VOCAL FATIGUE IN PROFESSIONAL THEATRE ARTISTS AS QUANTIFIED BY THE VOCAL FATIGUE INDEX – VERSION 2

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A Dissertation Submitted in Part Fulfillment of Degree of Master of Science
(Speech-Language Pathology)

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July 2020

CERTIFICATE

This is to certify that this dissertation entitled "**Vocal fatigue in professional theatre artists as quantified by the Vocal Fatigue Index – Version 2**" is a Bonafide work submitted in part fulfillment for degree of Master of Science (Speech-Language Pathology) of the student Registration Number: 18SLP004. This has been carried out under the guidance of a faculty of this institute and has not been submitted earlier to any other University for award of any other Diploma or Degree.

Mysuru

July 2020

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DECLARATION

This is to certify that this dissertation entitled "**Vocal fatigue in professional theatre artists as quantified by the Vocal Fatigue Index – Version 2**" is the result of my own study under the guidance of Dr. K Yeshoda, Associate Professor, Department of Speech – Language Sciences, All India Institute of Speech and Hearing, Mysuru, and has not been submitted earlier to any other University for award of any other Diploma or Degree.

Mysuru ***Registration Number: 18SLP004***

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TABLE OF CONTENT

List of tables

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CHAPTER I

INTRODUCTION

Our voice plays a vital role in communicating our thoughts, expressing a range of emotions, and conveying our needs. The ability to use vocal apparatus to express feelings, describe an event, and establish communication is unique to human beings. The act of speaking is a very specialized way of using the vocal mechanisms of respiration, phonation, resonation, and articulation**.** In theatre, the voice is imperative for both speaking and singing. With their voices, performers communicate the dramatic truths of the characters through the dialogue of a play or the songs (Kalaiselvi, 2006).

There is an increasing segment of the population dependent on vocal communication for its livelihood like actors, singers, lawyers, cheerleaders, etc. (Kalaiselvi, 2006). They are referred to as professional voice users. Murry and Rosen (2000) define professional voice users as those who require the use of their voice to maintain income.

1.1 Professional Voice Users

According to Stemple (1993), Professional voice users are those who are directly dependant on vocal communication for their livelihood. This includes singers, actors, teachers, salesperson, lawyers, etc.

Koufman and Issacson (1991) proposed a classification based on levels of vocal usage as follows:

Level I: Elite vocal performers include singers and actors for whom even a mild variation in their voice will have dire consequences on their livelihood.

Level II: The level II vocal performers include teachers and professors termed as professional voice users, even a moderate aberration in their voice will limit their job performance.

Level III: The non-vocal professional voice users such as lawyers, businessmen, etc., will come under this category. This group will have a negative impact on their professional demands only when their vocal performance is severely affected.

Level IV: This group is termed as non-vocal non-professional voice users, which includes vendors, office workers, etc., for whom, voice is not a significant concern for their job fulfilment. Though voice disorders in this group will not cause any hindrance in their work, it may have a huge impact on their social liabilities.

Actors and/ theatre artists are Level I Elite vocal performers. They indulge in speaking, screaming, moving, and dancing throughout the performance. They need to regulate their vocal techniques during rehearsal and performance due to changes in the room acoustics. Further environmental variables like smoke, dust, and physical interference with costumes and makeup might impact the actor's vocal performance. Enacting may need tough characterization and dialects for which the individual may not

be equipped. Those actors with a day job and long rehearsal will have a severe impact on their vocal mechanism (Zeine & Walter, 2002).

1.2 Mechanisms Contributing to Vocal Fatigue

The origin of vocal fatigue is not very clear, but, Titze in 1983 claimed that there are umpteen number of biomechanical and neuromuscular components contributing to the respiratory and laryngeal muscles fatigue and variations in the viscous properties of non-muscular vocal fold tissue (Solomon, 2008).

1.2.1 Neuromuscular Fatigue

The muscles active for longer duration at higher levels can induce fatigue in the peripheral nervous system and the muscles it innervates. One can perceive increased effort to produce the voice due to the fatigue in the respiratory and phonatory system (Solomon, 2008).

1.2.2 Non-muscular Tissue Fatigue and Viscosity

Non-muscular tissue fatigue, also termed mechanical fatigue, refers to the amount of strain that a material can endure prior to the breaking down. Fatigue causes damage to the non-muscular structure, which is progressive and is caused due to the stress (force per unit area) imposed by strain on the material. Biomechanical fatigue is highly pertinent to the larynx as it is composed of elastic, non-muscular tissues, which is subjected to recurrent and rapid vibrations. During phonation, the vocal fold mucosa undergoes mechanical stress with each cycle of vocal fold vibration. This phenomenon is due to the damage caused to lamina propria, and the shear stress endeavoured at the endpoints of the tissue. During the production of high pitches, due to the movement of cricothyroid

muscles, there will be an increase in vocal fold length in the anterior-posterior direction, which results in tensile stress. Contact stress results from the contact of the vocal folds at the vocal processes of the arytenoid cartilages. Furthermore, contact and collision stresses are applied at the vibratory portion of the vocal folds. Titze (1994) investigated different types of non-muscular strains and their possible effect during phonation. Though the magnitudes and durations of these stresses are unclear, mechanical fatigue can have adverse effects on laryngeal mucosa (Solomon, 2008).

