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Research Article

The Study of Vocal Fatigue Symptoms in Speech Therapy Students by Focusing on In-Turned and Ex-Turned Students

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ABSTRACT

Introduction: The voice is a professional tool for speech-language pathologists (SLPs). Due to the daily professional use of voice, SLPs, especially novices in this profession are exposed to voice injuries and disorders. Identifying high-risk vocal behaviors in this group can prevent the spread of more serious laryngeal injuries. This study aimed to investigate voice fatigue symptoms in speech therapy students.

Materials and Methods: In this study, 129 speech therapy students were divided into two main groups of in-turns and ex-turns. In three sections of the semester (beginning, middle, and end), the vocal fatigue index (VFI) questionnaire and two auditory-perceptual voice scales were completed for both groups. The within-between comparisons were made by considering other side factors, such as gender and students' professional knowledge status in SPSS software v. 19.0.

Results: In the in-turns group, the mean score of VFI at the middle (P=0.025) and the end (P=0.010) of the semester were significantly higher than at the beginning of the semester. Also, the mean score VFI of the in-turns at the middle and end of the semester were higher than of the ex-turned speech therapy students (P=0.011). The effects of students' gender and their knowledge status on the findings were not statistically significant (P>0.05).

Conclusion: This study showed that new vocal-speech behaviors related to clinical activities in the clinic environment of speech therapy can increase laryngeal tensions and vocal fatigue in in-turned speech therapy students.

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1. Introduction

Having a natural voice as a crucial component of speech is essential for verbal communication. If the voice is heard abnormally, it can distract the listeners from the main content of the message [1]. The production of a natural voice in the larynx is without consuming much energy so that the person does not feel it [2]. Vocal fatigue is a voice compliant, which is usually the result of bad behavioral habits and vocal misuse of the respiratory-phonatory system [3]. Symptoms of vocal fatigue can be caused by incorrect vocal behaviors such as shouting, talking loudly, or being talkative. Clinical reports indicate that the laryngeal muscles are over-stressed in people with vocal fatigue [4]. Because the voice fatigue symptoms are assessed based on patient self-report, they are ignored by most physicians interested in objective information and clinical examinations [5]. However, in the field of speech therapy, all aspects of voice disorders are considered to achieve successful treatments. Therefore, the assessment and diagnosis of voice fatigue (as Subjective information about voice problems) is essential to include in the treatment process of voice disorder.

The voice is a vital indicator in some jobs. Professional voice users, such as teachers, lawyers, and music singers need a high-quality voice for their livelihood. It means that a healthy voice has a crucial socio-economic aspect in this category of jobs [6, 7]. Speech therapists are one of the vital groups of professional voice users who use their voice as the main tool of their profession. Daily use of voice professionally, the need to change the voice in the face of speech therapy clients (especially for children), and the implementation of voice-based speech therapy methods by the therapist for clients are the factors that can cause fatigue and voice discomfort, and even more advanced voice disorders in speech therapists. Unfamiliarity with voice-based speech therapy methods, the existence of wrong vocal habits, and the lack of full awareness of voice health make speech therapy students (especially interns in the clinical field) more exposed to voice disorders. Most studies related to voice fatigue have been conducted in the community of teachers. According to evidence, the prevalence of voice fatigue in this group of professional voice users is very high [8-10]. It can be said, if vocal fatigue is diagnosed early in professional voice users, a more serious voice disorder can be prevented [4].

Given the importance of preventing voice problems and their impact on the future professional life of speech therapy students, their familiarity with high-risk voice behaviors should be planned. Hence, in the first step, the current situation among these students should be investigated. Based on a library search, no credible scientific evidence was found about this issue. Therefore, in this study, we tried to determine and compare the vocal fatigue index (VFI) between in-turned and ex-turned speech therapy students of Ahvaz Jundishapur University of Medical Sciences (AJUMS) and Hamadan University of Medical Sciences, and also we considered the possible effect of some factors, such as gender and level of specialized knowledge of speech therapy students on the severity of their voice fatigue.

