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EFFECTS OF TRADITIONAL TURKISH MUSIC EDUCATION ON VOICE RANGE PROFILE AND VOICE QUALITY

GELENEKSEL TÜRK MÜZİĞİ EĞİTİMİNİN SES ALANI VE SES KALİTESİ ÜZERİNE ETKİSİ

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Abstract

Aim: The aim of this study; to investigate whether traditional Turkish music education is as effective on voice range profile and voice quality as classical music education.

Methods: Twenty volunteers in the Conservatory and 10 volunteers the Turkish Amateur Music Choir were included in the study. Digital recordings of the subjects' voices were obtained before and after 8 months of voice training. Voice recordings were analyzed with the Dr. Speech voice analysis program. Voice analysis results were compared between groups.

Results: Voice range profile was found expanded as 3, 2, and 5 semitones in group 1 (29 to 32 semitones), group 2 (30 to 32 semitones) and group 3 (23 to 28 semitones), respectively. The parameters of harmonic component of voice such as HNR, SNR, and NNE improved in all groups after voice training. GRBAS scores were normal in the conservatory group before training and improved following training in all groups, with the amateur group being the most obvious. When the alterations were compared between the groups, no significant differences were observed between the first and second conservatory groups, whereas a significant difference was observed between the amateur group and the first and second conservatory groups in seven parameters (amplitude tremor, HNR, SNR, NNE and GRBAS).

Conclusions: This is the first study about the effects of traditional Turkish music education on subjective and objective parameters of the singing voice. Our research shows that traditional Turkish music education improved the singing voice improvements as much as with classical music.

Keywords: Quantitative voice assessment, voice, voice range profile, voice training

Öz

Amaç: Bu çalışmanın amacı; geleneksel Türk müziği eğitiminin ses alanı profili ve ses kalitesi üzerinde klasik müzik eğitimi kadar etkili olup olmadığını araştırmaktır.

Yöntemler: Çalışmaya Konservatuar'dan 20 gönüllü ve Türk Müziği Amatör Korosundan 10 gönüllü alındı. 8 aylık ses eğitimi öncesi ve sonrasında deneklerin seslerinin dijital kayıtları alındı. Ses kayıtları Dr. Speech ses analiz programı ile analiz edildi. Ses analizi sonuçları gruplar arasında karşılaştırıldı.

Bulgular: Ses aralığı profili sırasıyla Grup 1'de (29- 32) 3 yarım ton, grup 2'de (30- 32) 2 yarım ton ve grup 3'te (23- 28) 5 yarım ton genişletilmiş bulundu. HNR (harmonic to noise ratio), SNR (signal to noise ratio), NNE (normalized noise energy) gibi sesin harmonik bileşenlerinin parametreleri, ses eğitimi sonrası tüm gruplarda düzeldi. GRBAS skorları, konservatuvar grubunda ses eğitimi öncesi normaldi ve amatör grupta diğer gruplara göre daha belirgin düzeldi. Gruplar arasındaki değişimler karşılaştırıldığında, birinci ve ikinci konservatuvar grupları arasında anlamlı bir farklılık gözlenmezken amatör grup ile birinci ve ikinci konservatuvar grupları arasında yedi parametrede (amplitüd tremor, HNR, SNR, NNE ve GRBAS) anlamlı farklılıklar izlendi.

Sonuç: Bu çalışma geleneksel Türk müziği eğitiminin ses alanı ve ses kalitesi üzerindeki etkilerini inceleyen ilk çalışmadır. Araştırmamız, geleneksel Türk müziği eğitiminin, ses alanı ve ses kalitesi üzerinde klasik müzik kadar etkili olduğunu göstermektedir.

Anahtar Kelimeler: Sayısal ses değerlendirmesi, ses, ses aralığı profili, ses eğitimi

Introduction

With the rapidly developing technology and the reflection of technology in the field of medicine, research on language and speech disorders, which has gained more importance in recent years, has accelerated. The Dr. Speech voice analysis program and Praat are the most frequently used programs that provide a technological and objective evaluation of voice This is an important feature, especially for professional voice performers[1,2].