1.2.3 Sense of Effort

In addition to sites in the periphery, the central nervous system can be a locus of Fatigue. When performance deteriorates because of reduced central activation to the lower motor neuron pools of the peripheral nervous system, then central, or "mental", fatigue is implicated. This is reflected perceptually as an increased sense of effort (Enoka & Stuart, 1992). Therefore, the reduced function may not be externally observable; instead, the central nervous system makes adjustments to allow performance to continue at the same level of accuracy. Elaborate and somewhat invasive techniques have been used for research purposes to identify the contribution of central fatigue to overall fatigue, but, for clinical purposes, assessment primarily involves questionnaires and rating scales (Solomon, 2008).

1.2.4 Vocal Rest and Recovery

Signs and symptoms of vocal fatigue improve with a period of rest is a part of the definition of vocal fatigue. Several reports suggest that symptoms resolve with rest

(Chang & Karnell, 2004; Solomon & DiMattia, 2000; Vintturi et al., 2001; Welham & Maclagan, 2004; Yiu & Chan, 2003), these rest periods range from 15 minutes to 24 hours. Titze, Hunter, and Švec in 2007 compiled data related to duration spent on vocalization and the duration spent on silence to understand the effects of voice rest. In this study, they monitored teachers during a normal conversation and during lecturing for two weeks. It was reported that during the conversation, the silence period was more than that of voicing; this observation contradicted when teachers were lecturing. This suggests that the silence period was lesser, which further emphasizes that there was a lesser time window for the recovery of laryngeal muscles and tissues. There are several mechanisms that take place during recovery; fluids in the tissues of the larynx will be redistributed, and blood flow in laryngeal muscles will be restored, or active muscles will be evoked in terms of biomechanical and physiological properties, etc. They concluded that each of these mechanisms has its time window ranging from a few seconds to hours.

1.3 Vocal Fatigue in Professional Voice Users

Several studies have reported that actors, singers, and lecturers who are categorized as professional voice users have experienced vocal pathologies due to vocal abuse and laryngeal fatigue (Eustace, Stemple & Lee, 1996; Herrington, Lee, Stemple, McHone & Neime, 1998).

Mitchell (1996) and Sataloff (1987) reviewed a few of the issues faced by these elite vocal performers. Mitchell (1996) compiled medical and career-specific voice-related issues that the professional voice users undergo and the factors that affect their

vocal mechanism. Eustace et al. (1996) collected data from 88 patients whose primary complaint was chronic laryngeal fatigue. They stated that laryngeal fatigue was majorly seen in "professional voice users such as singers, actors, members of the clergy, and lecturers" (Zeine & Walter, 2002) (p.146).

Sapir, Keidar, and Mathers-Schmidt (1993) delineated a few factors contributing to vocal attrition. These factors include discomfort in the throat, benign lesions in the laryngeal mucosa, hoarseness, and vocal fatigue.

Stone and Shaft (1973) studied ten normal males to investigate whether atypical pitch and intensity cause any vocal changes. They concluded that phonation at higher pitch levels resulted in early and easy perception of vocal fatigue than compared to that of phonation at lower pitch levels. Holbrook and colleagues (1974, 1980) explored the effects of loud talking on vocal fatigue by comparing the duration of loud talking (>75dBA) and duration of talking in general. The results revealed that loud talking contributed to vocal fatigue but not the quantity of talking (Kitch and Oates, 1994).

Sander and Ripich carried out a similar study in 1983. But the results were contradicting to the survey done by Stone and Shaft (1973), that is, loud talking did not have any significant effect on vocal fatigue. But, one-third of their subjects experienced deterioration in their voice clarity. The authors stated that "vocal fatigue may relate to the precise vocal behaviors used by subjects to create loud voice, such as a vocal attack, and the relative contributions of the respiratory and laryngeal musculature to produce loud voice."

Vocal fatigue is a self-perceived set of symptoms; hence there was a need to develop a self-report tool to identify possible individuals with vocal fatigue. Over the years, there have been many studies on understanding vocal fatigue, its definition, and symptoms, but none could come to a common conclusion. This difference in the opinions was due to various reasons, such as scarcity of a consistent definition of vocal fatigue, lack of agreement amongst the authors about the tasks to be used, etc. To overcome all these limitations Nanjundeswaran, Jacobson, & Gartner-Schmidt in 2015 developed the Vocal Fatigue Index (VFI), a validated index that provides a cohesive description of characteristics and symptoms of vocal fatigue and identifies individuals with and without vocal fatigue. Initially, a beta version of VFI was developed, which included 21 items, two items were removed from the tool due to poor item to total correlation. This led to the generation of version 2 of VFI with 19 questions. During the course of the study, three factors were extracted, and the 19 items were assigned under these factors. Hence, Vocal fatigue Index version – 2 has 3 Factors :1. General tiredness of voice; 2. Physical discomfort associated with voicing, and 3. Improvement of symptoms with rest. Likert's 5-point rating scale was employed in the study (0 – never, 1 - almost never, 2 – sometimes, 3 – almost always, and 4 – always) for scoring of the responses.

Several investigators have begun to address experimental fatigue questions in a more ecologically valid manner. This has included studying individuals with symptomatic vocal fatigue complaints, in addition to conducting experiments under realistic occupational demands.

Many surveys have established that the prevalence of symptoms of vocal fatigue in certain professions is associated with high rates of voice pathologies (Gotaas & Starr

1993; Simberg, Sala & Vehmas, 2005; Russel, Oates & Greenwood, 1998). Many researchers have attempted to introduce an objective measure of fatigue crucial for the development of standards in prevention of acquired voice disorder (Vilkman, 2000).