2. Materials and Methods

Study participants

This study was conducted with a case-control design, on 129 incoming speech therapy students from 2017 to 2020 at Ahvaz Jundishapur University of Medical Sciences (AJUMS) and Hamadan University of Medical Sciences. The students who were in-turned (students who had the clinical internship units or were undergoing in the field) were enrolled in the case group and those who were ex-turned (students who did not pass the internship units in the field) were enrolled in the control group. Inclusion criteria included being a student of speech therapy, not having laryngeal diseases or diseases affecting the respiratory-laryngeal system based on self-reported form (designed checklist) and also two therapist-based perceptual scales, no history of voice-respiratory disorders based on self-reported form, and having no voice compliant at the beginning of the study. Also, the exclusion criteria included heavy smokers (those who smoke greater than or equal to 25 or more cigarettes a day) [11], catching a cold within two weeks before completing the questionnaires in each of the assessment periods, not completing the internship or eliminating the semester, reluctance to complete the questionnaires. In this study, a written consent form was obtained from all participants. This study was approved by the Ethics Committee of Ahvaz Jundishapur University of Medical Sciences (AJUMS) (Code of Ethics: IR.AJUMS.REC.1399.855).

Questionnaires and tools

VFI was used to assess the number of possible voice disorders [5]. The VFI includes 3 domains and 19 statements which are completed as a self-response and help to diagnose voice discomfort and fatigue. Its items include

the area of fatigue voice (11 items), the area of feeling physical discomfort in the larynx (5 items), and the area of improving acoustic symptoms due to rest (3 items). The examinees should rate each domain statement on a Likert scale from 0 to 4. That means according to a 5-point scale (0=never, 1=almost never, 2=sometimes, 3=almost always, 4=always), the examinee quantifies his/her vocal fatigue. Validity for the domains of the VFI questionnaire (Cronbach's alpha≥0.83), and also reliability for those (0.75< r (test-retest) <0.89) have been confirmed in the Persian population [12]. Based on the Persian version of the VFI, obtaining a score of 24.48±10.18 in the area of fatigue voice, a score of 8.53±4.85 in the area of feeling physical discomfort in the larynx, or a score of 7.59±3.08 in the area of improving acoustic symptoms due to rest can indicate the presence of voice disorders and voice fatigue [12].

In addition to the VFI questionnaire, two scales, the consensus auditory-perceptual evaluation of voice (CAPE-V) and grade, roughness, breathiness, asthenia, and strain (GRBAS) scales were used to assess the voice quality of the students. Both CAPE-V and GRBAS scales are auditory-perceptually clinician-based tools to identify the various aspects of voice disorder. In these scales, expert voice-raters listen to speech samples and determine whether a voice disorder is present. The Persian version of CAPE-V with an agreement coefficient above 92% and internal consistency of 0.95 evaluates the six indicators of voice problems, including the overall severity, roughness, breathiness, strain, pitch, and loudness [13]. The Persian version of this scale was used to assess the students' voices [13]. The evaluator uses a 100 mm line-segment and puts a mark on the line segment appropriate to the severity of the voice disorder from left to right. By longitudinal measuring from left to right, the farther away the rater's mark is from the left of the line segment, the greater the severity of the voice problem. According to this scale, zero indicates normal phonation, length 1-9 mm indicates mild voice disturbance, length 10-59 mm indicates moderate voice problem, and length 60-100 mm indicates severe voice disorder [14]. The GRBAS has a 0 to 3 Likert scoring system. The patient's perception is rated on a four-point scale, including 1=without disorder, 2=mild disorder, 3=moderate disorder and 4=severe disorder.

It is a valid and reliable tool used by expert clinicians to rate the voice quality of patients who complain of dysphonia. Using the GRBAS scale, the rater examines each voice quality (based on the roughness and breathiness parameters) after listening to the patient's voice samples. Evaluator by listening to a person's speech samples, rates his/her vocal health or the severity of dysphonia. This tool also has high clinical acceptability. A score of zero means healthy voice, and a score of 1 to 3 means mild, moderate, and severe voice disorder, respectively [14, 15].

Study design and data gathering

At the beginning of the semester, a personal information questionnaire to collect and record demographic information of participants, including gender, age, educational status, number of internship hours, type of clinical setting, as well as students' self-report checklist about general health and speech-voice status was provided to them. Then, in quiet conditions and individual sessions, a VFI questionnaire was given to each student. It was explained that by carefully reading the statements, they would rate it about themselves. If necessary, additional explanations and clarifications about the content of the questions were provided to the students. After the first stage, we informed the students that the VFI questionnaire and other scales will be taken again in the middle and the end of the semester. Participants were assured that their information would be recorded anonymously and confidentially.