Many subjective and objective methods are used to evaluate voice. The grade, roughness, breathiness, asthenia, strain (GRBAS) scale can be used for perceptual evaluation and is a subjective method[3,4]. Parameters such as fundamental frequency (F0), jitter (frequency perturbation), shimmer (amplitude perturbation), standard deviation of fundamental frequency (SD-f), standard deviation of amplitude (SD-amp), harmonic to noise ratio (HNR), signal to noise ratio (SNR), normalized noise energy (NNE), tremor of frequency (F-tremor), and tremor of amplitude (A-tremor) are mainly measured in objective evaluation[5,6]. The aim of classical music education is to teach how to use voice correctly and effectively. Vocal education includes correct learning of anatomy and physiology, posture, breathing, relaxation exercises, phonation, resonance, and articulation[7].

Turkish music is among the most popular genres of music. Popular music includes Turkish music, Classical music, and Far Eastern-Central Asian music [1]. The universal sets of this musics are different. The factor that creates the difference is the distance between the voice range profile in this set. In Far Eastern-Central Asian music, an octave is divided into six unequal ranges, in classical music it is divided into 12 equal semitones, and in traditional Turkish music, it is divided into 24 unequal ranges. This segmentation is one of the most influential elements both on the creation of melody and on performance and style. Music is universal and culturally expresses local customs and traditions.

This assertion may be about musical systems. Traditional Turkish music has emerged as a product of Central Asia, Seljuk, and especially the Ottoman civilization; it has become a very rich type of music both in terms of the number of melodies, forms, and methods. In traditional Turkish music, melodies follow each other without repeating themselves, whereas classical music repeats simultaneously or sequentially. When a Turkish, Chinese or an Australian artist performs the same note, they sing it in different styles [7,8].

Although the effects of classical music education have been investigated many times, the effects of traditional Turkish music education on the vocal range profile and vocal quality have not been investigated. In this study, the effects of Turkish music education on the vocal range profile and voice quality between conservatory students and an amateur choir were examined.

Materials and Methods

- *Research Group*

Twenty students from the Singing Class of Ege University Turkish Musical State Conservatory Voice Training Department and 10 volunteers from Celal Bayar University Turkish Music Amateur Choir participated in the study. The conservatory students had passed the conservatory acceptance examination, had a high voice range profile, and high voice quality, and had already received training. Eleven of the conservatory students (6 males and 5 females) were in the first year (group 1) and nine (3 males and 6 females) (group 2) were in the second year. In the amateur choir (1 male and 9 females) (group 3), volunteer students and staff were trained by a laryngologist, who is a knowledgeable professor about the anatomy and physiology of voice. All students participated in the training and study for 8

months between October 2011 and May 2012.

Eleven students from the conservatory indicate only group 1 participated in 16 hours of singing lessons per week (4 hours singing technique, 6 hours basic music solfege in normal speech tones and basic music theory, 6 hours Turkish music solfege and theory). Nine students from the conservatory indicate only group 2 participated in 27 hours singing training program per week (2 hours singing technique, 8 hours basic music solfege in speech tones and basic music theory, 6 hours Turkish music solfege and theory, 7 hours classical Western music technique repertoire, 4 hours classical Turkish music chorus work).

Ten people who attended the amateur choral performed breathing, relaxation, trill exercises aloud. (Trill without losing tension between half ton range; this goes up and down quickly or rather it goes up and down, which can be achieved by vibrating tongue and palate the sound of ‘‘r’’), and Turkish music singing 2-3 hours per week during the study period. They performed tongue trills exercises at home instructed by conductor. These participants had not been trained on notes at the conservatory like conservatory students. They were taught in the classic Turkish music style, call and response. Songs were sung by a laryngologist trained in vocal anatomy and physiology, and the amateur choir tried to sing it by listening. The amateur choir has no hobbies related to other types of music.

- *Data Collection Process*

A voluntary written proclamation form was obtained from the subjects. A general ear, nose, and throat (ENT) examination was performed. The participant form questioned identity information, smoking habits, hearing problems and reflux, whether the participants had undergone any surgery on otolaryngology, and previous voice training.