1.4 Need for the Study

Theatre artists are known to overuse and abuse voice as part of their professional demands. Vocal Fatigue is not well understood in theatre artists, and this population is with high professional demand (Salsbury, 2014). Vocal behaviours of theatre artists are unique owing to the different extent of vocal productions an artist is expected to execute during preparations, rehearsals, and performances. When such vocal behaviours are exhibited regularly or routinely by theatre artists, it may result in abusive vocal practices, leading to vocal fatigue. It is essential to investigate the presence of vocal fatigue in this group of professional voice users. Hence, this study was planned to identify professional theatre artists with vocal fatigue.

It will help determine the symptoms of vocal fatigue and create an insight into the implementation of hygienic vocal habits and behaviours.

CHAPTER II

REVIEW OF LITERATURE

Professional voice users are classified into different groups based on the circumstances in which they work. They include those who use their voice for an extended period (politicians, teachers in the classroom, telephone users, shopkeepers, and vendors), those who use their voice under adverse circumstances (person working is noisy or polluted environments – factory workers, workers in airplanes, sports areas, trains, blacksmith, etc.), and those who use their voice for special purposes (singers, theatre artists, etc.). Of these professional voice user groups, the voice of singers and actors has been the topic of extensive research. The demands on the voice of actors and singers are much higher compared to other professional voice users, as even a slight vocal difficulty may have severe repercussions on their performance (Kalaiselvi, 2006).

2.1 Theatre Artists

Ferrone, Galgano and Ramig in 2009 stated that "Voice is a primary source of artistic expression for the actor, and it is the instrument used to convey a wide variety of emotions." Actors must project their voices effectively to achieve a better perception of their voice to the listener. They try to make this with maximum intelligibility, and with minimum vocal effort. Actors are required to speak at a much louder level to compete with background noise and music (Pinczower & Oates, 2005).

Actors often engage in vocally violent behaviours, including screaming, groaning, crying loud talking and laughing, etc. to express various emotions during rehearsal and on-stage performance. They tend to produce intense pitch and loudness ranges along with

severe physical exertion. These behaviours result in increased tension in the circumlaryngeal area, further injuring the mucosal layer of the vocal folds and causing mutation in voice (Roy, Ryker, & Bless, 2000).

When compared to normal conversation, actors place increased demands on their voice during rehearsal and on-stage performance (Zeine & Walter, 2002). As these actors engage in both singing and speaking several times throughout the week, vocal loading on their vocal mechanism tends to be high. In addition to the high vocal demand, actors are required to perform in an environment with heavy smoke, dust, and poor room acoustics, etc. Studies have shown that, compared to non-vocal performers, actors are more prone to develop pathologies related to the larynx (Stemple, 1993). Vocal pathology does not only affect their on-stage performance but also causes enormous damage to their livelihood. Vocal fatigue is one of the frequent symptoms reported by actors due to increased vocal loading (Novak, Dl ouha, Capkova, & Vohradnik, 1991).

It is contemplated that, actors who place their vocal mechanism on high demand during rehearsal and performance are more prone to vocal injury (Emerich, Titze, Svec, Popolo, & Logan, 2005), despite having good vocal mechanism compared to that of non-vocal performers (Master, De Biase, Chiari, & Laukkanen, 2008). According to a study by Ferrone, Leung, and Ramig (2004), actors indulge in vocally violent behavior such as shouting, grunting, crying, and imitating voices to enact a particular character appropriately. Hence, they display symptoms of vocal fatigue. (Roy et al, 2000). They are also required to express different shades of emotion while acting (Raphael & Scherer, 1987). Guzman, Correa, Munoz, and Mayerhoff (2013) investigated the influence of emotional expression in spectral energy distribution in 37 professional theatre actors by

doing acoustic analysis on recordings of a read-aloud task while performing six different emotions (happiness, sadness, fear, anger, tenderness, and eroticism) and while performing it without emotion (neutral). They noticed that the expression of emotions affected the spectral energy and the influence that this had on the quality of voice. The work environment can have a negative impact on the voice quality of the actors. According to a study done by deGoulart and Vilanova (2011), the majority of the actors said to have faced problems related to the work environment, such as acoustics of the room, stage, etc. At times costumes and makeup is worn by the actors during performance can cause a massive hindrance in the projection of their voice, and intelligibility of their speech. They are required to alter their posture to suit the character that they are playing, and often there is improper or no amplification present (Hoffman-Ruddy, Lehman, Crandell, Ingram, & Sapienza, 2001).

Theatre performers are among the largest groups of professional voice users who develop voice disorders because of abusive speaking or singing habits, especially hyper functional voice techniques. Acting frequently requires voice production that favours a broader range of loudness, pitch, rhythm, and voice quality. These projection skills in actors may be the result of alterations in the overall shape of the vocal tract. This leads to an increase in spectral energy in the higher part of the spectrum (Smith, Finnegan, and Karnell, 2005; and Pinczower and Oates, 2005). Optimum projection is related to the breathing mechanism, resonators, and intelligibility of the text. These attributes are gained through vocal training. Lack of vocal training may lead to inappropriate projections by increasing laryngeal muscle tension and constriction, resulting in vocal strain and Fatigue. Actors are also expected to enact many emotions, and to give in to the

given circumstances of the plays they are performing. The realization of some of these emotions through voice may be considered to be vocally abusive behaviours. Such behaviours involve the use of pitch and loudness in their extremes, increased muscular tension, and forced and effortful explosion of air across the partially approximated vocal folds (Roy and Bless 2000). Using vigorous voices, actors often encounter vocal trauma, hoarseness, and other vocal symptoms when they assume a strained rough phonatory style for character portrayal (Sander and Ripich, 1983).