After completing the VFI questionnaire, speech sampling was performed for auditory-perceptual analysis on CAPE-V and GRBAS scales. To perform the Persian version of the CAPE-V scale, the standard instructions of this scale, fixed vowels /a/ and /i/, reading six short sentences, and also 30 s of continuous speech were used [13]. To perform the GRBAS scale, participants were also asked to produce two vowels /a/ and /i/ into a /hVd/ phonetic context, and also read ten sentences [14]. Similar to the VFI questionnaire, speech samples were collected for the CAPE-V and GRBAS scales at the beginning, middle, and end of the semester. All tasks were recorded for each participant in an isolated soundproof room, using a Boya BY-M1 omni-directional lavalier condenser microphone. The participants' voice samples were directly transmitted to a laptop (DELL Model, n Series; INSPIRON1300, China) via the microphone and stored in its voice recorder software. All protocols were orally explained to the participants. The microphone was positioned approximately 15 cm away from the subject's mouth. The recorded speech samples were given to an experienced assessor (assistant professor with more than 12 years of experience in the field of assessment and treatment of voice disorders) to be scored based on the scales. The evaluator was entirely unfamiliar with the participants' information and the specific objectives of the research project. He listened to

the voices of the participants via headphones and scored the voices of each of them based on the instruments.

Statistical analysis

In this study, after examining the normal distribution of data by the Shapiro-Wilk test, the repeated measures analysis of variance (ANOVA) with followed Bonferroni post hoc test was used to compare between-within groups. The level of statistical significance was set at $P \leq 0.05$. Analyses were performed using SPSS software, v. 19 (SPSS Inc., Chicago, IL, USA).

3. Results

Table 1 presents the characteristics and demographic characteristics of the participants. A total of 129 speech therapy students (34 men and 95 women) participated in this study. Of these, 63 students were in-turned or case group, and 66 students were ex-turned or control group. The level of specialized knowledge of speech therapy students with factors affecting the incidence of voice disorders was also reported in Table 1 as students' knowledge status. Passing courses related to laryngeal diseases and voice disorders were considered to the students' knowledge status. Accordingly, 96 students completed specialized courses related to laryngeal diseases and voice disorders, and 33 students did not complete any courses in these disorders. Finally, the mean scores of auditory-perceptual scales were considered as inclusion criteria for the absence of obvious vocal disorders in the participants at the beginning of the semester (Table 1).

According to Table 2, a significant difference is observed in mean values of "voice fatigue" between the in-turned and ex-turned students in the middle and end of the semester compared to the beginning of the semester ($P=0.011$). In the group of in-turned students, the Bonferroni post hoc test showed that the average score of "voice fatigue" in the middle ($P=0.025$) and end ($P=0.010$) of the semester were significantly higher than at the beginning of the semester. In these two time sections, the mean values of "voice fatigue" between the two groups of students were also significantly different ($P=0.001$). No significant differences were observed in other areas and comparisons ($P>0.05$).

Then, a between-within group two-way repeated measures factor analysis test was conducted to determine the possible effects of gender and students' knowledge status on the VFI outcomes. It means that a multi-factor analytic model, (2 genders of male vs. female)×(2 students' knowledge status, such as specialized units passed vs. not passed) was used to establish differences between the variables. The results showed that none of the factors caused a significant difference in the mean scores of the domains of the VFI between the in-turned and ex-turned students ($P>0.05$). Meanwhile, to determine the quality of effects of the factors on the results of students' VFI scores, we examined the relationship between the scores of the subjective test (self-report tests) and the scores of the objective test (rater-assessor). Since a statistically significant difference was observed only in the voice fatigue domain of VFI between in-turned and ex-turned students at three sections of the semester, therefore the relationship between this domain of the VFI and the scores of two auditory-perceptual scales of voice assessment (CAPE-V and GRBAS) was calculated. As shown in Table 3, a significant positive direct correlation is observed between all the values of the two auditory-perceptual scales and the participants' VFI score ($P<0.05$).

4. Discussion

This study aimed to compare the level of voice fatigue symptoms between in-turned and ex-turned speech therapy students during a semester. This study was the first study to investigate the problems of fatigue caused by voice among Iranian speech therapy students. However, studies have been previously conducted on voice fatigue in some professions, such as teachers, actors, or singers [16, 17]. The findings of Laukkanen et al. suggested that among teachers, after a vocally high-loading work-day with students, their laryngeal muscle activity increases and causes vocal fatigue [16]. Kitch and Oates also asked 20 professional actors and singers to complete the VFI questionnaire. They found that nearly 40% of this group reported some degree of voice fatigue, and vocal abuse/misuse was the main cause of these disorders [17]. As mentioned, the field of speech therapy is one of the professions whose users should use their voice as the main professional tool. Therefore, this population is exposed to laryngeal and vocal injuries like other similar professions, such as teachers [6, 7]. One of the most common causes of functional voice disorders is performing abnormal vocal behaviors that are inconsistent with the larynx's physiological function, such as imitating the voice of others, shouting, or talking louder than usual (so-called vocal misuse) [18] or seemingly natural but erroneous use of the range of ability of the vocal folds and larynx (so-called vocal abuse), such as excessive talking, throat clearing, coughing [18].

