Erciyes Med J 2019; 41(3): 275–81 • DOI: 10.14744/etd.2019.48108
ORIGINAL ARTICLE – OPEN ACCESS

Phonatory-Aerodynamic Characteristics of Drama Students

Fatma Esen Aydınlı[1], Rıza Korhan Sezin[2], Esra Özcebe[1], Ayşen Köse[1], Rıza Önder Günaydın[3]

ABSTRACT

Objective: Theater actors are considered as elite vocal performers whom quality of voice is of utmost importance. It was thought that speech breathing characteristics of theater actors were different compared with those of lay talkers. However, findings on this issue were generally based on studies conducted by the respiratory kinematics and muscular activity via using indirect air volume measures. These measures were by no means related with the respiratory– phonatory interaction. One of the objective methods that is used for evaluating voice quality is the phonatory-aerodynamic characteristics. Phonatory-Aerodynamic System (PAS) primarily examines the respiratory–phonatory interaction. The aim of the present study was to search the phonatory-aerodynamic characteristics of drama students.

Materials and Methods: A total of 37 vocally healthy participants aged between 21 and 30 years were separated into two groups; the first group included drama students (n=19), and the second group comprised lay talkers (n=18). Phonatory-aerodynamic evaluations were done via PENTAX Medical PAS Model6600.

Results: During the phonation of vowel [a], female and male drama students used greater percentage of vital capacity (VC) than public speaker couples. Similarly, findings indicated that female drama students used greater percentage of VC while producing syllables [papapapapa]. As for connected speech, female participants of both groups completed reading in similar durations, but they inspirated faster and they needed lesser number of inspirations.

Conclusion: It is concluded that the phonatory-aerodynamic characteristics of theater students are different compared with those of lay talkers predominantly for female participants. The present study's results may serve clinicians' basic objective data regarding the speech breathing characteristics of theater actors.

Keywords: Aerodynamics, phonation, voice, speech breathing, professional voice user

Cite this article as:
Esen Aydınlı F, Sezin RK, Özcebe E, Köse A, Günaydın RÖ. Phonatory-Aerodynamic Characteristics of Drama Students. Erciyes Med J 2019; 41(3): 275-81.

[1]Department of Speech and Language Therapy, Hacettepe University Faculty of Health Sciences, Ankara, Turkey
[2]Department of Speech and Language Therapy, Health Sciences University Faculty of Health Sciences, İstanbul, Turkey
[3]Division of Laryngology& Phonosurgery, Department of Otolaryngology-Head & Neck Surgery, Hacettepe University Faculty of Medicine, Ankara, Turkey

Submitted
03.01.2019

Accepted
27.05.2019

Available Online Date
18.08.2019

Correspondence
Fatma Esen Aydınlı, Hacettepe University Faculty of Health Sciences, Department of Speech and Language Therapy, 06100 Sıhhiye, Ankara, Turkey
Phone: +90 534 786 85 76
e-mail: fesen04@gmail.com

INTRODUCTION

Theater actors are considered as elite vocal performers, and they are defined as individuals whom slight deterioration of voice quality may have fearful consequences. They use their voices as a basic instrument in doing their jobs, and they use their voices more frequently and differently compared with lay talkers (1). Talking for hours, yelling, screaming, and imitating voices are the most commonly reported vocal abuse/misuse behaviors during their rehearsals and stage performances (2). In addition, they frequently use loudness and pitch variabilities. While speaking with a loud voice, suddenly, they may turn to whispering, and in the same stage, they may mimic both male and female voices. In addition, to react to the exact emotional state while acting, they make intonation and emphasis changes by using pitch-altering mechanism. Moreover, these behaviors may be associated with physical movements. Therefore, the speech characteristics of theater players are supposed to be different compared with those of lay talkers.

Production of speech is based mainly on the formation of voice. Voice production needs a complex interaction among several systems. One of these is the interaction of the respiratory and phonatory systems (3). The respiratory system should provide relatively constant airflow through the glottis by getting over the subglottal pressure. The exhalation phase of respiration provides primarily force source used in phonation. Moreover, expiratory flow must organize suitable aerodynamic forces to allow different articulatory effects for different speech sounds (3).

According to Hixon (4), mechanical patterns within the speech breathing system show a great variation between the individuals when they prepare to initiate and sustain phonation. In addition, some studies proposed that patterns of breathing while using theatrical voice or singing voice may differ from the voice used for conversational speech (4, 5).