At the beginning of the first semester, videolaryngostroboscopy (VLS) was performed using a Storz 8020 laryngoscope to identify whether the participant had laryngeal pathologies. Those who were found to have closing defects, vocal nodules, sulcus vocalis, Reinke’s edema, vocal polyps, traumatic corditis in the vocal cords in stroboscopic examinations were excluded from the study. In all groups, students who did not participate in voice training courses for any reason and smoking, had hearing problems and reflux, undergone any surgery on otolaryngology, in the last three months were excluded. Students who regularly attended conservatory and amateur choir trainings, whose voice recordings were completed and whose GRBAS scores were normal, were included in the study.

Voice recordings were performed in a quiet room using a computer, the Cool Edit program, and a Philips condenser microphone. Voices were recorded using mono, 44.100 Hz sample rate and 16-bit sample depth. Ten minutes of vocal warm up exercise was performed before the student’s voice recordings. The microphone was held at a distance of 10 cm by a researcher, and a total of 40-90 seconds of recording was taken by keeping the speech tone and a few low and high pitched sounds for 5-10 seconds.

Vocal range refers to the full spectrum of pitches that a human voice can produce, starting from the lowest note and reaching to the highest note. The vocal range of the students was identified using a Yamaha Porta Sound PC 100 branded piano by a professional conservatory lecturer. Musically acceptable bass and high-pitched notes were identified with semi-tone sensitivity. Modal registers for boys and girls were included in the vocal range profile. The same procedures were repeated at the end of the study corresponded to 8th month in both groups.

The instrumental and perceptual evaluation was done by the same person who was unaware of the results before and after for

all participants. For GRBAS scoring, audio samples were listened to by 2 separate people and averaged. Their average scores were accepted for statistical analysis; 0=normal, 1=mild impairment, 2=medium impairment, and 3=worst.

- *Voice analysis*

After all the audio recordings were taken, all audio was listened to again, and the 3-4 second tracks with high musicality tone were recorded as a separate audio file. Among them, at least three voice recordings were selected, which were the best for pre- and post-training. It was decided which voice recording would be chosen by listening to the recorded voices of the students and the amateur choir by the two researchers according to the clarity of the voice. The clarity of the voice was depended to the decreased noise ratio. That is: as the noise ratio in the environment decreases, the clarity of the voice increases. The same vowel is chosen for all recordings and all singers.
The same passages were used in the pre and post tests for each singer. A total of six fragmented averages (three first semesters and three second semesters) for each student were analyzed using the Dr. Speech Voice analysis program (Tiger DRS Inc, Seattle, WA). The results of this analysis were used for the statistical analysis. By performing voice analysis on each recording, F0, jitter, shimmer, SD-f, SD-amp, HNR, SNR, NNE, f-tremor, and a-tremor data were found. These parameters are the most frequently used parameters that give information about the quality of the voice. Jitter and shimmer % values are the average values of the others.
In this study, parameters such as mean F0, max-min F0, mean amplitude, max-min amplitude, mean period, and max-min period, which were measured using the Dr. Speech Voice Analysis program, were not evaluated statistically because these parameters vary according to the sex of the person, the voice they produce, the duration of the sound, the intensity, the microphone characteristics, and the distance. Therefore, these parameters may not be suitable for measuring the effect of voice training on voice quality.

- *Statistical Analysis*

Analysis of the data was performed using the SPSS 11.5 package program. In the data obtained by counting, frequency (percentage) was accepted as descriptive measures, and in variables obtained by measurement, mean, standard deviation, median, minimum-maximum were accepted as descriptive measures. $p<0.05$ was considered statistically significant. The Mann Whitney U test and Wilcoxon Signed Ranks test was used for comparison between groups.

- *Ethical Approval*

This study was approved by the local ethics committee with the decision dated 23.03.12 and numbered 114.

Results

Three groups joined the study. The average ages were 20.8 years for group 1, 21.1 years for group 2, and 26.7 years for group 3. Group 1 consisted of five females and six males, group 2 was consisted by six females and three males, and group 3 consisted of nine females and one male. There was no statistically significant difference between the groups in terms of age and gender.
The mean values of pre-training data were compared among the groups using the Mann Whitney -U test. There was no significant difference in the parameters between the first and second groups before the training. The comparison between group1, group2, and group3, significant differences were found in voice range profile, jitter %, shimmer %, A-tremor, HNR, SNR, NNE, hoarseness, roughness,

Table 1. Averages of groups' pre-training data and comparisons between the groups.

