

**VOCAL FATIGUE IN SPEECH-LANGUAGE PATHOLOGISTS: AN
ENQUIRY USING VOCAL FATIGUE INDEX-VERSION 2 (VFI-2)**

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August 2022

CERTIFICATE

This is to certify that this dissertation entitled “**Vocal Fatigue in Speech-Language Pathologists: An Enquiry Using Vocal Fatigue Index-Version 2 (VFI-2)**” is bonafide work submitted in part fulfilment for the degree of Master of Science (Speech-Language Pathology) of the student with Registration Number 20SLP017. This has been carried out under the guidance of the faculty 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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DECLARATION

This is to certify that this dissertation entitled “**Vocal Fatigue in Speech-Language Pathologists: An Enquiry Using Vocal Fatigue Index-Version 2 (VFI-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 the award of any other Diploma or Degree.

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“The LORD is my shepherd; I shall not want.

Surely goodness and mercy shall follow me all the days of my life:

And I will dwell in the house of the LORD forever.”

Psalm 23:1,6 KJV

I'm so grateful to God for His faithfulness in my life. Indeed, He has been my good shepherd, He has been my God and I have never lacked anything. He has made me thrive in every season and has lifted me through every situation. He has given me the green pasture moments, the still water moments; yes, He has restored my soul every time I was thirsty or empty. He has paved the paths before me and led me to His Will. In all my valley moments He has never left me alone and has filled me with joy. He has been my defense in my every trial and prepared a table for me to feast when things were going down. His anointing is over me and yes, my cup's running over, and there is abundance of blessing in Him.

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CHAPTER I

Introduction

Voice, is said to be a significant communication tool in humans and is of emotional, economic, and social importance. The voice unfolds the inner self of an individual and is a mirror image of the personality of oneself (Rosen & Sataloff, 1997). Any sort of disturbance, disruption, or damage to the voice can lead to many problems in an individual's daily living. And if one's livelihood depended on it, then damage to his or her voice would turn out to be expensive.

Sataloff (2001) defines professional voice users as "individuals who utilize their voice for occupational competence and for their livelihood". These include teachers, salesmen, singers, actors, clergy, politicians, broadcasters, orators and several other professionals. These groups of individuals have a higher risk for developing voice-related problems if appropriate vocal hygiene is not followed. Not only can there be voice related symptoms but there can additional problems like emotional strain and anxiety also be faced by these professionals. The severity of the problem depends on the nature of the profession, the ability to meet the professional demands and commitments.

Koufman and Isaacson (1991) put forth the classification of the professional voice users based on their vocal usage and risks involved into four categories. They are,

Level 1: The elite vocal performer is a person for whom even the slightest difference in voice can have grave consequences. This category includes vocalists and actors; the quintessential level 1 performers are the opera singers.

Level 2: Professional voice users is a person with moderate vocal variations who may be unable to execute their job efficiently. Most clergy, teachers, lecturers,

receptionists, and other professionals fall within this category.

Level 3: Non-vocal professional users are individuals whose occupational competence would be hampered by a serious vocal condition. Lawyers, physicians, businessmen and women, and others make up this group.

Level 4: The non-vocal nonprofessional is a person for whom vocal quality is not a requirement for adequate job performance. Clerks, labourers, and other workers fall within this category. Although these individuals may have major social consequences as a result of their vocal condition, they are not prohibited from performing in their jobs.

Speech-language pathology is a profession that places demand on the professional's voice and falls within Level 2 of the classification system mentioned above (Joseph et al., 2020; Moradi et al., 2021). Mozzanica et al. (2016) investigated the phonation time of 28 SLPs wearing an APM (ambulatory phonation monitor) throughout the work hours to be of 27.3%. This level of phonation time is comparable to the level of phonation time registered for teachers, who are commonly considered to be heavy voice users. SLPs practice in a variety of settings where vocal loading tasks come into the picture; the settings include diagnostic and treatment sessions, multidisciplinary team meetings and family and client education. Communication can sometimes take place in noisy environments, such as rehabilitation centres or classrooms, which puts additional strain on their voice. When working with patients who have voice problems, it's common to have to model vocal techniques in a concentrated period of time. Others who work with the hearing impaired may speak out loud in order to be heard (Searl & Dargin, 2021). Hyperfunction of the vocal folds also known as vocal loading, is very common among professional voice users, which

has a greater probability resulting in vocal fatigue. Vocal fatigue (VF) is said to be one among the first signs of vocal loading (Boominathan, 2008).

Even after years of research, defining vocal fatigue remains a challenge. “The 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,” according to Solomon (2008). Lifestyle changes and maintaining good vocal habits may assist to decrease fatigue and curb further advancement of difficulties in voice in many situations, if detected early on. If vocal fatigue persists, it implies hyperfunctioning of vocal folds, which can progress to organic voice disorders such as vocal polyps or vocal nodules. If intervention is provided at an advanced stage, the professional voice users may require voice therapy, vocal hygiene regimens, or possibly medical and surgical intervention (Solomon, 2008; Welham, 2003).