Aerodynamic characteristics include air volume, air pressure, and air flow. In the measurement of air volume, direct and indirect methods are used. Indirect methods measure the relative change of dimensions in the abdomen and thoracic cage during respiration via respiratory magnetometer and respiratory inductance plethysmography. The direct measurement of air volume is done by putting a mouth mask via spirometer or pneumotacho-

Table 1. Age characteristics of female and male participants according to groups

	Group 1 Age		Group 2 Age		p
	Mean±SD	Min.–Max.	Mean±SD	Min.–Max.	
Female	23.50±1.71	21–26	23.60±3.20	21–29	0.579
Male	23.33±1.58	21–25	24.38±3.85	21–30	0.963

SD: Standard deviation; Min.: Minimum; Max: Maximum

graph (6). One of the tools involving a pneumotachograph is the Phonatory-Aerodynamic System (PAS). The PAS is a personal computer-based hard and software system that improves the clinical understanding of phonatory behaviors by providing indirect phonatory information about the valving activity of the larynx. It does not only provide information about breathing but also provide information about the interaction of the phonatory–respiratory mechanisms. The interaction between aerodynamic and vocal fold muscular forces generates the vocal fold vibration. Thus, as it is one of the main necessary components for phonation to occur, it is a must for voice clinicians to measure aerodynamic forces or stating more clearly the push and pull effect of the air flow and pressure (7).

The researches regarding theater actors' breathing during speech are mainly respiratory kinematics and muscular activity by using indirect air volume measures (4, 8, 9). To the best of our knowledge, there is no any particular study searching the phonatory-aerodynamic characteristics of theater actors. The aim of the present study was to search the phonatory-aerodynamic characteristics of drama students and to compare these with lay talkers.

MATERIALS and METHODS

All study procedures were approved by the ethical committee of the University of Hacettepe (project no. GO 19/237).

Settings

The theater actors were enrolled into the study from the volunteer students of Hacettepe University Ankara State Conservatory Department of Drama. Healthy control participants (lay talkers) were enrolled from the volunteers selected from the relatives of patients treated in the Hacettepe University Hospital, Speech and Language Therapy Unit. All the evaluation procedures were done in the Hacettepe University Hospital, Speech and Language Therapy Unit.

Participants

The participants of the study were separated into two groups; the first group consisted of drama students, and the second group consisted of nonprofessional healthy speakers (lay talkers). The study group participants were composed of the drama students included in the previous study (10). All of the selected participants did not have a voice disorder history and any voice complaints at the day of the evaluation. In addition, upper respiratory tract infections or nasal allergies were screened on the day of the evaluation since it was an exclusion criteria for the study. Furthermore, participants with systematic or neurologic disease and hearing loss were excluded from the study. All the participants' voices were listened by two experienced Speech and Language Pathologists (SLPs) and included in the study if they had audio-perceptually normal voice quality. In addition, participants with a voice handicap index-10 (VHI-10) score <7 were included. The theater actors were third- and fourth-year students, they had acting lessons in their curriculum, and they had been doing rehearsals and performing theater plays as part of their lessons. Theater players were excluded from the study if they had an abnormal result in the videolaryngostroboscopic (VLS) examination. Since gender-dependent variables were reported for the phonatory-aerodynamic measurements (7, 11), female and male participants were compared separately.

Participant Demographics

A total of 37 participants were included in the study. The age of the participants were between 21 and 30 years. In group 1 (n=19), 10 (52%) participants were female, and in group 2 (n=18), equal number of female participants comprised 55% of the whole group. The two groups were similar with regard to gender (p=0.858). The mean age±standard deviation (SD) was 23.94±3.404 years in group 1 and 23.42±1.610 years in group 2, and there was no significant difference between the groups with regard to age (p=0.685). In Table 1, female and male participants' age values according to the groups were also presented. According to Table 1, the age characteristics of male and female participants between the two groups were found to be similar. p-Values were equal to 0.579 for female and 0.963 for male participants.

Evaluations

VHI-10 questionnaire

VHI-10 is a self-rating questionnaire that reflects the perception of a patient's perceived voice handicap (12). The participants were asked to read sentences and rate them using a 5-point rating scale in which 0=never, 1=almost never, 2=sometimes, 3=almost always, and 4=always. This tool is used with the purpose of including vocally healthy participants.

Auditory-perceptual evaluation

The two experienced SLPs listened to the voice recordings of the participants while producing sustained phonation of [a] and CAPE-V/Turkish sentences (13). The CAPE-V/Turkish sentences were selected that have proven to be valid and reliable in the auditory-perceptual evaluation. If one of the SLP thought that the participant had dysphonia (even if mild), the participant was excluded from the study.

VLS examination

Since the theater actors are accepted as professional voice users and more prone to voice disorders, they had been examined by VLS. The KayPENTAX digital strobe (KayPENTAX, Lincoln Park, NJ, USA) was used for this purpose by an experienced ear, nose, and throat specialist. KayPENTAX Rls 9100 B tool was used for capturing images and recording voices. Participants who had any abnormality in the structure, mobility, or physiology of the larynx were excluded from the study.