	GROUP 1		GROUP 2		GROUP 3	
	Mean (min-max) SD	P between 1- 2	Mean (min-max) SD	P between 2- 3	Mean (min-max) SD	P between 1-3
Voice range profile (Semi-tone)	29,2±3.3 (25-34)	0.56	29.8±2.8 (23-32)	0.01	22.8 ±5.7 (14-33)	*0.01*
Jitter %	0.07±0.02 (0.02-0.1)	0.32	0.1 ±0.04 (0.06-0.2)	0.01	0.2±0.1 (0.1-0.4)	<0.001
Shimmer %	1.04±1.1 (0.80-1.30)	*0.88*	1.1±0.5 (0.50-2)	0.02	2.2±1.2 (0.3-5.1)	<0.001
F-tremor	2.1±1.1 (1-4.90)	0.79	2.4±0.3 (1-4.50)	0.39	3.6 ±3.4 (1.1-12)	0.32
A-tremor	1.8±0.9 (1-4.50)	0.16	1.5±0.7 (1-3.40)	<0.001	6 ±4 (1-12)	<0.001
HNR	27.5 ±2.7 (24-33)	0.97	27.2±4.4 (20-33)	<0.001	20.1±4 (14-26)	<0.001
SNR	25.8±3 (20-31)	0.54	26.7±3.9 (20-32)	<0.001	18.9±4 (13-25)	<0.001
NNE	-17.1±2.9 (-23, -18)	0.22	-19.1±3.9 (-25, -13)	<0.001	-9.3 ±4 (-16,-5)	<0.001
Hoarseness	0.09 ±0.3 (0-1)	0.88	0.1±0.3 (0-1)	<0.001	0.9±0.3 (0-1)	<0.001
Roughness	0.09±0.09 (0-1)	0.88	0.1 ±0.3 (0-1)	0,60	0.2±0.4 (0-1)	0.49
Breathiness	0 ±0 (0-0)	0.999	0±0 (0-0)	<0.001	1.8±0.3 (0-3)	<0.001

Mann Whitney U test, F-tremor: Tremor of frequency, A-tremor: Tremor of amplitude, HNR:The harmonic-to-noise ratio , SNR:The signal-to-noise ratio , NNE: Normalized noise energy, GRBAS: The grade, roughness, breathiness, asthenia, strain

breathiness, and general sound quality (GRBAS) parameters before voice training (Table 1).

The pre-training and post-training values of each group were assessed separately. The averages of the data before the participants' training and the data after the training were one of 14 parameters in group 2, and seven of 14 parameters in group 3 were positively and compared with Wilcoxon signed ranks test. It was seen that four of 14 parameters in group 1, significantly changed. It was observed that the voice range profile expanded by three semitones in the first group, from 29 to 32 semitones; by two semitones in the group 2, from 30 to 32 semitones; and by 5 semitones, from 23 to 28 semitones in the group 3. It was observed that the voice range profile increased by an average of 2- 5 semitones and the greatest expansion was in the amateur choir. The values before and after training in jitter, shimmer, F-tremor, A-tremor, SD-f, SD-amplitude, which are among the objective parameters, were already within normal limits in groups 1 and 2. Therefore, the improvements that occurred were not considered significant. in group 2. Significant improvements were seen in voice range profile and A-tremor in group 3. In the HNR, SNR, and NNE parameters related to the harmonic component of the sound, the changes in groups 1 and 2 were not significant in the values before and after