Vocal fatigue has always been challenging to identify and describe its characteristics. To describe self-reported symptoms of voice disorders, tools like Voice Handicap Index developed by Jacobson et al. (1997) and Voice Related Quality of Life (V-RQOL) given by Hogikyan and Sethuraman (1999) were utilised.

The Voice Handicap Index (VHI) (Jacobson et al., 1997) was designed and validated over three phases. In the first phase, an 85-item questionnaire with three dimensions (functional, emotional, and physical) was constructed based on prior interviews with patients with voice disorders and administered to a clinical group (65 patients). Following the administration, the number of questions was limited to 30 in this phase, with 10 items in each domain. In the second phase, the questionnaire's test-retest reliability was checked on 63 patients, and it was found to be strong in all three domains. In the last phase, the authors attempted to verify the correlation of VHI scores with self-rated voice disorder severity, and found a moderate correlation

between the two measures. As a result, the authors stated that VHI might be used to assess a population's self-perception of voice problems and its impact on daily life. VHI, on the other hand, does not evaluate vocal fatigue.

To address this issue, Nanjundeswaran et al. (2015) developed and validated the Vocal Fatigue Index (VFI), which could be used to detect VF and to document the symptoms. Nevertheless, VFI has not been tested explicitly on occupational voice users, the group of speakers whose vocal load puts them at high risk for vocal fatigue and other more severe problems, Hunter and Banks (2017) remarked. There are very limited evidences where-in VFI is used to assess vocal fatigue in SLPs. As SLPs are professional voice users and are at risk for vocal fatigue and voice related problems as much as the other occupational voice users, as a result, VFI can be considered a useful predictor for evaluating vocal fatigue among SLPs working in different set-ups.

1.1 Need for the study

Speech Language Pathologists have to indulge in regular voice use for professional requirement. Hence, they could be classified as Level 2: the professional voice users, Koufman and Isaacson (1991). Regular and extensive voice use often leads to fatigue of the biological mechanism involved in its production. There is limited research done on vocal fatigue in speech language pathologists, further limited research using Vocal Fatigue Index - version 2. Also, no studies have compared vocal fatigue in qualified speech language pathologists working in different setups. Therefore, it would be informative to investigate the vocal fatigue in speech language pathologists working in different setups. Hence, the present study was planned to explore the self-reported vocal symptoms among speech language pathologists using VFI-version 2. Here, an attempt was made to explore whether SLPs working in different set-ups across India report vocal fatigue and whether they being

professionals trained to treat voice problems, follow the proper use of vocal mechanism and practice vocal hygiene and to avoid risks of developing vocal problems.

1.2 Aim

To understand the voice changes due to voice overuse in Speech Language Pathologists working in different setups; hospitals, academic institutions and private clinics using the Vocal Fatigue Index (VFI)-Version 2.

1.3 Objectives

1. To investigate the presence of vocal fatigue, if any, in Speech Language Pathologists using VFI-version 2.
2. To compare the variations in vocal fatigue, if found, across gender and set-ups.

CHAPTER II

Review of Literature

2.1 Vocal fatigue

Vocal fatigue (VF) is a multidimensional clinical condition with several causes. There are several hypotheses about the underlying cause or mechanism, and a number of evidences in research have documented its manifestations. The question of whether vocal fatigue should be defined as a group of symptoms that a person experiences or as physiological changes that occur as a result of vocal loading has posed a significant challenge. Clinicians characterize VF as local exhaustion experienced by an individual and a weak voice due to voice use for a longer period of time, according to a published clinical consensus document (Verdolini, 2014). In general, clinicians have explained VF as follows; VF is a global syndrome characterized by a group of symptoms that follow a sequence, which occur during the speech event or even after, which includes an individual's perception of increased vocal effort, physical discomfort at the level of larynx, tension at the level of neck and shoulders, pain or discomfort at throat or neck, decreased pitch range, reduction in vocal flexibility, reduction in the projection of voice, diminished control over voice, loss of voice, and an increase in the symptoms throughout the speaking day, with symptoms typically improving with rest (Colton et al., 2006).

Vilkman (2004) defined VF as a self-perceived state characterized by negative sensations related to voicing. Accordingly, vocal fatigue was defined by McCabe and Titze (2002) as a "progressive increase in [presumably self-reported] phonatory effort accompanied by a progressive decrease in phonatory capabilities". Lastly, Solomon (2008) included the ideology of rest in the definition of VF, suggesting that vocal

fatigue can be characterized 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”.

Kostyk and Rochet (1998), condensing information contributed by Scherer et al. (1987) and enlisted 18 key symptoms of vocal fatigue. These primary symptoms are listed in table 1.