Actors are often required to wear huge or heavy costumes based on their performances, which interferes with their performances. At times, there will be improper or no amplification present in the stage. These external factors add to the performance demands faced by actors. Actors face several kinds of vocal challenges to cope with the acoustical environment of the stage, where actors are required to perform on the stage of an open set with loud background noise from the crowds, traffic, etc. In addition to these challenges, actors might have to engage a prolonged time in performance based on the duration of their plays, demands on their performance, other contributing environmental variables include physical interference with costumes and improper amplification ranging from inferior microphone placement to no amplification at all (Hoffman-Ruddy, Lehman, Crandell, Ingram and Sapienze, 2001).

Attires worn by the actors to portray a particular character act as an external limitation that can be confining, resulting in improper posture during the performance (e.g., hunch-back). Likewise, few outfits are hard to endure in extreme conditions of heat, which further contributes to the general tiredness of the body. All of these external factors can result in laryngeal pathology in theatre artists (Hoffman-Ruddy et al., 2001).

2.2 Vocal Fatigue

Vocal fatigue, otherwise called laryngeal fatigue, is a composite multidimensional phenomenon. Expanding feelings of exertion, discomfort during phonation, diminished vocal quality, etc. are few of the symptoms experienced by voice users, as Solomon indicated in 2008. These symptoms are noticed to magnify as the day progresses and reduces with a period of voice rest typically increase across the speaking day and improvement after resting. According to Solomon (2008), certain physiological and biomechanical mechanisms such as neuro-muscular fatigue, increase in viscous properties of vocal folds, decrease in blood flow, and mechanical tissue fatigue strain is speculated to add to vocal fatigue.

All the more comprehensively, laryngeal fatigue is depicted as a global syndrome characterized by a set of symptoms experienced by voice users during or after the speech, which includes an individual's impression of expanded vocal exertion, laryngeal uneasiness, the tension in neck or shoulder areas, pain in the region of throat and neck, decrease in pitch range, loss of vocal adaptability, diminished vocal projection, reduced control over vocal mechanism, loss of voice, etc. The symptoms are reported to increase if they continue to speak throughout the day, regularly reducing symptoms with vocal rest (Solomon, 2008; Gotaas & Starr, 1993; Kitch & Oates, 1994; and Kostyk & Putnam Rochet, 1996).

Laryngeal fatigue is resultant of improper adjustments made in the vocal mechanism, which occurs as an outcome of extensive use of voice for a longer duration. These vocal adjustments suggest the unwanted changes in the functioning of the vocal mechanism. Vocal fatigue is usually explained by its signs and symptoms. Increase in

effort to produce voice, discomfort, inflexibility, decrease in pitch range, reduced projection of voice, increase in symptoms as the day progresses, decrease in symptoms after a period of voice rest, etc., are symptoms delineated after surveying persons with vocal fatigue (Gotaas & Starr, 1993; Kitch & Oates, 1994).

Vilkman (2004) stated laryngeal fatigue as "a subjective term, which refers to negative sensations related to voicing", which complements the subjective feeling of fatigue. McCabe and Titze (2002) profited on a well-acknowledged definition of fatigue from the literature of physiology and kinesiology (Enoka & Stuart, 1992), which incorporates both the subjective and the noticeable-behavioural outcomes of prolonged physical activity, in their definition: “a progressive increase in phonatory effort accompanied by a progressive decrease in phonatory capabilities." The ideas generated by these statement talks about the potential contributions of neurophysiological mechanisms, both at peripheral and central levels, as well as biomechanical contributions to vocal fatigue.

2.3 Vocal Fatigue in Theatre Artists

Singers and theatre artists require the greatest care to conserve their voices. During stage performances, theatre players often have to use their voices for long periods, often in unstable and unhealthy conditions associated with high loudness levels and varying pitches (Rubin, Praneetvatakul, Gherson, Moyer & Sataloff, (2006); Hazlett, Duffy & Moorhead, 2011).

There are many aspects which have an impact on vocal fatigue in actors and actresses after a theatre performance: (1) the effort applied on the voice and the body during a performance; (2) the acoustic of the hall; (3) effort on the mental status of the actor; (4) the professional quality of the speaker, the forcing of the voice (Novak, 1991).

Kitch and Oates in 1994 aimed to investigate the subjective experience of 10 actors and singers during an episode of vocal fatigue. They used a 4-part self-reported questionnaire, which included open-ended questions related to cause, context, severity, and understanding of vocal fatigue, closed type of questions pertaining to their perception of voice quality concerning vocal fatigue, vocal projection and pitch range related questions to actors and singers respectively, it also included questions related to profiling of tension. Results revealed that most of the subjects associated their understanding of laryngeal fatigue with soreness, change in voice quality, and voice loss, etc. All the subjects delineated the cause of vocal fatigue to be vocal abuse and misuse, improper use of vocal techniques, stress related to performance, etc. Both the groups stated that they were subjected to vocal fatigue when demands on their performance were high, during physical illness, performance in the presence of background noise, etc. Actors reported to have mild to moderate levels of fatigue, whereas singers stated to have mild to severe fatigue levels. Actors reported having difficulty in projecting their voice and said that they had to apply extra effort. They also experienced general constriction, which resulted in difficulty reaching extreme pitch and loudness levels. Whereas, singers experienced pitch and loudness inflexibility, change in voice quality, and said to apply extra efforts to achieve optimal quality. Both the groups complained of having extreme tension in the

regions of the neck, face, and jaws; further, actors complained tension in the region of the chest and back during performance.