Table 2. Comparison of groups' mean of pre-training data and post-training data

PARAMETER	GROUP 1			GROUP 2			GROUP 3		
	Before Mean ±SD (min-max)	After Mean ±SD (min-max)	P	Before Mean ±Sd (min-max)	After Mean ±SD (min-max)	P	Before Mean ±SD (min-max)	After Mean ±SD (min-max)	P
Voice range profile (Semi-tone)	29,2±3.3 (25-34)	31,9 ±3.7 (27-38)	*0.007*	29.8±2.8 (23-32)	32.2±4.1 (26-39)	0.105	22.8±5.7 (14-33)	27.2±5.9 (19-36)	*0.005*
Jitter %	0.07±0.02 (0.02-0.1)	0,1±0.1 (0-0.40)	0.623	0.1 ±0.04 (0.06-0.2)	0.07 ±0.03 (0-0.20)	0.141	0.1±0.1 (0.1-0.4)	0.1±0.1 (0-0.40)	0.292
Shimmer %	1.±0.1 (0.80-1.30)	1.5±0.3 (1.10-2.1)	*0.003*	1.1±0.5 (0.50-2)	1.6±0.5 (1.1-2)	0.066	2.2±1.2 (0.3-5.1)	2±0.8 (1.16-3.3)	0.838
F-tremor	2.1±1.1 (1-4.90)	1.70 (1-3.20)	0.292	2.4±0.3 (1-4.50)	1.4±0.7 (1-3.10)	0.063	3.6±3.4 (1.1-12)	2.3±1.7 (1-5.3)	0.415
A-tremor	1.8±0.9 (1-4.50)	0.86 1.3±0.3 (1-1.90)	*0.050*	1.5 ±0.7 (1-3.40)	2.6±1.4 (1.10-5)	0.097	6 ±4 (1-12)	1.2 ±0.2 (1-1.8)	*0.008*
SD-f	1.3±0.8 (0.50-3)	1.3±0.5 (0.80-2.3)	0.766	1.8 ±0.9 (0.60-4)	1.8±0.8 (0.80-3)	0.635	2.3±1.2 (0.9-4.9)	1.8±0.8 (0.8-4.07)	0.283
SD-amp	7 ±1.7 (4.70-1)	5 ±0.6 (4-6)	*0.005*	7.3±2.2 (5-12)	±1.1 (2-6.50)	*0.008*	4.8±2 (0.5-6.7)	5.8 ±2.7 (1-10)	0.203
HNR	27.5±2.7 (24-33)	28.7±1.4 (25-31)	0.181	27.2 ±4.4 (20-33)	27.2±2.6 (24-31)	0.999	20.1±4 (14-26)	26.5±3 (21-31)	*0.012*
SNR	25.8±3 (20-31)	27±2.4 (22-30)	0.109	26.7±3.9 (20-32)	26.1 ±2.5 (23-30)	0.495	18.9±3.7 (13-25)	25.8 ±3.2 (20-30)	0.11
NNE	-17.1±2.9 (-23, -18)	-17.3±3.5 (-23 ,-11)	0.894	-19.1±3.9 (-25, -13)	-17.1±2.9 (-22, -13)	0.154	-9.3 ±4 (-16,-5)	-15.9 ±5 (-25 , -10)	*0.008*
Hoarseness	0.09 ±0.3 (0-1)	0±0 (0-0)	0.317	0.1±0.3 (0-1)	0 ±0 (0-0)	0.317	0.90 (0-1)	0.10 (0-1)	*0.005*
Roughness	0.09±0.09 (0-1)	0±0 (0-0)	0.317	0.1±0.3 (0-1)	0 ±0 (0-0)	0.317	0.2±0.4 (0-1)	0.1±0.3 (0-1)	0.564
Breathiness	0 ±0 (0-0)	0.09±0.9 (0-1)	0.317	0±0 (0-0)	0±0 (0-0)	0.999	1.8±0.3 (0-3)	0.2 ±0.4 (0-1)	*0.016*
GRBAS (Overall Voice Quality)	0,2±0.6 (0-2)	0.09±0.3 (0-1)	0.655	0.2±0.6 (0-2)	0±0 (0-0)	0.317	2.9±1.2 (0-4)	0.5±0.9 (0-3)	*0.011*

Wilcoxon Signed Ranks test SD-f: The standard deviation of the fundamental frequency , SD-amp:The standard deviation of amplitude , F-tremor: Tremor of frequency , A-tremor: Tremor of amplitude, HNR:The harmonic-to-noise ratio , SNR:The signal-to-noise ratio , NNE: Normalized noise energy, GRBAS: The grade, roughness, breathiness, asthenia, strain

the training, but these values were significant group 3. In the parameters of hoarseness, breathiness, and GRBAS scale regarding the perceptual analysis of voice, the changes in groups 1 and 2 were not significant but were significant in the group 3. An increase in modal register width was observed in all groups after voice training (Table 2).

