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Effectiveness of Vocal Function Exercises (VFE) for Vocal Fatigue in Madrassa Students

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Abstract

The purpose of the current study is to explore the effectiveness of vocal function exercises (VFEs) on vocal fatigue in madrassa students. The study used randomized control trials with between-groups experimental research design. A sample of 24 girls enrolled in a madrassa in Lahore was selected. The study was conducted over 6 weeks from March to May. A treatment group was formed in which the participants were given vocal function exercises and vocal hygiene education. For the control group, only vocal hygiene education was provided to the participants. The Mann-Whitney *U* test revealed a substantial difference in mean scores between pre- and post-testing of the vocal fatigue index (VFI) in treatment group, $p < .05$ with a large effect size $r = 0.62$ (>0.5). Moreover, after treatment, there is a significant difference in vocal fatigue index scores (except VFI factor 3) of the treatment group as compared to the control group, $p < .05$ with a large effect size $r = .85$ (>.5). Vocal function exercises were efficient in improving the vocal fatigue of madrassa students. Thus, this study offers novel understandings by providing empirical support. VFEs could be a practical treatment approach for the management of voice disorders in children. Nevertheless, further research is needed to establish the effectiveness of this treatment approach for individuals with vocal fatigue.

Keywords: Voice disorders, vocal fatigue, physiologic voice therapy, vocal function exercises, madrassa students

Introduction

Voice is a primary mode of oral communication. It conveys information about an individual's age, gender, health, and emotional state, making it a key component of personal identity. More specifically, voice can be described as vocalization. However, individuals may sometimes experience problems with their voices. Sometimes, people can have problems with their voices. These issues can be grouped into four categories: how your voice sounds when you breathe, how rough or uneven it sounds, how much strain or effort it takes to speak, and how your voice resonates or sounds in your nose. Sometimes, these problems can make your voice too loud or soft (Stemple et al., 2004). Voice problems that are not the result of a physical problem, known as functional voice disorders, may be characterized by two main types: those caused by emotions (psychogenic) and those caused by tense muscles (muscle tension). Emotional ones can make it difficult to control your voice or cause it to sound different than usual. Muscle tension strains can make your voice hoarse or produce two different sounds (Baker, 2016). It is common for people suffering from vocal strain to experience symptoms such as vocal tension, tightness, tiredness, weakness, and changes in voice quality. However, the symptoms and clinical measures of vocal fatigue can vary from person to person. Some individuals may experience changes in their vocal quality, while

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others may experience increased physiological strain. Nanjundeswaran et al. (2014) broadly define vocal fatigue as weariness and a frail voice that occurs after long periods of voice use. Hunter et al. (2020) conceptualize vocal fatigue as influenced by various external factors, which impact vocal requests and responses. Therefore, proper vocal hygiene and caution are essential to prevent vocal overuse and fatigue. Although vocal fatigue is subjective, it has a measurable physiological and biological basis and can be objectively measured. Neuromuscularly, additional muscles are recruited when the required skeletal muscle fatigue and strength exceed the functional capacity. However, this is not entirely applicable to laryngeal muscles, as they are mainly composed of fatigue-resistant muscle fibers that sustain normal speech without tiring quickly. Vocal fatigue can trigger reactive hyperfunction of deep or extrinsic laryngeal muscles, which can lead to negative effects on voice (Kagan & Heaton, 2017). Researchers found that excessive laryngeal muscle tension caused a decrease in the offset and onset of the relative fundamental frequencies (RFF) surrounding a voiceless consonant (Teixeira & Behlau, 2015). Vocal fatigue can occur when vocal patterns become maladaptive or impaired due to prolonged use of the voice. It is a common concern among those with hyper-functional voice disorders. Symptoms can include tiredness, tightness, and dryness in the larynx while speaking, which worsens during the day but improves with rest. Other signs of vocal fatigue may include hoarseness, loss of voice, difficulty maintaining pitch, decreased volume and range, and increased muscle tension (Mahalingam et al., 2021).