Novak et al. (1991) studied the effect of theatre performance on vocal fatigue in 45 well-trained actors (32 males and 13 females). They used LTAS to study vocal fatigue acoustically and considered fundamental frequency, the center of gravity, and skewness of straight line as parameters. They took tape recordings of actors before and after the theatre performance. There was a significant change in one of the settings; the straight line's skewness was observed to be higher after the performance. This suggested that there was laryngeal muscle hypotony. Few subjects complained of self-perception of vocal fatigue post-theatre performance. Authors contemplated that, this could be caused due to poor acoustical conditions of the hall, but could not be confirmed objectively.

Due to the unique demands placed on the voice during repeated performances, including harsh vocal behaviours (screaming, shouting, crying, etc. for the portrayal of characters), actors are at high risk for vocal pathology (Roy et al, 2000) and considered to be at high risk for vocal fatigue. Vocal fatigue, general physical fatigue, throat fatigue, throat tightness or constriction, strained or tense throat, difficulty in producing and sustaining voice, reduction in pitch range, and greater difficulty in creating higher pitches are some of the descriptions given (Raphael and Scherer, 1987).

An actor's potential to perform can be genuinely affected by laryngeal Fatigue and changes in the quality of the voice (Eustace, Stemple & Lee 1996; Mitchel, 1996). It is said that actors with vocally violent behaviours such as abuse and misuse are more prone to develop laryngeal fatigue and pathologies related to the larynx (Sataloff, 1987). The effect of training and vocal health on laryngeal pathology has not been studied well.

However, recent studies suggest that vocal training has a good impact on the performance of singers. Whether there is a higher incidence of such vocal pathologies in actors with less training in the use of their voice or in actors who are less informed about vocal hygiene has not been established (Eustace, 1996; Mckinney, 1997). Hence it is very important to understand vocal fatigue in professional theatre artists.

2.4 Aim of the Study

To explore the symptoms of vocal fatigue in professional theatre artists

2.5 The Objective of the Study

To investigate the presence of symptoms of vocal fatigue using the Vocal Fatigue Index-2 in professional theatre artists.

CHAPTER III

METHOD

3.1 Participants

A total of 30 professional theatre artists (15 males and 15 females) in the age range of 28-45 years participated in the study. They were recruited from the government recognized institutes in Karnataka, such as Rangayana, Mysuru, Natana Rangashale, Niranthara Foundation Mysuru, Rangavalli and Ninasam, Heggodu.

3.1.1 Inclusion and Exclusion Criteria

All participants were professionals who are actively involved in acting for the past five years. The subjects with any speech, hearing, neurological related complaints, and infections related to ear, nose, and throat were excluded from the study.

3.2 Test Material

Vocal Fatigue Index-2, developed by Nanjundeswaran et al. (2015), was used to evaluate symptoms related to vocal fatigue. Version 2 of VFI included 19 statements, which reflected the symptoms of vocal fatigue. These 19 statements were listed under three different factors. Factor 1 included 11 statements related to general tiredness of voice; Factor 2 included five statements related to physical discomfort associated with voicing, and Factor 3 included four statements related to improvements of symptoms with rest.

Factors 1 and 2 were negatively worded; greater scores in these factors indicated vocal fatigue. Unlikely, Factor 3 was worded positively, hence lesser scores showed vocal fatigue.

As these three factors were conceptually different, a total score was not obtained. Instead, the total score for individual factors was calculated separately. Version 2 of the Vocal Fatigue Index is chosen for this study as the test-retest reliability was strong, as well as the sensitivity and specificity for correctly distinguishing individuals with and without vocal fatigue.

3.3 Procedure

The current study adhered to the bio behavioural and ethical research guidelines of the institute. Participants were explained about the aim and the procedure of the study, and written consent was obtained from each participant.

Initially, a detailed demographic which included the subject's age, gender, total years of theatre training, theatre experiences, and the number of shows or plays performed, etc., were elicited from the subjects. Later Vocal Fatigue Index (version 2) was directly administered to the subjects mentioned above and was also sent electronically to those artists who reside in other parts of the state. Subjects were instructed to indicate how frequently they experience the symptoms related to vocal fatigue based on a 5-point rating scale (0 – never, 1 - almost never, 2 – sometimes, 3 – almost always, and 4 – always).

3.4 Analysis

A total of 30 completed questionnaire forms were collected from the participants. Each Factor was scored separately and was subjected to further statistical analysis.

CHAPTER IV

RESULTS AND DISCUSSION

The present study aimed to explore the symptoms of vocal fatigue in professional theatre artists (15males and 15 females) using Vocal Fatigue Index – 2.

The following statistical analysis was carried to explore the symptoms for vocal fatigue and to check the gender effects between the factors using 'Statistical Package for Social Sciences' software (SPSS, version 20.0)

1. Shapiro Wilk's test of Normality
2. Descriptive statistics
3. Independent t test to check for gender effects
4. Pairwise comparison between Factors
5. Correlation analysis

4.1 Results of Normality

Shapiro Wilk's test of Normality was carried out on the data. The data in Table 1 revealed that Factor 1, that is, general tiredness of voice, Factor 3, that is, improvement of symptoms with rest, and a combined total of Factor 1 and 2 are normally distributed in both male and female population (p-value > 0.05), whereas Factor 2, that is, symptoms related to physical discomfort in voicing in male population did not follow the normal distribution.