Phonatory-aerodynamic evaluation

The phonatory-aerodynamic evaluations were made in a silent and well-lit room by using the PENTAX Medical PAS Model 6600 (KayPENTAX Corp. Montvale, NJ, USA). The calibration proce-

Table 2. Comparison of CSPH parameters between the groups in female participants

Variable	Group 1			Group 2			p
	Mean±SD	Median	Range	Mean±SD	Median	Range	
Mean SPL (dB)	76.06±4.96	76.25	70.02–83.79	75.72±4.31	74.51	67.50–82.64	0.870
Phon. time (s)	9.45±4.77	7.91	5.00–20.97	5.99±1.15	5.73	4.45–7.68	0.011*
Peak exp. airflow (L/s)	0.29±0.09	0.28	0.15–0.45	0.21±0.06	0.21	0.11–0.31	0.048
Mean exp. airflow (L/s)	0.21±0.68	0.22	0.08–0.29	0.16±0.05	0.16	0.08–0.26	0.062
Exp. volume (L)	1.80±0.46	2.02	0.69–2.28	0.99±0.44	0.91	0.36–1.94	0.002*

SPL: Sound pressure level; dB: Decibel; SD: Standard deviation; phon.: Phonation; exp.: Expiratory; s: Second; L: Liter; *p<0.025

dure was done according to the PAS manual. An experienced SLT explained each procedure before application. In this evaluation, the mask was placed to cover the mouth and nose of the participant attentively to prevent leaking of the air. Then, three recordings were gathered for the following protocols: comfortable sustained phonation (CSPH), voicing efficiency (VOEFF), and running speech (RUSP) protocols.

In the CSPH protocol, the participants were asked to place the mask after a deep inhalation and then sustained [a] phonation (minimum of 5 s) at a comfortable volume. Three recordings were done for each participant. In this protocol, mean sound pressure level (SPL), phonation time, peak expiratory airflow, mean expiratory airflow, and expiratory volume parameters were recorded. The mean values of the three recordings were calculated.

In the VOEFF protocol, an intraoral tube was placed in the mouth, and the participants were warned not to bite the tube. The participant was explained the rate of saying [pa] and also asked to follow the finger directions of the SLT for correct speed. In this protocol, the participants repeated the [pa] syllable five times for 1 cycle, and a total of three repetitions of each cycle were completed. Moreover, mean peak air pressure, expiratory volume, target airflow, and mean airflow during voicing parameters were taken into account.

In the RUSP protocol, the participants were asked to read the first four sentences of a phonetically balanced paragraph after taking a deep breath. During reading, they were also asked to continue inhaling and expiring through the mask. The number of inspiration, total reading time, expiratory airflow duration, inspiratory airflow duration, expiratory volume, peak inspiratory airflow, and inspiratory volume parameters were recorded.

Statistical Analysis

The SPSS version 22.0 software (SPSS Inc., Chicago, IL, USA) was used for statistical analyzes. Shapiro–Wilk test was used for testing normality. For the normally distributed variables, the groups were compared by using parametric Student's t-test. Non-parametric Mann–Whitney U test was used for comparing the values of non-normally distributed variables. The variance homogeneity and selected p-values were determined by Levene's test. Pearson chi-square test was used to examine the difference between the groups with regard to age and gender characteristics. Bonferroni correction was used for multiple testing. A p-value <0.025 was considered significant in Bonferroni-corrected tests.

RESULTS

The descriptive findings in each group for female participants and comparison of the same findings between the two groups of the CSPH protocol are presented in Table 2. According to Table 2, it is seen that mean comfortable phonation time was found to be 3.46 s longer in female drama students than in lay talker couples. In addition, during CSPH, female theater students used more expiratory volume, and they reached higher peak expiratory airflow values than lay talker couples: p-values were equal to 0.048 and 0.002 for the two parameters, respectively. Although mean expiratory airflow values were numerically higher in group 1, this difference was not found to be significantly important (p=0.062).

In addition, SPLs used in comfortable phonation were similar between the groups (p=0.870).

The descriptive findings in each group for male participants and comparison of the same findings between the two groups of the CSPH protocol are presented in Table 3. The expiratory volume parameter was the only parameter found to be significantly different between the groups (p=0.022). That is, male drama students used more expiratory volume in CSPH than lay talker couples. Although not statistically proven, the higher values gathered in theater players of mean SPLs and comfortable phonation time values compared with public couples were remarkable.

The descriptive findings in each group for female participants and comparison of the same findings between the two groups of the VOEFF protocol are shown in Table 4. In this protocol, although it was not significantly different between the groups, the mean peak air pressure, median was the only parameter that did not differ between the groups (p=0.143), whereas all the other parameters (expiratory volume, target airflow, and mean airflow during voicing) of this protocol were found to be higher in group 1 than in group 2. It is seen that syllables were produced with more expiratory airflow and more air in drama students than in lay talker couples.