Based on the available literature, the physiological techniques have stronger empirical support than alternative approaches, primarily due to a larger volume of research and a superior level of empirical data available on these techniques (Hamdan et al., 2021; Bane et al., 2019). The three key components of the physiological approach are enhancing the coordination between the major subsystems involved in vocal production, strengthening the laryngeal muscles, and promoting a healthy mucous lining of the true vocal cords (Stemple, 2000). A substantial body of research has investigated how common voice problems are among professionals who rely on their voices, such as teachers (Jayakumar & Yasin, 2021). Patients with voice abnormalities are treated using an integrative strategy, with the most popular techniques being voice amplification, VFEs, and vocal hygiene therapy. Vocal health therapy educates patients about voice health, promotes nontraumatic phonatory behaviors, and changes lifestyle habits. VFEs involve supervised vocal training. The training aims to decrease laryngeal muscle strain, enhance coordination between breathing and resonance, and achieve optimal phonation (Lee et al., 2004). A longitudinal study was conducted on girls between 18 and 25 with normal voices that examined the effect of changing the VFE dose in home practice. The effect was observed on the target of Maximum Phonation Time achievement in three groups with varied amounts of VFE, i.e., practicing VFE four times a day, two times a day (Traditional dosage), and one time a day. It was concluded that groups with high doses showed significant progress in MPT compared to groups with low doses who performed the exercises once a day (Patel et al., 2012).

A study revealed that students pursuing the Alimah degree are highly susceptible to developing voice problems, with a periodic occurrence rate of 70%. The study used a self-assessment questionnaire and found that out of 150 Alimah students, 70% had voice problems during the course. Of those who reported voice problems, 11% said they almost always had them, while 13% said they always had them. The researchers also collected

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information about the students' lifestyles, finding that 68% used a loud voice when communicating with their family members (Kaneko et al., 2020). The decline in respiratory capacity caused by aging leads to presbyphonia, a condition that affects the voice. Diaphragmatic breathing helps relieve the strain of the respiratory muscles, which can cause respiratory and vocal disorders. A study aimed to investigate whether voice treatment can improve the quality of life for those who have presbyphonia. A non-probabilistic convenience sampling method was used to select 10 participants with a diagnosis of presbyphonia, chosen from otolaryngologists and speech therapists. The therapy involved exercises to improve vocal function and stamina. People were divided into three groups according to age. More participants were men. Results showed that people with presbyphonia benefit after voice intervention (Imtiaz et al., 2022). The findings on the perception and patterns of use and abuse of the voice revealed that 88.3% of the participants agreed that taking preventive measures reduces the risk of voice problems. However, 83.3% of the participants admitted to shouting as part of their vocal habits. Interestingly, the participants did not associate positive attributes, such as magnificence, with a loud voice, as 82.2% of them reported that they found the loud voice unpleasant (Malik & Kiyani, 2023).

A previous study showed that 70% of 150 Alimah course students encountered voice related issues throughout their coursework (Kaneko et al., 2020). Additionally, in the recent past, considerable research has been conducted on Islamic preachers to study the frequency and underlying cause of voice related issues. In the current literature, limited studies have been conducted regarding voice intervention for children studying in a Madrassa. Studying this population with respect to vocal fatigue and the effect of VFEs might help understand the management of voice problems students face during the Tahfeez ul Quran. The present study focused on madrassa students with at least 1 year of Tahfeezul Quran experience. Studies have revealed that VFEs are the most adopted strategies to manage functional voice disorders (Lee et al., 2004). VFEs play a crucial role in decreasing laryngeal muscle tension and imbalance and promote better coordination between oscillation (vocal fold vibration), respiration, and resonance to support effective phonation. Therefore, the current study used VFEs to reduce vocal fatigue in madrassa students.

Hypotheses

H1: VFE is likely to decrease vocal fatigue in madrassa students of the experimental group.
H2: There will be a significant difference between the VFI scores of those who receive vocal function exercises (experimental group) and those who do not (control group).

Method

Research Design

A randomized control trial with a between-group experimental research design was conducted. Two groups were formed. One group was the treatment group, in which the participants were given VFEs and vocal hygiene education. The other group was the control group, which was given vocal hygiene education only.