Table 1

Results of Shapiro Wilk's Normality test

Factors	Gender	statistic	Degree of freedom	significance
Factor 1	Male	0.910	15	0.136
	Female	0.941	15	0.391
Factor 2	Male	0.833	15	0.010*
	Female	0.943	15	0.415
Factor 1 and 2	Male	0.954	15	0.597
	Female	0.956	15	0.621
Factor 3	Male	0.885	15	0.57
	Female	0.885	15	0.56

*$p<0.05$

The results of the present study are discussed under the following sub-headings

- Self-reported symptoms of vocal fatigue in males and female.
- Comparisons of VFI scores in each factor between male and female population.
- Comparison between factors within the female population.
- Comparison between factors within the male population.

4.1.1 Self-reported Symptoms of Vocal Fatigue in Male and Female Professional Theatre Artists

Cross-tabulation of the responses for each factor of each individual was carried out separately using SPSS software. Table 2 reveals that in Factor 1, that is, general

tiredness of voice in males; limited talking after using the voice for a period, avoiding social situations, inability talk to family members after voice use, and inability to talk after using the voice for a period were less frequently reported symptoms. The commonly reported symptoms were tiredness in voice, increased sense of effort with talking, hoarseness in voice, difficulty in projecting voice, effortful to produce voice, and feeling of weakness in voice after using it for a period.

Table 2

Cross-tabulation of factor wise responses in male professional theatre artists

VFIQ	**Never**	**Almost never**	**Sometimes**	**Almost always**	**Always**
FACTOR 1					
VFIQ1	2	7	6	0	0
VFIQ2	2	2	11	0	0
VFIQ3	1	6	6	2	0
VFIQ4	1	6	8	0	0
VFIQ5	5	7	2	1	0
VFIQ6	3	5	6	1	0
VFIQ7	4	5	4	2	0
VFIQ8	9	6	0	0	0
VFIQ9	0	4	10	1	0
VFIQ10	1	6	6	2	0
VFIQ11	0	7	8	0	0
FACTOR 2					
VFIQ1	15	0	0	0	0
VFIQ2	1	2	12	0	0
VFIQ3	1	10	4	0	0
VFIQ4	1	4	10	0	0
VFIQ5	14	1	0	0	0
FACTOR 3					
VFIQ1	0	0	1	9	5
VFIQ2	0	0	0	10	5
VFIQ3	0	1	5	8	1

Note: VFIQ – Vocal Fatigue Index Question

As observed in Table 2, in Factor 2, which is physical discomfort associated with voicing, the less frequently reported symptoms in males were pain in the neck, sore

voice, and discomfort in the neck with voice use but, throat pain and throat ache were frequently reported symptoms in males. In Factor 3, that is, the improvement of symptoms with rest, the majority of the population reported to have reduced effort and hoarseness during voice production with rest.

As observed in Table 3, in Factor 1, that is general tiredness of voice in females; limited talking after a period of voice use, inability talk to family after voice use, and inability to speak after using the voice for a period were less frequently reported symptoms. The frequently reported symptoms were tiredness in voice, increased sense of effort with talking, hoarseness in voice, feeling like work to use voice, avoiding social situations, difficulty projecting voice, effortful to produce voice and sense of week voice.

The data in Table 3 reveals that in Factor 2, that is, physical discomfort associated with voicing, follows the same trend as that of males. The less frequently reported symptoms were pain in the neck, sore voice, and discomfort in the neck with voice use. Whereas, throat pain and throat ache were frequently reported symptoms in females.

For Factor 3, the majority of the population only reported a decrease in hoarseness of voice with rest.

Based on Individual scores on VFI-2, Participants were categorized into vocal fatigue group and non-vocal fatigue group for each Factor according to the cutoff scores given by Najundeswaran et al. For Factor 1, none of the participants were categorized to vocal fatigue group as scores were <24, though they exhibited symptoms related to general tiredness of voice.

Table 3

Cross-tabulation of factor wise responses in female professional theatre artists

VFIQ	Never	Almost never	Sometimes	Almost always	Always
FACTOR 1					
VFIQ1	4	5	6	0	0
VFIQ2	1	2	12	0	0
VFIQ3	2	3	6	4	0
VFIQ4	0	4	10	1	0
VFIQ5	4	4	6	1	0
VFIQ6	3	7	4	1	0
VFIQ7	1	4	10	0	0
VFIQ8	4	9	2	0	0
VFIQ9	1	2	10	2	0
VFIQ10	2	2	9	1	1
VFIQ11	0	2	12	1	0
FACTOR 2					
VFIQ1	5	7	3	0	0
VFIQ2	2	3	9	1	0
VFIQ3	1	8	6	0	0
VFIQ4	4	2	9	0	0
VFIQ5	4	5	5	1	0
FACTOR 3					
VFIQ1	0	10	5	0	0
VFIQ2	2	10	0	3	0
VFIQ3	1	0	4	6	4

For Factor 2, None of the Male theatre artists were categorized to vocal fatigue group, whereas 7 out of 15 female theatre artists were categorized into vocal fatigue group having scores >7. For Factor 3, as it is positively worded, greater scores indicated improvement with rest or better Recovery. All the participants had scores above 7, indicating good recovery.

