another contributing factor to the increased female scores could be the possibility that females are more sensitive to changes in their own vocal intensity than males.

Factor 2 measured physical discomfort with voice use, so higher scores may indicate increased perception of physical discomfort by females. Hunter and banks (2017) justified that increased scores in factor 2 of the VFI could be due to increased pain sensitivity for females compared to males. Factor 3 was an indicator of the vocal systems ability to recover from fatigue. The current study revealed poorer results in females compared to males; i.e. the ability of the female participants to recover from VF was lesser than male participants. This could be attributed to the inherent biological differences in vocal apparatus. Female larynges were seen to have lower levels of hyaluronic acid (which helps in repair of damaged tissue) in the vocal folds compared to males (Butler, Hammond, & Gray, 2000). Hence these variances could be a contributing factor for the gender differences observed in factor 3.

Thus, the significant findings of the present study were that Kindergarten teachers had greater extents of VF and that female teachers rated their self-percept of VF worse than male teachers. These findings were also seen to correlate with some of the relevant literature.

CHAPTER 6

Summary and Conclusion

The present study aimed to explore the self-reported vocal fatigue symptoms among different levels of school teachers: KG, PRI, SEC, HSEC and PE, using Vocal Fatigue Index (VFI)-Version 2. The objectives of the study were: to estimate the extent of vocal fatigue exhibited by school teachers using VFI, to compare the VFI scores among school teachers KG, PRI, SEC, HSEC and PE and to check for gender differences, if any, in the VFI scores across categories SEC, HSEC and PE.

The results of the study were as follows:

- Extent of VF exhibited by different categories of teachers: KG was seen to have highest degree of VF among all the categories.
- Comparing the VFI scores for each factor across KG, PRI, SEC, HSEC and PE:
    - In Factor 1, KG revealed significantly higher scores than SEC
    - In Factor 2, KG and PRI revealed significantly scores than PE
    - Factor 3, SEC, HSEC and PE revealed significantly higher scores than KG
- Comparison of gender difference in the categories SEC, HSEC, and PE: Factor 3 scores revealed significantly higher scores for males than females in HSEC

Future directions of the study:

- VFI could be done in larger population of teacher.
- VFI can be correlated with objective measures.
- Factor specific estimation of sensitivity in identifying vocal fatigue can be explored.

References

Aronson, A. E., & Bless, D. M. (2009). *Clinical voice disorders*. Stuttgart: Thieme.

Bottalico, P., Graetzer, S., & Hunter, E. J. (2016). Effects of speech style, room acoustics, and vocal fatigue on vocal effort. *The Journal of the Acoustical Society of America,139*(5), 2870-2879. doi:10.1121/1.4950812

Bovo, R., Galceran, M., Petruccelli, J., & Hatzopoulos, S. (2007). Vocal Problems Among Teachers: Evaluation of a Preventive Voice Program. *Journal of Voice,21*(6), 705-722. doi:10.1016/j.jvoice.2006.07.002

Butler, J. E., Hammond, T. H., & Gray, S. D. (2000). Age- and Gender-Related Collagen Distribution in Human Vocal Folds. *Annals of Otology, Rhinology & Laryngology,109*(10), 913-920. doi:10.1177/000348940010901004

Chang, A., & Karnell, M. P. (2004). Perceived phonatory effort and phonation threshold pressure across a prolonged voice loading task: A study of vocal fatigue. *Journal of Voice,18*(4), 454-466. doi:10.1016/j.jvoice.2004.01.004

Colton, R. H., Casper, J. K., & Leonard, R. (2006). *Understanding voice problems: A physiological perspective for diagnosis and treatment* (3rd ed.). Baltimore, MD: Lippincott Williams & Wilkins.

Cooper, D. S., & Titze, I. R. (1985). Generation and dissipation of heat in vocal fold tissue. *Journal of Speech and Hearing Research, 28*, 207 – 215.

Enoka, R. M., & Stuart, D. G. (1992). Neurobiology of muscle fatigue. *Journal of Applied Physiology,72*(5), 1631-1648. doi:10.1152/jappl.1992.72.5.1631

Fritzell, B. (1996). Voice disorders and occupations. *Logopedics Phoniatrics Vocology, 21*(1), 7-12. doi:10.3109/14015439609099197

Gotaas, C., & Starr, C. D. (1993). Vocal Fatigue Among Teachers. *Folia Phoniatrica Et Logopaedica, 45*(3), 120-129. doi:10.1159/000266237

Hogikyan, N. D., & Sethuraman, G. (1999). Validation of an instrument to measure voice-related quality of life (V-RQOL). *Journal of Voice, 13*(4), 557-569. doi:10.1016/s0892-1997(99)80010-1

Hunter, E. J., & Banks, R. E. (2017). Gender Differences in the Reporting of Vocal Fatigue in Teachers as Quantified by the Vocal Fatigue Index. *Annals of Otology, Rhinology & Laryngology, 126*(12), 813-818. doi:10.1177/0003489417738788

Jacobson, B. H., Johnson, A., Grywalski, C., Silbergleit, A., Jacobson, G., Benninger, M. S., & Newman, C. W. (1997). Voice Handicap Index. *PsycTESTS Dataset*. doi:10.1037/t31070-000

Kitch, J. A., & Oates, J. (1994). The perceptual features of vocal fatigue as self-reported by a group of actors and singers. *Journal of Voice, 8*(3), 207-214. doi:10.1016/s0892-1997(05)80291-7

Kostyk, B. E., & Rochet, A. P. (1998). Laryngeal airway resistance in teachers with vocal fatigue: A preliminary study. *Journal of Voice,12*(3), 287-299. doi:10.1016/s0892-1997(98)80019-2

Koufman, J. A., & Isaacson, G. The spectrum of vocal dysfunction. *Otolaryngol Clin North Am*. 1991 ;24:985–988.6.