Participants and Sampling Strategy

A sample of 24 girls studying in a madrassa in Lahore was selected based on accessibility. Given the ethical considerations and the limited pool of eligible participants

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who met the inclusion criteria (e.g., age, Tahfeez ul Quran enrollment, vocal fatigue indicators), a purposive sampling strategy was employed. The mean age of the participants was 12.21 years (*SD*=.78). The mean level of education (no. of para) was 17.88 (*SD*= 2.25), and the average learning duration of the Tahfeez ul Quran Course was 1.54 years (*SD*=.51)

Inclusion Criteria

The participants meeting the following inclusion criteria were recruited

- Girls aged 11 to 13 years studying in Madrassa
- Girls pursuing the Tahfeez ul Quran course for at least one year
- Having MPT lower than the normal range and phonation with vocal strain/effort.

Exclusion Criteria

- Those with medical conditions or who have been taking medication that might affect voice production, such as those with respiratory conditions were excluded.
- Students with a previous/current history of voice therapy were also excluded.

Table 1

Sociodemographic Characteristics of the Participants (N=24)

Characteristics	*n*	*%*
Family System		
Nuclear Family	14	58
Joint Family	10	42
Year of Admission		
2020	2	8
2021	11	46
2022	11	46
Medical History (Respiratory disorders)		
Present	-	-
Absent	24	100
Taking Medication		
Yes	-	-
No	24	100
Previous or current history of Voice Therapy		
Yes	-	-
No	24	100

Assessment Measures

This study used a tool to screen the perceptual characteristics of voice, which was applied to all ages. Quick screen for voice (Lee et al., 2004) was used to screen out the students with lower MPT and phonation with vocal strain or effort. The screening tool included all the subsystems of voice, such as respiration, resonance, phonation, and vocal flexibility. This study used a standardized tool to identify people with possible vocal fatigue. The vocal fatigue index consisted of 19 items. Vocal fatigue is defined by three factors included in the test: voice tiredness and avoiding the use of voice, physical distress, and improvement of voice problems with rest (Nanjundeswaran et al., 2015).

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Procedure

Formal permission was sought from the Departmental Doctoral Program Committee (DDPC) of the Centre for Clinical Psychology, Lahore, to begin the research. Students were approached with permission from the madrassa's principal. After voice screening and assessment, the participants were screened using the Slosson intelligence test. Those with IQs below to above-average IQs were selected. Selected students were further divided into two groups. Participants were randomly assigned to experimental or control group. Each group consisted of 12 participants who were balanced on constant conditions such as IQ, VFI scores, course instructor, and level of education (number of Quran chapters they have memorized). Homework logs had been provided to each group to maintain a record of practice. Therapy included the VFEs following four phases: (a) holding the vowel sound "i" as long as possible; (b) glide smoothly from the lowest note to the highest note; (c) glide smoothly from the highest note to the lowest note; (d) sustain the musical notes C, D, E, F and central G for as long as possible. Each exercise was performed twice, and it was important to perform them gently without causing shortness of breath. The exercises were performed twice a day for six weeks as per the VFE protocol. Each exercise session usually took between 5 to 10 minutes. To facilitate home practice, a training audio tape was provided to all subjects. Throughout the 6-week intervention period, subjects were encouraged to maintain their typical daily routines.

Ethical Considerations

- Before starting the research, a consent form was signed by all participants. Participants were informed that their information would be solely for research purposes.
- Confidentiality and anonymity were maintained.
- Participants were treated fairly and without harm in the best possible way.
- The dignity of all participants was taken into consideration.
- All relevant codes of conduct and ethical guidelines were followed.
- Concerned authorities were duly contacted to obtain permission to conduct the study.

Results

The following tests were used for data analysis. Wilcoxon signed rank test was used to explore the effectiveness of vocal function exercises through pre- and post-testing, and Mann-Whitney U test was executed to compare treatment and control group scores.

Table 2

Wilcoxon Signed Rank Test for Comparison of Pre and Post-VFI Scores of Students who Received Vocal Function Exercises (N=12)

	Pre-Scores		Post Scores			
Variables	*M*	*Mdn*	*M*	*Mdn*	Z	*P*
Vocal Fatigue Index						
Factor 1	32.67	32.00	15.67	16.00	-3.06	.002**
Factor 2	16.75	17.50	6.17	6.00	-3.07	.002**
Factor 3	5.00	6.00	8.58	8.50	-2.68	.007**

*Note. *p<.05, **p<.01*

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Table 2 is showing the Wilcoxon signed rank comparison of VFI in pre and post-testing for the treatment group. Findings showed a statistically substantial variation between before and after scores on VFI factor 1, z = -3.06, p< .01, with a large effect size r= .62 (>0.5). For factor 2 also, there was a statistically significant reduction in post scores compared to pre scores, with z = -3.07, p< .01 and large effect size r= .63 (>0.5). Scores on factor 3 were significantly lower after therapy than before treatment, with z = -2.68, p< .01 and large effect size r = .53 (>0.5).