The above results are backed up by the study done by Kitch and Oates in 1994 on ten actors and ten singers using a self-report questionnaire of vocal changes related to voice fatigue. Based on the self-rating scale, it can be delineated that most of the subjects

experienced soreness in their throat and difference in voice quality. Most of the actors reported having to apply extra effort in order to project their voices well. Both actors and singers' groups have experienced to have tension in the region of neck, throat, and jaws. Further, actors complained to have extreme pressure in the chest and back region. This justifies the frequently reported symptoms in which both male and female theatre artists had difficulty projecting their voice or effort to produce the voice. They also demonstrated that high levels of tension were reported by both groups in the throat, neck, and jaw areas. The actors also reported high levels of tension in their chests and backs at this time. Our participants did not frequently report these symptoms though females had higher scores in Factor 2, which indicates that they had increased discomfort with voicing.

4.1.2 Comparison of VFI Scores in each Factor Between Male and Female Population

An Independent sample t test was carried out to check for gender differences for each factor. The results from the descriptive statistics revealed that mean scores of Factor 1 and a combined total of Factors 1 and 2 were more in females than males, whereas the mean score of Factor 3 was more in males than in females, as shown in Table 4. However, Table 5 reveals that only a combined total of Factors 1 and 2 were significantly different (p-value < 0.05).

Table 4

Mean, Median and Standard Deviation of Factor wise VFI scores

	Gender	N	Mean	Standard deviation	Median
Age	Male	15	33.80	5.735	32.00
	Female	15	32.93	5.133	30.00
	Total	30	33.37	5.366	31.50
Years of experience	Male	15	14.40	6.947	15.00
	Female	15	12.60	5.011	12.00
	Total	30	13.50	6.022	13.00
Factor 1 total	Male	15	14.80	3.427	14.00
	Female	15	17.00	4.551	18.00
	Total	30	15.90	4.113	15.00
Factor 2 total	Male	15	4.60	1.454	5.00
	Female	15	6.33	2.380	6.00
	Total	30	5.47	2.129	6.00
Factor 1 and 2 totals	Male	15	19.40	3.562	20.00
	Female	15	23.33	6.411	24.00
	Total	30	21.37	5.474	20.00
Factor3 total	Male	15	9.20	1.424	9.00
	Female	15	8.93	1.907	9.00
	Total	30	9.07	1.660	9.00

Table 5

t, df, and significance for the VFI factors across the gender

	T-test for Equality of Means		
	t	df	Sig. (2-tailed)
Factor 1 total	-1.496	28	0.146
Factor 1 and 2 totals	-2.077	28	0.047*
Factor 3 total	.434	28	0.668

*p<0.05

Mann – Whitney test was carried out to check the significant gender effects on Factor 2 as it did not follow the normal distribution in males. The descriptive statistics

revealed that the mean scores for Factor 2 were more in females than males. This difference was also statistically significant (p-value < 0.05) as observed from Table 6.

Table 6

Results of test statistics and level of significance for VFI factor 2

	Factor 2 total
Z	-2.389
Asymp. Sig. (2-tailed)	.017*

*p<0.05

From the above results, it could be interpreted that general tiredness of voice (Factor 1) and Physical discomfort associated with voicing (Factor 2) was more in females. Whereas improvement of symptoms with rest (Factor 3) in other words, Recovery was better in males.

The above results correlate with a study done by Novak et al. (1991). They studied the effect of theatre performance on vocal fatigue in 45 actors using LTAS. Tape recordings of the subjects were obtained before and after the performance. It was noticed that there was an increase in the fundamental frequency of male actors (+2.7Hz) and a decrease in fundamental frequency in female actors (-7.3Hz) after the performance. This shift in fundamental frequency was statistically significant. The skewness of the straight line of formant regions was greater in male actors, which suggests that there was hypertonicity in laryngeal muscles, Whereas, in the case of female actors, the results were quite the opposite, suggesting hypotonicity. The authors hypothesized that females undergo higher mental stress during the performance and hence the difference between male and female theatre actors, though it was not empirically supported.

4.1.3 Comparison of Factors in Females

A percentage descriptive analysis was done in order to compare between factors. Repeated measures of ANOVA were done to compare across the factors in females, and results revealed that all the factors were significantly different from each other with F value 62.935 (p-value > 0.05).

The pairwise comparison of factors was carried out through the Bonferroni test, and the results revealed that Factor 1 was significantly different from Factor 2 and 3, Factor 2 was significantly different from Factor 3 and 1, and Factor 3 was significantly different from factor 1 and 2 (p-value < 0.05).

A paired sample test was carried out to check the comparison between a combined total of Factors 1 and 2 and Factor 3, and the results revealed that a combined total of Factors 1 and 2 was significantly different from that of Factor 3 (p-value < 0.05) as observed in Table 7.

Table 7

Level of significance for comparison of VFI factors in females (t, df)

		t	df	Sig. (2-tailed)
Pair 1	factor 3 per – factor 1 2 per	8.144	14	.000*

*p < 0.05

4.1.4 Comparison of Factors in Males

As Factor 2 in males was not normally distributed, Friedman's test was carried out to compare the factors in males. As observed from Table 8, there was a significant difference across all the 3 factors (p-value < 0.05).

Table 8

Results of chi square statistics and level of significance for Comparison of VFI factors in males

N	Chi square	df	Asymp. Sig.
15	26.533	2	.000*

*p < 0.05

Pairwise comparison of factors was made using Wilcoxon Signed Rank test, and the results revealed that factor 1 was significantly different from Factor 2 and 3, Factor 2 was significantly different from Factor 1 and 3 and Factor 3 was significantly different from Factor 1 and 2 (p-value < 0.05) as observed in Table 9.