Table 1

Symptoms of vocal fatigue as reported by Kostyk and Rochet (1998).

Hoarse/husky vocal quality	Running out of breath while talking
Breathy vocal quality	Unsteady voice
Loss of voice	Tension in neck/shoulders
Pitch breaks	Throat/neck pain
Inability to maintain typical pitch	Throat fatigue
Reduced pitch range	Throat tightness/constriction
Lack of vocal carrying power	Pain on swallowing
Reduced loudness range	Increased need to cough/throat clear
Need to use greater vocal effort	Discomfort in chest, ears, or back of neck

2.2 Vocal fatigue in SLP's

Vocal loading, is common among professional voice users, and it usually results in vocal fatigue, this is one among the first indications of vocal loading. SLPs, like other Level II professional voice users such as lecturers and clergy, are at risk for vocal fatigue and voice disorders as a result of vocal loading. According to Gottliebson et al. (2007), 12% of the upcoming SLPs are at risk for developing voice related issues. If such a predisposing condition exists, other factors can be intensified, which can cause or prolong vocal fatigue throughout later years of a person's

professional life. Young SLPs who are just starting out in the field of rehabilitative services may only have theoretical understanding of vocal fatigue, which they may encounter in the course of their work. This may make it difficult to identify the causes of vocal fatigue, as well as the variables that contribute to its progression and its symptoms. They may also be unaware of how vocal fatigue can influence their job performance and what can happen if it is not treated.

In India, those SLPs that practice in various regions of the country tend to receive exposure to a wide variety of geographic, climatic, and lifestyle differences. SLPs work in primary health care centers in rural areas, where the work surroundings may be dusty, dry or humid. Whereas SLP's working in the urban areas, may work in clinical settings or institutions in the city, where the work environment may be humid, dry, noisy, or air-conditioned. The workload on an average handled by SLPs might differ greatly depending on whether they work in an urban or rural environment, as well as a variety of other variables. In these young SLPs, all of these characteristics may operate as risk, causal, or maintaining factors for vocal fatigue. The directions for appropriate voice use differ from one training institute to the next.

Gottliebson et al. (2007) found that out of 104 SLP students, 12% of them had vocal issues, which correlated with the prior findings on teachers (11%) and was higher than the control participants (3%-9%). According to a cross-sectional study reported by Lierde et al. (2010), Dutch female SLPs (197 participants in total, who were undergraduates or graduates), student SLPs (93%) reported to have pain or discomfort after voice usage (71% of them reported sore throat), and several of them had voice quality issues.

Rehabilitation therapists, particularly speech therapists, can be exposed to vocal abnormalities and complaints related to voice problems due to the treatment

procedures and long-term investment in persons with disabilities. As a result, voice problems in this group may raise concerns regarding their health and well-being, their occupational life, satisfaction with their job, and their personal lives. Some of the occupational characteristics that alter speech therapists' voices are as follows: Lengthy conversations to cater medical services to clients and counselling their communication partners, talking with clients with communication difficulties and attention deficits at a loud volume and without time for voice rest for voice recovery, greater caseloads, lengthy hours of work, round-the-clock duty, and exposure to infections that can lead to laryngeal disorders. According to Lierde et al. (2010), long-term vocal fatigue in rehabilitation therapists, particularly speech therapists, can result in voice disorders. Given the above mentioned, rehabilitation therapists recognize the need of determining the rate of vocal fatigue and, as a result, should be made aware about the concepts of vocal hygiene, voice care, and knowledge of potential impairments due to lack with voice care.

2.3 Vocal fatigue index (VFI)

Nanjundeswaran et al. (2015) developed and validated the Vocal Fatigue Index (VFI-2) in two phases, to help identify VF and document the symptoms associated with it. The authors agreed with the clinical viewpoint that VF is a collection of self-perceived symptoms. As a result, the necessity for a self-reporting tool arose. Initially, a beta version of VFI-1 with 21 questions was developed. Due to poor item-to-total correlation, two items from VFI-1 were later eliminated from the construct VFI-2, which now has 19 questions. The same questionnaire was given to the clinical population (105 participants) and the normal population (70 participants). The VFI-2 was characterized into three factors: (1) related to tiredness of voice and avoidance of voice use (11 questions), (2) related to physical discomfort of voice use

(5 questions), and (3) improvement of symptoms with rest (3 questions). VFI-2 responses are graded on a 5-point Likert scale, with 0-4 representing "never," "almost never," "sometimes," "almost always," and "always" respectively. The scale showed a sensitivity and specificity of 0.91, making it a useful tool for distinguishing between those with and without VF. The VFI-2 was validated and verified in dysphonic and healthy controls, with the findings indicating that VF is the underlying symptom for many voice issues. As a result, VFI-2 may be useful in identifying persons who have VF.