Table 3

Wilcoxon Signed Rank Test to See the Difference between Pre-Testing and Post-Testing of Students in the Control Group (N = 12)

	Pre-Scores		Post Scores			
Variables	*M*	*Mdn*	*M*	*Mdn*	Z	*P*
Vocal Fatigue Index						
Factor 1	31.83	32.00	31.08	31.50	-.874	.38
Factor 2	13.67	13.50	13.25	14.00	-.236	.81
Factor 3	6.67	6.50	7.25	6.00	-.564	.57

*Note *p<.05, **p<.01*

Table 3 shows the Wilcoxon signed rank comparison of VFI in pre and post-testing for the control group. Findings showed no substantial change in before and after scores on VFI factor 1, p> .05, with a small effect size r= .18 (<0.3). Also, for factor 2, there was no statistically significant reduction in post-scores compared to pre-scores, p> .05 with a small effect size r= .05 (<0.3). There was no significant difference in pre and post-scores of factor 3 either, p> .05 with small effect size r = .12 (<0.3).

Table 4

Mann-Whitney U Test for the Differences between Treatment and Control Group on Post Scores of VFI

	Treatment Group		Control Group				
Variables	*Mr*	*Mdn*	*Mr*	*Mdn*	*U(24)*	*Z*	*P*
Vocal Fatigue Index							
Factor 1	6.50	16.00	18.50	31.50	.000	-4.17	.000***
Factor 2	6.67	6.00	18.33	14.00	2.00	-4.10	.000***
Factor 3	14.25	8.50	10.75	6.00	51.00	-1.23	.24

*Note. *p<.05, **p<.01, ***p<.001*

Table 4 shows differences between the treatment and control groups in the after-therapy scores of VFI. Findings revealed that there was a significant difference between the treatment group and control group on post scores of VFI factor 1, p < .001 with large effect size r= .85 (>.5). Also, for factor 2, there was statistically significant difference in post scores of treatment group as compared to control group p< .001 with large effect size r= .84(>.5). But there was no significant difference between post scores of treatment group and control group on factor 3, p> .05 with small effect size r = .25(<.3).

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Discussion

The present research has illuminated the effectiveness of vocal function exercises on vocal fatigue in madrassa students. This study was designed to examine the experimental effect of VFE. The first hypothesis, H1 of the present study, that VFE is likely to decrease vocal fatigue in madrassa students who undergo therapeutic intervention (experimental group), has been supported with statistically significant results. Analyzing the results, we found that the students in the treatment group showed improved voice with a reduction of fatigue after therapy. These findings are consistent with past research (Malik & Kiyani, 2023; Pedrosa et al., 2016;). Findings reveal a significant decrease in VFI scores of students who practiced vocal function exercises twice daily for six weeks after therapy. This means that students felt less fatigue in their voices while reciting and during daily life conversations by following VFE and vocal hygiene education. They reported that they could produce voice without effort, which depicted that voice strain and effortful phonation were also improved. The Wilcoxon signed rank test results in Table 1 support this hypothesis.

The effect of VFE on vocal fatigue was statistically noteworthy and consistent with former studies, which illustrated that the treatment group experienced significant improvements in post-test measures, such as flow rate, phonation volume, and maximum phonation times. These improvements indicate greater efficiency in closing the vocal folds. It was revealed that both treatment groups showed similar results in terms of therapy effect size for all three voice measures (Imtiaz et al., 2022; Angadi et al., 2019). A significant difference was noticed between the treatment and control group scores of VFI after therapy. Hence, these findings support hypothesis H2, that there would be a considerable difference between the VFI scores of those who receive Vocal function exercises (experimental group) and those who do not (control group). This substantiated change represents that in the absence of VFE, VH education did not induce any significant change in post-test scores of the control group, which meant that those students who practiced the VFEs showed improvement in vocal fatigue (see Table 3). Findings also suggest no significant change in VFI scores of those students who only followed vocal hygiene education. Thus, it can be concluded that vocal hygiene is indirect voice therapy, which can only improve voice if practiced with direct physiologic or symptomatic voice therapies (see Table 2), as has been proven in a previous study where the Treatment group included VFE and VH, whereas; the control group was given VH education only. It was concluded that the treatment group showed significant differences in voice outcome measures compared to the control group. VH group did not show a significant positive change in results (Gelfer & Van Dong, 2012; Yiu et al., 2021).