The changes following voice training were investigated among the groups. The difference between the pre- and post-training values of each parameter was found for each participant; and the averages of the groups were compared using the Mann - Whitney U test. There was no significant difference between groups 1 and 2 in any parameters, but significant differences were found *between group 3* and the other groups. When the amateur choir and the first year and the second-year students of the conservatory were compared, there was a significant difference in *seven parameters including a-tremor, HNR, SNR, NNE, and GRBAS* ($p<0.05$) (Table 3).

Discussion

The education and training of the singing voice in an esthetically pleasing manner takes years and can only be achieved based

Table 3. Comparison between the groups: the average of differences between pre- and post-training values.

PARAMETER	Group 1 Mean± (min-max)	group 1-3 p	Group 2 Mean± (min-max)	group 2-3 p	Group 3 Mean± (min-max)	group 1-3 p
Voice range	2.6 ±0.1 (0-9)	0.281	3.4 ±0.8 (0-7)	0.506	4.4 ±1.3 (1-8)	0.075
Jitter %	-0.2±0.4 (-0.3, -0.1)	0.432	0.2±0.7 (-0.2, 0.1)	0.897	0.3±0.8 (-0.10, 0.20)	0.429
Shimmer %	-0.5±0.2 (-1, -0.1)	0.939	-0.5±.8 (-2, 0.90)	0.165	0.2±0.1 (-1.06, 3.2)	0.120
F-Tremor	0.4±1.1 (-1.5, 3.40)	0.490	1 ±0.7 (-1.2, 3)	0.437	1.2±0.8 (-2.9,11.3)	0.916
A-tremor	0.4 ±0.8 (-0, 2.90)	0.023	-1.1±0.9 (-4, 1.5)	*0.001*	4.7±1.7 (0-11)	*0.002*
HNR	-1.1±0.9 (-6, 2)	0.422	0.0 (-6, 6)	*0.011*	-6.4±1.4 (-12, 0)	*0.019*
SNR	-1.2±0.4 (-6, 1)	0.206	0.6±0.2 (-5, 7)	*0.003*	-6.8 ±0.8 (-12, 0)	*0.004*
NNE	0.1±0.4 (-8, 9)	0.380	-2 ±0.5 (-8, -4)	*0.004*	6.6 ±1.4 (-1, 15)	*0.012*
Hoarseness	0,09±0.1 (0-1)	0.084	0,1±0.1 (0-1)	0.003	8±0.7 (0-1)	*0.001*
Roughness	0.09±0.1 (0-1)	0.084	0.1±0.1 (0-1)	0.999	0.1±0.1 (-1, 1)	0.918
Breathiness	-0.1 ±0.8 (-1, 0)	0.343	0 ±0 (0-0)	*0.003*	1.6±0.6 (0-3)	*0.002*
GRBAS (Overall voice quality)	0.1±0.3 (-1, 2)	0.553	0.2±0.7 (0-2)	*0.003*	2.4 ±0.5 (0-4)	*0.002*

Mann Whitney U test, F-tremor: Tremor of frequency, A-tremor: Tremor of amplitude, HNR: The harmonic-to-noise ratio , SNR: The signal-to-noise ratio , NNE: Normalized noise energy, GRBAS: The grade, roughness, breathiness, asthenia, strain

on capability. Voice training and voice rehabilitation are also exceptionally useful in correcting pathologies that result from poor performance of the professional voice [9]. The effects of classic music education on voice field and voice quality have been researched before. Previous studies have generally compared professional voice users who received voice training with a control group, but we could not find any studies that compared voice quality and voice range profile before and after vocal training in Turkish music. In this study, the effects of professional Traditional Turkish music education in conservatory and amateur choral, on objective and subjective voice parameters were examined.

It is not possible to obtain a completely improved objective measurement of aspects learned by voice training. Normally, 2 to 4 years of voice training improves the voice. However, voice training given in a short period such as 6 months also affects the voice quality and range positively [10,11]. Voice training can improve breathing, position (body posture while singing), posture, sound intensity, resonance, smoothness, and timbre, and other factors

improve with singing training. The parameters we used in this study: voice range, jitter (%), shimmer (%), HNR, NNE, SNR, were used to evaluate voice quality in many previous studies [12,13,14]

In group 1, the vocal range expanded by three semitones (29 to 32), in group 2 two semitones (30 to 32), and in group 3 by 5 semitones (23 to 28). we observed. Conservatory students are generally students who have passed the conservatory exam and have a wider vocal range than the amateur choir. Therefore, the expansion of the vocal range in the conservatory group is less than in the amateur choir.