2.4 VFI-2 in different groups of professional voice users

VFI-2 has been documented in different groups of professional voice users, such as, teachers, actors, singers, etc. One such study was reported by Babu (2019), explored the vocal fatigue related symptoms among different levels of teachers using VFI-2. Out of the 100 teachers (20 participants from kindergarten, primary, secondary, higher secondary levels and physical education) it was found that the kindergarten teachers had the highest degree of vocal fatigue and was reasoned that kindergarten teachers tend to have more vocally demanding activities like singing rhymes, group play activities, etc., and hence, reported more vocal fatigue symptoms than the others.

Anuroopa (2020) studied the symptoms of vocal fatigue in 30 professional theatre artists using the VFI-2. She reported that female theatre artists had greater vocal fatigue than male theatre artists. She also stated that males reported better improvement in voice on rest than females. These findings were explained to be because of the fact that females use high pitch, use voice more extensively and also undergo higher mental stress during their performance compared to the males.

2.5 VFI in SLPs

Anand et al. (2021) aimed to investigate the vocal fatigue through subjective and objective measures in speech language pathology students after 30-minutes vocal loading task (VLT). Another objective was to assess the effects of psychosocial factors on vocal fatigue. SLP students (17 participants) performed the VLT using the LingWAVES software program. Vocal fatigue was calculated subjectively using rating scales which included the Vocal Fatigue Index and the Borg vocal effort scale and objectively using variations of relative sound pressure level, fundamental frequency, pitch strength, smoothed cepstral peak prominence (CPPS), and acoustic voice quality index before, during, and after VLT. The findings showed that vocal effort and fatigue increased significantly after the 30-minute VLT. Subjective VFI scores on factors 1 and 2 significantly increased post-VLT indicating that VLT did result in vocal fatigue. Acoustic measures of relative SPL and fundamental frequency increased systematically during the task and after the task was completed. All SLP students were moderately stressed and measures associated with pitch were highly related with perceived stress.

Moradi et al. (2021) in Iran, conducted a cross-sectional study that investigated vocal fatigue in rehabilitation therapists (inclusive of speech therapy, physiotherapy, audiology, and occupational therapy). They compared vocal fatigue using VFI-2 among speech therapists and other rehabilitation therapists. A comparison of the scores of the VFI-2 in the rehabilitation therapists revealed that there was a significant difference between the scores of speech therapists and other field therapist scores ($p < 0.05$). They highlighted that due to the nature of the fields and the usage of their voice during daily communications with a variety of clients, especially those with special disabilities, the probability of voice problems and

complaints in these professionals ought-to be considered. Henceforth, the necessary training for vocal hygiene and prevention of voice problems for these professionals ought-to be noted. A major step towards such an endeavour will be to identify the risks that may contribute to developing voice problems in SLPs and investigating the possibilities of vocal fatigue in them would prove beneficial in providing timely sensitization for preventing development of voice problems.

CHAPTER III

Method

3.1 Participants

A total of 82 SLPs (34 males, 48 females) were the participants in the study. The SLPs worked in any of the three set-ups: academic institutions (11 males and 11 females), hospitals (13 males and 15 females) and private clinical set-ups (10 males and 22 females). The participants considered were within the age range of 22-45 (Mean: 28.98 & SD: 4.29) years. Practicing SLPs in India were included in the study. Table 2 depicts the details of participants in different setups.

Table 2

Participants details based on gender and set-ups

Count		Set-up			Total
		Academic Institutions	Hospitals	Private Clinics	
Gender	Male	11	13	10	34
	Female	11	15	22	48
Total		22	28	32	82

3.1.1 Inclusion and Exclusion Criteria

All participants were professionals and had a minimum of 2 years of clinical experience. Participants who were > 45 years of age and had < 2 years of clinical experience were excluded from the study.

3.2 Test material

The tool used to investigate the VF symptoms was Vocal Fatigue Index - Version 2 (VFI-2) given by Nanjundeswaran et al. (2015), which consisted of a total

of 19 questions. The questions were categorized into 3 factors, with Factor 1 associated with tiredness of voice and avoidance of voice use, Factor 2 associated with physical discomfort of voice use, and Factor 3 associated with improvement in symptoms with rest. Each question was rated on a 5point Likert scale in which 0 - represented 'never', 1 - represented 'almost never', 2 - represented 'sometimes', 3 - represented 'almost always' and 4 - represented 'always.'

Factor 1 consisted of questions worded negatively so a higher score indicated vocal fatigue. Factor 2 consisted of questions also worded negatively related to the physical discomfort due to voice use so that a greater score indicated vocal fatigue. Factor 3 was associated with the improvement of vocal symptoms on rest, and consisted of questions which were worded positively, so a lesser score indicated vocal fatigue. Since each factor was conceptually different, a total score was not calculated. Instead, the total score for individual factors was calculated separately. Version 2 of the Vocal Fatigue Index was 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. In this study Factor 1 is represented as 'F', Factor 2 is represented as 'P' and Factor 3 is represented as 'R'. The table 3 given below shows the number of questions and cut-off scores for each factor.