Table 1. Demographic characteristics of the participants

Variables	Groups	Mean±SD/No. (%)
Age (y)	In-turned	21.6±1.1
	Ex-turned	20.1±0.8
Gender	Male	34(26.4)
	Female	95(73.6)
Educational status	In-turned	63(48.8)
	Ex-turned	66(51.2)
Knowledge status	Passing specialized units	96(74.4)
	Do not pass specialized units	33(25.6)
Initial score of the CAPE-V	Total students	0.4±0.1
Initial score of the GRBAS Mode (min-max)	Total students	1(0–1)

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CAPE-V: Consensus Auditory-Perceptual Evaluation of Voice; GRBAS: Grade: Roughness: Breathiness: Asthenia: Strain

Table 2. Voice fatigue index values among the participants in semester sections

The VFI Domains	Time of Testing	Mean±SD		Test result**
		In-turned Students	Ex-turned Students	
Voice fatigue	Beginning the semester	4.70±2.4	4.86±2.5	t=0.230, P=0.818
	Middle of the semester	8.95±4.2	5.03±2.3	t=4.112, P=0.001
	Ending the semester	9.62±4.1	5.16±1.9	t=5.111, P=0.001
Test result*	-	$F_{(2,124)}$=5.28, P=0.011		-
Physical discomfort	Beginning the semester	1.96±1.2	1.81±1.1	t=0.441, P=0.880
	Middle of the semester	2.33±1.4	1.15±0.9	t=0.912, P=0.556
	Ending the semester	2.01±1.5	1.55±0.9	t=0.900, P=0.505
Test result*	-	$F_{(2,124)}$= 0.22, P=0.621		-
Improvement of symptoms	Beginning the semester	3.72±2.1	2.32±2.1	t=0.123, P=0.901
	Middle of the semester	4.16±2.2	3.06±1.3	t=0.393, P=0.716
	Ending the semester	4.80±2.3	4.11±1.5	t=0.135, P=0.822
Test result*	-	$F_{(2,124)}$= 0.14, P=0.713		-

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VFI: Voice Fatigue Index; CAPE-V: Consensus Auditory-Perceptual Evaluation of Voice; GRBAS: Grade, Roughness, Breathiness, Asthenia, Strain.

* Between-within repeated measure factors test; ** Independent sample t-test.

Table 3. Correlation between VFI value and the perceptual scales

Variables		CAPE-V			GRBAS		
		Beginning the Semester	Middle of the Semester	Ending the Semester	Beginning the Semester	Middle of the Semester	Ending the Semester
VFI	Beginning the semester	r=0.98 P=0.001	r=0.89 P=0.001	r=0.88 P=0.001	r=0.98 P=0.001	r=0.90 P=0.001	r=0.95 P=0.001
	Middle of the semester	r=0.98 P=0.001	r=0.77 P=0.011	r=0.71 P=0.011	r=0.90 P=0.001	r=0.93 P=0.001	r=0.93 P=0.001
	Ending the semester	r=0.99 P=0.001	r=0.70 P=0.011	r=0.97 P=0.001	r=0.95 P=0.001	r=0.93 P=0.001	r=0.96 P=0.001
CAPE-V	Beginning the semester	-	-	-	r=0.95 P=0.001	r=0.95 P=0.001	r=0.95 P=0.001
	Middle of the semester	-	-	-	r=0.98 P=0.001	r=0.94 P=0.001	r=0.94 P=0.001
	Ending the semester	-	-	-	r=0.90 P=0.001	r=0.94 P=0.001	r=0.95 P=0.001

JMR

VFI: Voice Fatigue Index; CAPE-V: Consensus Auditory-Perceptual Evaluation of Voice; GRBAS: Grade, Roughness, Breathiness, Asthenia, Strain.