Siupsinskien et al. examined the effects of voice training on vocal capabilities in vocally healthy age and gender differentiated groups measured by voice range profile (VRP). When compared with nonsingers, both genders of trained adult and child singers exhibited increased mean pitch range, highest frequency, and VRP area in high frequencies ($p < 0.05$)[15]. Voice training has significant positive effects on vocal capability parameters measured by VRP, Suipsinskien et al. in contrast, we saw more VRP increases in the amateur choir in our study. This may be because the amateur choir initially had a lower VRP.

In our study, the amateur choir sang using the traditional Turkish method 2-3 hours per week after 5-10 minutes of warm-up exercises (trill, vibration of lip- palate and tongue). As a result of the ongoing 8-month voice training study, a clear improvement in the voice quality parameters and a 5 half-tone expansion in the voice range profile were observed. This showed that with training, the singers could expand their voice range profile even by singing, and that they could produce a higher quality voice. In addition, in some studies; It has also been claimed that an 18-month long-term study is needed for voice training to cause a significant change in voice quality [11].

In the HNR, SNR, NNE parameters, the changes in groups 1 and 2 were not significant in the pre- and post-training values, in group 3 these changes were significant. We observed a significant difference in seven parameters (a-tremor, HNR, SNR, NNE, hoarseness, breathiness, GRBAS) in the amateur choir compared with the conservatory first year students and second year students in post-training results. The harmonic values of the voice were positively affected in all groups. The lack of significant change in the jitter% value in our study (group 1, 2 and 3) may be due to the short duration of the voice training, Objective parameters, jitter, shimmer, A-tremor, F-tremor, SD-amp, and SD-F were already close to the minimum in groups 1 and 2 and the improvement after the voice training showed no significance. Conservatory students have a certain musical ear, and they can play at least one musical instrument and pass the acceptance exam. It is difficult to improve an already high musicality tone voice in 8 months. However, the quality of the amateur choir students was worse than that of the conservatory students, and the short-term voice training was sufficient to change their voice quality positively. Moreover, it has been shown that a significant improvement in voice range and quality could be possible with 3 hours of training and singing in traditional Turkish music, once per week for 8 months [8].

There are some limitations in the study. By making similar studies in the future with larger study groups, the effects of voice education on voice range profile and voice quality can be evaluated in greater detail. We used the VLS in the exclusion of organic voice pathologies. Our study was

not designed for comparing VLS values. After the voice training, studies that evaluate with VLS can be planned. During the 8-month vocal training, some students left the school and the choir, could not attend regular lessons and choral work, and could not be recorded for the second voice analyses, which affected the ratio of women to men among the groups. Self-perception assessment was not used in the education of groups. The records were only seen by the investigators for the study and were not shared. Therefore, the positive effects of visualization of singers were not implemented. Finally, if the goal was to verify how Turkish music increases the vocal range profile, no comparison has been made with another musical genre, if able to have the same effects.

Conclusion

This is the first study about the effects of traditional Turkish music education on subjective and objective parameters of the singing voice. Our research shows that traditional Turkish music education improved the singing voice, as much as with classical music education. İmprovements were observed both in conservatory students and amateur chorus, but excellent changes in voice range profile was observed in amateur chorus.

Some part of this study was presented as oral presentation at "24th International Rhinocamp 2021" held in Marmaris, entitled as "Effects of Traditional Turkish Music Education on Voice Range Profile and Voice Quality'

Author contributions

Concept A.K., A.V.Y., Design – A.K., Supervision A.K., A.V.Y., Materials – A.K., Data collection &/or processing – A.K., A.V.Y., Analysis and/or interpretation -A.K., Literature search – A.K., Writing – A.K., Critical review – AK.
All authors read and approved the final manuscript.

Conflict of interest

The authors declare that they have no conflict of interest.

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Ethical approval

Permission was obtained from the Celal Bayar University, Medical Faculty Clinical / Human Research Ethics Committee for this study, and Helsinki Declaration rules were followed to conduct this study.(decision dated 23.03.12 and numbered 114)

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