Table 3

VFI-2 factors, number of questions, maximum scores and cut-off scores

Factors	Number of questions	Maximum scores	Cut-off score
F	11	44	≥ 24
P	5	20	≥ 7
R	3	12	≤ 7

3.3 Procedure

The current study adhered to the bio behavioural and ethical research guidelines of the institute. The questionnaire was distributed among the study population through an e-platform using Google forms after obtaining informed consent from the participants via the google forms. The questionnaire template included a short overview of the study specifying the aim and procedure of the study. The questionnaire was sent by e-mail and text messages to different SLPs.

Initial part of the google form consisted of the demographic details, including the subject's age, gender, total years of experience, total working hours per day, etc. This was followed by the Vocal Fatigue Index (version 2) questions and was mailed to SLPs across India. Subjects were instructed to mention their responses to indicate how frequently they experienced the symptoms related to vocal fatigue using the 5-point rating scale (0 – never, 1 - almost never, 2 – sometimes, 3 – almost always, and 4 – always).

A total of 82 responses obtained via google forms from the participants were scored for each factor separately and individual question scores as well as the total factor scores were tabulated.

3.4 Statistical analysis

The scores obtained were collected, compiled and subjected to descriptive and inferential statistics. Statistical Package for Social Sciences (SPSS) version 21.0 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 for overall results of vocal fatigue in SLPs and for both gender wise comparison and set-up wise comparison.

- Mann-Whitney U test was carried out to check the gender effects in SLPs within each set-up.
- Kruskal-Wallis test was carried out to check the significance between the different set-ups. Followed by, Mann-Whitney U test for Post Hoc analysis (pairwise comparison).
- Mann-Whitney U test was also carried out to draw comparison between SLPs working in one set-up versus multiple setups.
- Kruskal-Wallis test was also carried out to check the significance between different modes of therapy.
- Spearman's Correlation analysis was used to assess the relationship between the hours of voice usage and the factors of VFI-2.

CHAPTER IV

Results and Discussion

The present study aimed to explore the symptoms of vocal fatigue in SLPs working in three different set-ups using VFI-2. A total of 82 SLPs from different set-ups: academic institutions (11 males and 11 females), hospitals (13 males and 15 females) and private clinical set-ups (10 males and 22 females) formed the participants. The SPSS data sheet was prepared with the scores of Factor 1 (represented as 'F'), Factor 2 (represented as 'P'), and Factor 3 (represented as 'R') separately.

4.1 Results of Normality

The data were subjected to the Shapiro-Wilk normality test to check if the data deviated from the normality. The outcomes showed that the data did not follow the normal distribution ($p > 0.05$) for over-all results of the presence of vocal fatigue in SLPs. Similarly, for the gender wise comparison among SLPs within each set-up and for the setup wise comparison. Hence, for further statistical analysis, nonparametric tests were performed.

The results of the present study are discussed based on the objectives of the study for the presence of vocal fatigue in SLPs and also gender-wise and setup-wise comparison using VFI-2.

4.2 Overall result of the presence of vocal fatigue in SLP's using VFI-2

Table 4

Mean and Standard deviation of VFI-2 scores in males and females.

Factors totals	Males		Females		Cut-off score for VF
	Mean	SD	Mean	SD	
F Total	14.59	9.72	22.77	9.03	≥ 24
P Total	5.09	5.34	7.29	5.50	≥ 7
R Total	7.56	3.69	9.23	2.91	≤ 7

Descriptive statistics of factor wise VFI scores for all male and female SLPs are depicted in Table 4. From Table 4, it was observed that mean scores of Factor 1 (F Total) is 14.59 for males and 22.77 for females, which is lesser than the cut-off score (≥ 24); this reveals that all the participants as a whole deny the presence of tiredness in their voice and avoidance of voice use. The mean score for Factor 2 (P Total) is 5.09 for males, which is also lesser than the cut-off score (≥ 7); but the mean score for P Total for females is 7.29 which is greater than the cut-off score (≥ 7); which indicates that the male SLP's deny the presence of physical discomfort of voice use whereas females report the presence of physical discomfort of voice use. The mean scores of Factor 3 (R Total) is 7.56 for males and 9.23 for females which is also greater than the cut-off score (≤ 7) indicating improvement in the voice after rest.

From these results it can be understood that in female SLPs the F Total mean scores were closer to the cut-off and they also reported of the presence of physical discomfort and also improvement in their voice after rest. Hence, they could be considered as being at risk for developing vocal fatigue symptoms provided appropriate time periods of rest not taken. Whereas the male SLPs did not report the presence of vocal fatigue symptoms and hence are comparatively at less risk for

developing vocal fatigue symptoms than females.