The findings showed that the rate of voice fatigue complaints of in-turned students increased in the middle and end of the semester compared to the beginning of the semester (Table 2). However, these differences were not seen in the area of the laryngeal physical discomfort of the VFI. This means that the participants had no changed structure of vocal folds and they also reported no altered musculo-skeletal behaviors in their throat or larynx. These findings were also confirmed in the therapist-rater scales. In a study by Moradi et al. , they found that speech therapists were more prone to laryngeal vocal problems than other rehabilitation therapists because speech therapists need to use their phonatory system more during the day [19]. Also, Joseph et al. reported that more than 71% of their studied young speech therapists had vocal fatigue complaints. They attributed some factors, such as excessive use of voice, voice use for recreational purposes, speaking loudly, and working in noisy environments to fatigue in the phonatory system [20].

As can be seen in Table 3, significant correlation was directly observed between the results of the VFI and the results of the therapist-rater scales (CAPE-V, and GRBAS), especially in the "voice fatigue" part of VFI. This section is one of the main domains of the VFI, which indicates voice fatigue due to functional pressure [5, 12]. It should also be noted that although the mean VFI voice score of in-turned students in the middle and end of the semester increased significantly compared to the beginning of the semester, it did not exceed the normal range (5.21±2.80 in the voice fatigue domain, 2.05±1.07 in physical discomfort domain, and 4.26±2.32 in improvement of symptom domain) [12] and did not enter the range of pathological disorders of the voice. Most abnormally vocal behaviors of in-turned-speech therapy students are a vocal abuse/misuse type (such as speaking loudly in the clinic with deaf clients, performing high-pressure voice techniques, high-pressure oral production methods in cleft palate speech disorders, improperly imitating puppets' voices in the form of role-playing or language therapy for young children) during the course. Based on clinical evidence, if such vocally irritating behaviors are used for a long time so that these behaviors become a part of a person's speech habits, they can cause physical damage to the larynx to such an extent that it causes tissue changes in the vocal folds, such as nodules, polyps or cysts [3, 21, 22].

In this study, we made some comparisons based on various groupings to measure the effect of different factors on the main results. We analyzed the gender and knowledge status of speech therapy students as two possible influencing factors. However, the results showed that these two factors did not have significant effects on changing the outcomes. The gender finding is consistent with other studies, such as Naderifar et al. [12], Ahlander et al. [23], and Preciado-López et al. [24]. In their study, they found no differences in the scores of male and female teachers' voice fatigue or those with voice disorders caused by benign laryngeal lesions who assessed by the VFI. Regarding the students' knowledge status (passing or not passing specialized courses related to voice disorders), because we did not have a similar study, this result is reported as a new finding. Banks et al. stated that various factors can affect increasing the voice fatigue of professional voice users that should be identified in future studies [25]. Although the clinical behaviors and

the expected functions of speech therapy students were the same in the clinic environment and in dealing with clients, and all students had their initial clinical experiences, the students' little experience in observing voice hygiene in the clinic environment made them unable to do their theoretical information correctly and completely. Therefore, the factor of students' knowledge status did not affect the final results of the VFI.

Study recommendations

We encountered some limitations in conducting this study. The sample size of the study was small. Due to the diversity of clinical centers, the students' semester, and their vocal habits, we could not calculate the main effect of these factors on the results. It is recommended to design future studies with a larger sample size. Second, to increase the validity of the results, it is necessary to use acoustic assessments along with perceptual assessments of voice. Finally, given that the current article was the first study on voice fatigue of speech therapy students, we did not have a similar study to compare the present findings with it. Therefore, further studies are required to resolve these limitations.

5. Conclusion

This study showed that the entry of speech therapy students into the in-turned course can to some extent lead to incorrect voice behaviors, which may lead to other possible disorders if left unchecked. However, based on the analysis, the two factors of gender and passing specialized units did not have a significant effect on the findings. Vocal fatigue in speech therapy students can be influenced by other factors that should be investigated in further studies. As suggested, closer monitoring of clinical instructors on student performance, additional training, and holding short-term practical courses on how to observe voice hygiene along with performing clinical procedures, and giving appropriate feedback to the in-turns on their vocal behaviors are suggestions that can be made to prevent voice fatigue.

Ethical Considerations

Compliance with ethical guidelines

The research was approved by the regional Ethics Committee in Ahvaz Jundishapur University of Medical Sciences (AJUMS), Iran (Code: IR.AJUMS.REC.1399.855).

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Authors' contributions

All authors equally contributed to the preparation of this paper.

Conflict of interest

The authors declared no conflict of interest.

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