McCabe, D. J., & Titze, I. R. (2002). Chant Therapy For Treating Vocal Fatigue Among Public School Teachers. *American Journal of Speech-Language Pathology, 11*(4), 356-369. doi:10.1044/1058-0360(2002/040)

Michael, J. F. & Wendahl, R. (1971). Correlates of voice production. In Travis, L. E. (Ed). *Handbook of speech pathology and audiology*, Prentice-hall Inc., 465-480.

Nanjundeswaran, C., Jacobson, B. H., Gartner-Schmidt, J., & Abbott, K. V. (2015). Vocal Fatigue Index. *Psyc TESTS Dataset*. doi:10.1037/t43605-000

Pekkarinen, E., Himberg, L., & Pentti, J. (1992). Prevalence of vocal symptoms among teachers compared with nurses: A questionnaire study. *Scandinavian Journal of Logopedics and Phoniatrics, 17*(2), 113-117. doi:10.3109/14015439209098721

Roy, N., Merrill, R. M., Thibeault, S., Parsa, R. A., Gray, S. D., & Smith, E. M. (2004). Prevalence of Voice Disorders in Teachers and the General Population. *Journal of Speech, Language, and Hearing Research,47*(2), 281-293. doi:10.1044/1092-4388(2004/023)

Russell, A., Oates, J., & Greenwood, K. M. (1998). Prevalence of voice problems in teachers. *Journal of Voice*, 12, 467 – 479.

Sala, E., Airo, E., Olkinuora, P., Simberg, S., Strom, U., Laine, A., Pentti, J., & Suonpaa, J. (2002). *Vocal loading among day care center teachers*. Logopedics Phoniatrics Vocology, 27, 21–28.

Smith, E., Lemke, J., Taylor, M., Kirchner, H. L., & Hoffman, H. (1998). Frequency of voice problems among teachers and other occupations. *Journal of Voice, 12*(4), 480-488. doi:10.1016/s0892-1997(98)80057-x

Solomon, N. P. (2008). Vocal fatigue and its relation to vocal hyperfunction. *International Journal of Speech-Language Pathology, 10*(4), 254-266. doi:10.1080/14417040701730990

Solomon, N. P., & DiMattia, M. S. (2000). Effects of a vocally fatiguing task and systemic hydration on phonation threshold pressure. *Journal of Voice, 14*, 341 – 362.

Stemple, J. C., Glaze, L. E., & Klaben, B. G. (2000). *Clinical voice pathology: Theory and management* (3rd ed.). San Diego, CA: Singular Publishing.

Stemple, J. C., Stanley, J., & Lee, L. (1995). Objective measures of voice production in normal subjects following prolonged voice use. *Journal of Voice*, 9, 127 – 133.

Titze, I. R., & Sundberg, J. (1992). Vocal intensity in speakers and singers. *The Journal of the Acoustical Society of America*, *91*(5), 2936-2946.

Titze, I. R., Hunter, E. J., & Svec, J. G. (2007). Voicing and silence periods in daily and weekly vocalizations of teachers. *Journal of the Acoustical Society of America, 121*, 469 – 478.

Vilkman, E. (1998). Occupational safety and health arrangements for voice and speech professionals in Europe. 24th *World Congress of the International association of Logopaedics and Phoniatrics*, Amsterdam, August 23-27.

Vilkman, E. (2004). Occupational Safety and Health Aspects of Voice and Speech Professions. *Folia Phoniatrica Et Logopaedica, 56*(4), 220-253. doi:10.1159/000078344

Vintturi, J., Alku, P., Sala, E., Sihvo, M., & Vilkman, E. (2003). Loading-related subjective symptoms during a vocal loading test with special reference to gender and some ergonomic factors. *Folia Phoniatrica et Logopaedica, 55*, 55 – 69.

Welham, N. V., & Maclagan, M. A. (2003). Vocal Fatigue: Current Knowledge and Future Directions. *Journal of Voice,17*(1), 21-30. doi:10.1016/s0892-1997(03)00033-x

Appendix

Name: Age/ Sex:

Teaching grade: Years of teaching experience:

Medical History:

Use of amplifying devices or any teaching aids:

VFI-Version 2

PART 1						
1	I don't feel like taking after a period of voice use	0	1	2	3	4
2	My voice feels tired when I talk more	0	1	2	3	4
3	I experience increased sense of effort with talking	0	1	2	3	4
4	My voice gets hoarse with voice use	0	1	2	3	4
5	It feels like work to use my voice	0	1	2	3	4
6	I tend to generally limit my talking after a period of voice use.	0	1	2	3	4
7	I avoid social situations when I know I have to talk more	0	1	2	3	4
8	I feel I cannot talk to my family after a work day	0	1	2	3	4
9	It is effortful to produce my voice after a period of voice use	0	1	2	3	4
10	I find it difficult to project my voice with voice use	0	1	2	3	4
11	My voice feels week after a period of voice use	0	1	2	3	4
PART 2		0	1	2	3	4
12	I experience pain in the neck at the end of the day with voice use	0	1	2	3	4
13	I experience throat pain at the end of the day with voice use	0	1	2	3	4
14	My voice feels sore when I talk more	0	1	2	3	4
15	My throat aches with voice use	0	1	2	3	4
16	I experience discomfort in my neck with voice use	0	1	2	3	4
PART 3		0	1	2	3	4
17	My voice feels better after I have rested	0	1	2	3	4
18	The effort to Produce my voice decreased with rest	0	1	2	3	4
19	The hoarseness of my voice gets better with rest	0	1	2	3	4

0 - Never	1 - Almost Never	2 - Sometimes	3 - Almost always	4 - Always