In a study reported by Anand et al. (2021), a comparison of VFI scores pre and post vocal loading tasks in 17 female SLP students was done as a part of their subjective measures along with the objective measures. The mean scores of Factor 1 and 2 both pre and post vocal loading tasks didn't meet the cut-off scores indicating that none of the 17 SLP students reported the presence of tiredness of voice and avoidance of voice use or physical discomfort of voice use. For Factor 3 both pre and post vocal loading tasks met the cut-off score indicating no improvement in voice on rest. These results contradicted the findings of the present study.

In another study by Moradi et al. (2021), a comparison of VFI-2 scores among different rehabilitation therapists (25 SLPs, 25 occupational therapists, 25 audiologists and 25 physiotherapists) revealed that the SLPs had mean scores less than the cut-off for Factor 1 and Factor 2, indicating no report of the presence of tiredness of voice and avoidance of voice use or physical discomfort of voice use. Factor 3 met the cut-off score showing no improvement in voice on rest and was again contradictive to the findings of the present study.

4.3 Gender-wise and setup-wise comparison using VFI-2

4.3.1 Comparison of gender difference within each set-up using VFI-2

Table 5

Mean and Standard deviation of VFI-2 scores for males and females setup-wise.

Factors	Academic institutions				Hospitals				Private clinics			
	Males		Females		Males		Females		Males		Females	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
F Total	9.55	5.84	20.36	8.82	18.08	8.66	22.53	10.62	15.60	12.59	24.13	8.07
P Total	2.64	3.88	6.81	5.19	7.31	4.91	6.07	4.96	4.90	6.42	8.36	6.01
R Total	6.73	4.15	7.23	2.10	8.38	2.96	9.07	3.10	7.40	4.14	10.09	2.91

Descriptive statistics of factor wise VFI-2 scores for male and female SLPs within each setup are depicted in Table 5. Here, it was observed that mean scores for Factor 1 (F Total) in males and females across all setups was lower than the cut-off score (≥ 24), except for females working in private clinics (Mean = 24.13). The mean score for Factor 2 (P Total) in males and females across all set-ups is lower than the cut-off score (≥ 7), except for males working in hospital setups (Mean = 7.31) and females working in private clinics (Mean = 8.36). The mean scores for Factor 3 (R Total) in males and females across all set-ups is higher than the cut-off score (≤ 7), except males and females working in academic institutions (Males: Mean = 6.73; Females; Mean = 7.23) and males working in private clinics (Mean = 7.40).

Based on these descriptive statistics, it is made known that females working in private clinics reported the presence of tiredness of voice and avoidance of voice use and also, males working in hospital setups and females working in private clinics

reported the presence of physical discomfort of voice use. However, SLPs working in academic institutions (both males and females) and males working in private clinics reported no improvement in voice on rest.

Following this, Mann – Whitney test was carried out to check the gender differences within each set-up. The results revealed a significant difference in F Total and P Total in academic setup (F Total: $|z| = 2.734$ at $p < 0.05$; P Total: $|z| = 2.451$ at $p < 0.05$), and also a significant difference in F Total in private clinic setup (F Total: $|z| = 2.180$ at $p < 0.05$). The remaining groups did not have a significant difference across the values.

These results demonstrate that there is a significant difference between males and females in the way they experience vocal fatigue like symptoms in academic institutions. Females in academic institutions reported to have greater vocal fatigue symptoms (i.e., tiredness of voice and avoidance of voice use and physical discomfort in the voice) than their males counterparts.

There was significant difference between males and females in the way they experience vocal fatigue symptoms in private clinics. Females in private clinics reported to have greater vocal fatigue symptoms (i.e., tiredness of voice and avoidance of voice use) than the males in private clinics. Considering these results, it is seen that female SLPs tend to report greater vocal fatigue symptoms (tiredness of voice and avoidance of voice use and physical discomfort of voice use) than male SLPs. Bottalico et al. (2016) also reported similar findings in which female subjects rated vocal effort to be significantly higher than males; these increased scores in females indicate presence of tiredness in voice and avoidance of voice use and could be possible that females are more sensitive to changes in their own vocal intensity than males. Similar findings were reported by Hunter and Banks (2017) in teachers

who were 3 times as likely to report vocal tiredness or vocal avoidance and over 3 times as likely to report physical voice discomfort compared to vocally healthy adults. Additionally, female teachers were more likely to have scores approaching those with dysphonia, as female teachers reported greater vocal fatigue symptoms than male teachers and that their scores were closer to that of the dysphonic individuals. Babu (2019) also reported that female teachers showed greater vocal fatigue symptoms across all the 3 factors of VFI-2 than male teachers. Hunter and Banks (2017) justified that the increased scores for physical discomfort of voice use could be due to increased pain sensitivity for females compared to males.