Table 9

Results of test statistics and level of significance for pairwise comparison of VFI factors in males

	factor 2 per – factor 1per	factor 3 per – factor 1per	factor 3 per – factor 2per
Z	-2.955[c]	-3.408[d]	-3.415[d]
Asymp. Sig. (2-tailed)	.003*	.001*	.001*

*p <0.05

A paired sample test was carried out to compare the combined total of Factors 1 and 2 with Factor 3. The results revealed that they were significantly different from each other (p-value < 0.05), as shown in Table 10.

Table 10

t, df and level of significance for pairwise comparison of VFI factors in males

		t	df	Sig. (2-tailed)
Pair 1	factor 3per – factor 1 2per	12.037	14	.000*

*p < 0.05

4.1.5 Correlation Between Years of Experience and Factors

Pearson correlation and Spearman correlation in females and males respectively were carried out to check for correlation between years of experience in acting and the VFI factors. Results revealed that there was no significant correlation between years of experience and the factors (p-value < 0.05).

Though there were vocal fatigue-related symptoms in terms of general tiredness of voice and physical discomfort in the neck present in theatre artists, it was not significant enough to label them under vocal fatigue group except for the female population in Factor 2. This could be because the population selected for this study were all professional theatre artists with a minimum of five years of experience and were trained. Scherer et al. in 1986 investigated relationship between training and vulnerability to vocal fatigue in trained and untrained voice users. The results revealed that reaction to fatigue was different in trained voice users when compared to untrained voice users. Authors reasoned that trained voice users are less vulnerable to vocal fatigue. Another study investigated the effect of vocal training on the respiratory mechanism in a comparison study between trained and novice actors. The respiratory patterns in novice

actors did not show any major changes and variations in the abdomen and ribcage movement was not significant. Displacement of the abdomen was not noticeably different in novice actors. They did not make any rapid respiratory alterations like trained actors during plays (Ferrone et al, 2009). Apart from vocal training and practicing vocal hygiene, recovery could be another possible reason. All the participants had greater recovery with rest as depicted by higher scores in Factor 3. This statement is supported by many studies. In a study done by Scherer et al. in 1986, a single subject study was conducted on a professional voice user with a task of loud talking for 1.5 hours, followed by a period of voice rest. A pre and post-test recording were carried out. It was noticed that shimmer value had shifted to the baseline level, and also there was an improvement in symptoms after voice rest (Chang & Karnell, 2004; Solomon & DiMattia, 2000; Vintturi et al., 2001; Welham & Maclagan, 2004; Yiu & Chan, 2003), with rest periods ranging from 15 minutes to 24 hours.

4.2 Summary of Results

- Using crosstabulation of the responses for each factor for each individual frequently and less frequently reported symptoms were explored.
- According to cutoff scores provided by Najundeswaran et al., male theatre artists were not categorized under vocal fatigue groups as their scores of all factors were less than the mentioned cutoff scores. Whereas in females, based on the scores of Factor 2, were categorized into vocal fatigue group. Both males and females had greater scores in Factor 3, indicating improvement of symptoms with rest.
- Mean score of Factor 1, Factor 2, and a combined total of Factor 1 and 2 was more in females, though only Factor 2 and a combined total of Factor 1 and 2

were significant. This suggests that females had greater vocal fatigue when compared to that of males.

- The mean score of Factor 3 was more in males indicating better recovery with rest and was statistically significant.
- Pairwise comparison showed that there was a significant difference between all the three Factors in both male and female professional theatre artists.
- There was no correlation between the years of theatre experience and the three Factors

Chapter V

SUMMARY AND CONCLUSION

The present study aimed at exploring the symptoms of vocal fatigue in 30 professional theatre artists using the Vocal Fatigue Index- version 2. Vocal Fatigue Index was administered to all the participants were asked to rate their symptoms related to vocal fatigue. Later the scores of each factor were compiled separately and were subjected to statistical analysis using SPSS software. The results revealed that,

- Using crosstabulation of the responses for each factor for each individual frequently and less frequently reported symptoms were explored.
- According to cut-off scores provided by Najundeswaran et al., Male theatre artists were not categorized under the vocal fatigue group as their scores of all factors were less than the mentioned cut-off scores. Whereas in females, based on the scores of Factor 2, were categorized into vocal fatigue group. Both males and females had greater scores in Factor 3, indicating improvement of symptoms with rest.
- Mean score of Factor 1, Factor 2, and a combined total of Factor 1 and 2 was more in females, though only Factor 2 and a combined total of Factor 1 and 2 were significant. This suggested that females had greater vocal fatigue when compared to that of males.
- The mean score of Factor 3 was more in males indicating better recovery with rest and was statistically significant.
- Pairwise comparison showed that there was a significant difference between all the three factors in both male and female professional theatre artists.
- There was no correlation between the years of theatre experience and the three factors.

Though the theatre artists reported symptoms related to vocal fatigue, it was not significant enough to categorize them under vocal fatigue group. These findings could be due to effective vocal training, good vocal hygiene habits, and also recovery. However, there was no significant relationship between years of experience and vocal fatigue. The present study is a preliminary attempt in understanding vocal fatigue in theatre artists. Future studies can aim at understanding vocal fatigue in relation to vocal training, hygiene and recovery.

5.1 Implications

1. This enables us to delineate the symptoms of vocal Fatigue in theatre artists, which in turn facilitates in carrying out vocal health education programs in professional voice users.
2. It creates insight into the importance of voice rest in professional voice users.

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