An earlier study conducted in Pakistan indicated that vocal problems are often underestimated and do not receive adequate clinical treatment. It is unclear whether this lack of awareness is due to a lack of knowledge or the temporary nature of most vocal disorders. The results on the perception and patterns of use and abuse of the voice revealed that 88.3% of the participants agreed that taking precautionary measures could help avoid voice alterations. However, 83.3% of the participants admitted to yelling and shouting as part of their vocal habits. However, it is essential to note that these participants did not seek professional help and did not perceive their voices as pleasant (Gillivan-Murphy et al., 2005; Thomas & Maruthy, 2020). Consequently, findings indicated that vocal fatigue was measured based on three factors of the vocal fatigue index, but a significant difference between groups

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was observed in only two factors. Factor 1 was related to voice tiredness and voice use avoidance, which was reduced after implementing the VFE. Factor 2 was physical distress, which also showed improved scores after therapy. Factor 3 measured the betterment of symptoms after rest, which was equally enhanced in both groups as both followed the VH education (see Table 4).

Conclusion

It is concluded from the present study that vocal function exercises have been efficient in reducing vocal fatigue in madrassa students. Vocal fatigue is an aspect of voice disorders that has been widely studied in recent research. This research illustrates new insights for research by presenting empirical support for its incidence in madrassa students. Previous studies also recommended the study of vocal fatigue in treatment effectiveness studies. Thus, the current research has covered this gap and concluded that vocal function exercises would efficiently reduce vocal fatigue in individuals who overuse their voices.

Limitations

Like any research, this study has limitations. It was limited in terms of sample size. The subject population lacked diversity as they all came from similar backgrounds. Caution should, therefore, be taken in interpreting the 24 statistics, considering that they represent only a small sample. Follow-up sessions were not conducted due to time constraints. It was also because some students showed so much improvement that they did not need a follow-up session, and some had not shown significant change yet which would require continuation of practicing exercises for better results. A laryngoscopy or video stroboscopy was not performed to screen out structural abnormalities related to voice problems. The students' class schedule and madrassa environment did not allow the involvement of an ENT consultant.

Strengths of the Study

The findings of this study provide awareness about vocal fatigue in madrassa students and the role of vocal function exercises in reducing VF. It focuses on and highlights the importance of VFE as an efficient method to reduce VF for better vocalization. This study has positive implications for excessive voice users in managing their fatigued voice and for SLPs, researchers, and clinical professionals while dealing with voice problems of individuals who overuse their voice.

Implications for Future Research

A review of the current literature on voice disorders reveals a significant gap in research concerning the effectiveness of VFEs for treating vocal fatigue in children. While exsiting literature have demonstrated the effectiveness of VFEs in adult populations, there remains a lack of statistical data supporting their use in children. Future research should aim to address this gap by focusing on data on aerodynamic and acoustic measurements associated with vocal fatigue in children. Furthermore, monitoring participant compliance is recommended as Ellis and Beltyukova (2011), the group whose adherence to the traditional VFE protocol was monitored showed significantly greater improvement than the group that was not observed. The monitored group had to submit audio or video recordings of their

exercises. In future studies, it might also be beneficial to include an interactive web-based application that can show instructional videos demonstrating the correct VFE techniques as well as record MPT audio samples to signal compliance to the principal investigator.

Clinical Implications

The research study has provided important information for speech therapy professionals. First, the literature review highlighted the scarcity of research on vocal fatigue. Additionally, there is a lack of research on successful pediatric treatment options for functional voice disorders. It is necessary to gather extensive standard information on children without vocal pathologies to undertake adequate studies in children with voice problems. This study reported positive results regarding the potential improvement of vocal efficiency in madrassa students through vocal function exercises. Accordingly, VFEs may be a helpful treatment method for children with vocal issues. Nevertheless, more research is needed to definitively conclude on the effectiveness of VFEs as a treatment method for individuals with vocal fatigue.

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