4.3.2 Comparison of different set-ups within males and within females using VFI-2.

Based on the descriptive statistics of factor wise VFI-2 scores for SLPs across different setups as depicted in Table 5, further statistical analysis was carried out.

To determine the data's significance level, Kruskal Wallis statistical test was administered. The results revealed a significant difference in the R Total for females ($\chi^2(2)=7.665$, $p<0.05$). Therefore, a follow-up analysis was done using the Mann-Whitney U test. There was no significant difference statistically across setups for males using VFI-2.

In the pair-wise comparison, R Total in females across different setups, one group academic institution and private clinic setup ($|z|= 2.490$ at $p<0.05$) showed significant differences. The remaining groups did not have a significant difference across the values.

This result reveals that there is no much variation in the voice usage across different set-ups in males. Whereas in females they reported that the improvement in voice on rest varied across different setups. On further probing, the post hoc analysis revealed that the female SLPs across academic institutions and private clinics was the

group that contributed to the difference in the improvement in voice on rest. Based on the mean scores in Table 5, the female SLPs in private clinics (Mean score: 10.09) show improvement in voice on rest; whereas female SLPs in academic institutions (Mean score: 7.23) showed no improvement in voice on rest, hence they are at more risk compared to the other female SLPs as they can develop vocal fatigue symptoms over prolonged usage of voice which can lead to vocal fatigue and further lead to other voice problems. A probable explanation could be the fact that in academic institutions, additional responsibilities are on the SLPs, such as, guided academic, clinical supervision, research guidance, interaction with patients and administrative responsibilities, all of which involve continuous voice use and consequent vocal load.

4.4 Other findings

4.4.1 Comparison between SLP's working in one set-up versus multiple set-ups

Out of the 82 participants, only 21 SLPs reported to be working in multiple set-ups. To check for the influence of working in multiple set-ups on vocal fatigue using VFI-2, Mann-Whitney U test was administered. The results revealed no significant difference (F Total: $|z| = 0.393$ at $p = 0.694$; P Total: $|z| = 0.000$ at $p = 1.000$; R Total: $|z| = 1.720$ at $p = 0.085$) between SLPs working in one set-up and SLP's working in multiple set-ups using VFI-2. When the mean scores of factors 1 and 2 were compared, the SLPs working in multiple setups (F Total: Mean score = 19.62; P Total: Mean score = 6.76) had almost similar mean scores as that of SLPs working in a single setup (F Total: Mean score = 19.29; P Total: Mean score = 6.24) indicating no much difference in the way they experienced tiredness of voice and avoidance of voice use and physical discomfort in voice. For the third factor, when the mean scores were compared, the SLPs working in multiple setups (R Total: Mean score = 7.24) scored slightly lower than the SLPs working in a single setup (R Total:

Mean score = 8.98) indicating individuals working in a single setup reported better improvement in voice on rest. In other words, SLPs working in multiple setups showed poor improvement in voice on rest as the mean score for the third factor meets the cut-off score and this could be attributed to reason that SLPs working in multiple setups have increased work load, so their hours of voice usage is greater and hence hours for voice rest is reduced affecting vocal recovery.

4.4.2 Comparison of the type of mode used during therapy

Out of the 82 participants, 7 SLPs used online mode for therapy, 36 SLPs used offline mode for therapy and 39 SLPs used both the modes for therapy. To check for the influence of the type of mode used during therapy on vocal fatigue using VFI-2, Kruskal-Wallis test was carried out. The results revealed no significant difference (F Total: $\chi^2(2) = 0.853$, $p = 0.653$; P Total: $\chi^2(2) = 1.326$, $p = 0.515$; R Total: $\chi^2(2) = 2.054$, $p = 0.358$;) among the different modes of therapy using VFI-2. When the mean scores were compared, offline mode of therapy showed greater mean scores (F Total: Mean scores = 19.92; P Total: Mean scores = 7.11; R Total: Mean scores = 9.06) than online mode of therapy (F Total: Mean scores = 16.71; P Total: Mean scores = 6.29; R Total: Mean scores = 7.86) and dual mode (i.e., both offline and online mode; F Total: Mean scores = 19.35; P Total: Mean scores = 5.72; R Total: Mean scores = 8.18); this indicates that SLPs using offline mode of therapy reported greater vocal fatigue like symptoms (factors 1 and 2) and also better improvement in voice on rest (factor 3) when compared to the other modes of therapy. The reason could probably be that SLPs working mainly in offline mode have to adjust to their environment, elaborate on the techniques, activities and carry out extensive counselling and hence exert greater vocal effort than SLPs using other modes of therapy.

4.4.3 Correlation between the hours of voice usage and the factors of VFI-2

Table 6

Correlation between hours of voice use and the scores of factors of VFI-2.

	Spearman's rho correlation coefficient 'r'	Sig. (2-tailed) 'p'
Hours Vs F Total	0.354**	0.001
Hours Vs P Total	0.289**	0.008
Hours Vs R Total	0.271*	0.014

Note. **. Correlation is significant at the 0.01 level (2-tailed)

*. Correlation is significant at the 0.05 level (2-tailed)

Spearman's rho correlation was carried out to determine the relationship between hours of voice use and the factors of VFI-2. Table 6 represents the results of correlational analysis done using Spearman's rho correlation test. The results represented that the correlation was found between hours of voice and the three factors of VFI-2 (Hours Vs F Total: $r = 0.354^{**}$, $p < 0.01$; Hours Vs P Total: $r = 0.289^{**}$, $p < 0.01$; Hours Vs R Total: $r = 0.271^{*}$, $p < 0.05$) suggesting increased voice use hours increased the chances of vocal fatigue symptoms (mainly tiredness of voice and avoidance of voice use and physical discomfort of voice use). The third factor (improvement in voice on rest) showed a positive correlation with hours of voice use. This could be attributed to the fact that since SLPs are not meeting the cut-off scores for the factors 1 and 2, i.e., no obvious recognizable vocal fatigue symptoms and/ they may not notice the presence of vocal fatigue symptoms and hence, could not possibly appreciate the improvement in voice with vocal rest. In other words, individuals with vocal fatigue symptoms could be better able to appreciate the changes in their voice on rest.

4.5 Summary of Results

- Descriptive statistics for all the 3 factors for males and females across all setups was carried out. The females participants had scores closer to the cut-offs than males for factors 1 and 2 and were at risk for developing vocal fatigue like symptoms than males.
- Gender-wise comparisons were made using Mann-Whitney U test and it revealed that there was a significant difference in factors 1 and 2 between male and female SLPs working in academic institutions; and significant difference in factor 1 between SLPs working in private clinics. The mean scores were compared based on these results and it was found that female SLPs reported more vocal fatigue like symptoms than male SLPs.
- Kruskal-Wallis test was administered to carry out setup-wise comparison and the factor 3 showed statistical significance in females, further post hoc analysis was carried out and the pair-wise comparison showed that one group i.e., academic institutions and private clinics were statistically significant. This indicated that female SLPs working in academic setups were at a greater risk for vocal fatigue compared to other female SLPs.
- No statistical significance was found on comparing SLPs working in a single setup versus SLPs working in multiple setups.
- No statistical significance was found in the comparison of SLPs providing therapy using different modes.

CHAPTER V

Summary and Conclusion

The present study aimed at exploring the symptoms of vocal fatigue using the Vocal Fatigue Index- version 2 in working SLPs across different setups. A total of 82 SLPs were categorized based on the set-up they were working in as: academic institutions (11 males and 11 females), hospitals (13 males and 15 females) and private clinical set-ups (10 males and 22 females).

Vocal Fatigue Index-2 was administered to all the participants who rated their symptoms of vocal fatigue as indicated in the VFI-2 protocol. Later the scores of each factor were compiled separately and subjected to statistical analysis using SPSS software. The results revealed that,

- Descriptive statistics showed that females had scores closer to the cut-offs than males for factors 1 and 2 and were at risk for developing vocal fatigue like symptoms than males.
- Mann-Whitney U test for gender wise comparison revealed that there was a significant difference in factors 1 and 2 between male and female SLPs working in academic institutions; and significant difference in factor 1 between SLPs working in private clinics. Further comparison revealed that the female SLPs reported more vocal fatigue symptoms than male SLPs.
- Kruskal-Wallis test for setups wise comparison showed statistical significance in females and further post hoc analysis and the pair-wise comparison showed that one group i.e., academic institutions and private clinics were statistically significant. This indicated that female SLPs working in academic setups were at a greater risk for vocal fatigue compared to female SLPs on other setups.

- No statistical significance was found for SLPs working in a single setup and multiple setups.
- No statistical significance was found in SLPs using different modalities (offline vs. online) for providing therapy.

Though the SLPs reported symptoms related to vocal fatigue, it was not significant enough across all setups. These findings could be due to the nature of work at the setup, varied vocal demands, effective self-implementation of the vocal techniques, regular practice of vocal hygiene habits, and also adequate rest for vocal recovery. However, there was significant relationship between hours of voice use and vocal fatigue. The present study is a preliminary attempt in understanding vocal fatigue in SLPs. Future studies could aim at understanding vocal fatigue in relation to the nature of the work, vocal training, hygiene and recovery.

5.1 Implications

1. The study results give us insight into voice changes due to vocal demands and voice overuse in speech language pathologists and the risks involved.
2. The present study helps design preventive strategies for speech language pathologists with or without vocal fatigue symptoms in a holistic manner.
3. It also throws light upon the importance of vocal naps/ voice rest for recovery of voice in professional voice users.

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