The descriptive findings in each group for male participants and comparison of the same findings between the two groups of the VOEFF protocol are shown in Table 5. According to the findings, none of the VOEFF parameters were found to be different between the two groups.

In the RUSP protocol, female drama students (5.10±1.79) completed reading a paragraph with lesser inspirations than lay talkers (7.50±2.17). This difference was found to be significantly im-

Table 3. Comparison of CSPH parameters between the groups in male participants

Variable	Group 1			Group 2			p
	Mean±SD	Median	Range	Mean±SD	Median	Range	
Mean SPL (dB)	76.35±3.47	76.16	70.26–80.51	80.02±3.34	80.10	75.58–85.46	0.071
Phon. time (s)	11.46±6.29	10.15	5.35–26.14	6.93±2.51	5.95	5.30–12.51	0.071
Peak exp. airflow (L/s)	0.36±0.95	0.34	0.20–0.48	0.33±0.14	0.34	0.14–0.60	0.536
Mean exp. airflow (L/s)	0.23±0.09	0.23	0.08–0.37	0.21±0.11	0.22	0.07–0.38	0.754
Exp. volume (L)	2.32±0.70	2.43	1.07–3.40	1.37±0.61	1.48	0.57–2.43	0.020*

SPL: Sound pressure level; dB: Decibel; SD: Standard deviation; phon.: Phonation; exp.: Expiratory; s: Second; L: Liter; p<0.025

Table 4. Comparison of the VOEFF protocol parameters between the groups in female participants

Variable	Group 1			Group 2			p
	Mean±SD	Median	Range	Mean±SD	Median	Range	
Mean peak air pressure (cm H_2O)	10.30±5.40	9.91	5.03–23.59	7.21±2.06	6.45	4.87–10.86	0.143
Exp. volume (L)	0.09±0.05	0.10	0.03–0.19	0.04±0.02	0.04	0.01–0.08	0.012*
Target airflow (L/s)	0.20±0.08	0.21	0.09–0.33	0.11±0.05	0.12	0.01–0.20	0.025*
Mean airflow during voicing (L/s)	0.19±0.08	0.20	0.09–0.32	0.11±0.05	0.11	0.01–0.20	0.022*

cm: Centimeter; SD: Standard deviation; exp.: Expiratory; s: Second; L: Liter; *p<0.025

Table 5. Comparison of the VOEFF protocol parameters between the groups in male participants

Variable	Group 1			Group 2			p
	Mean±SD	Median	Range	Mean±SD	Median	Range	
Mean peak air pressure (cm H_2O)	6.87±2.41	7.27	4.22–10.06	8.92±2.31	8.54	6.16–13.06	0.174
Exp. volume (L)	0.08±0.04	0.09	0.01–0.15	0.12±0.06	0.11	0.04–0.24	0.252
Target airflow (L/s)	0.25±0.11	0.28	0.05–0.04	0.23±0.07	0.22	0.11–0.35	0.606
Mean airflow during voicing (L/s)	0.24±0.10	0.26	0.05–0.40	0.22±0.07	0.21	0.11–0.33	0.681

cm: Centimeter; SD: Standard deviation; exp.: Expiratory; s: Second; L: Liter

portant (p=0.015). Comparison of the other parameters of the RUSP protocol between the groups is shown in Figures 1 and 2. According to Figure 1, it is seen that drama students had significantly higher peak inspiratory airflow and higher peak expiratory airflow rates than lay talker couples. The mean and SD values of the peak inspiratory airflow parameter were 2.69±0.46 in group 1 and 1.89±0.57 in group 2. For the peak expiratory airflow parameter, they were 1.05±0.31 in group 1 and 0.74±0.16 in group 2. Expiratory volume value was numerically higher for female drama students than for lay talker couples, but the difference was not significant. Expiratory volume rates were 4.25±1.33 in drama students and 3.07±0.86 in lay talker couples. Although numerical inspiratory volume values of drama students (2.49±0.78) were higher than those of lay talkers (2.30±0.95), this was not significantly important. According to Figure 2, it is seen that both groups completed reading the paragraph in a similar total duration. To explain, female drama students read the paragraph in 15.56±1.55 s, and lay talkers completed to read in 16.65±1.14 s. Reviewing the inspiratory airflow duration, it is seen that female drama students inspirated faster (3.26±0.57) than lay talkers (4.28±0.59). However, it is seen that expiratory airflow durations were similar between the groups; mean values were 20.42±1.96 for drama students and 21.80±1.85 for lay talkers.

The descriptive findings in each group for male participants and comparison of the same findings between the two groups of the RUSP protocol are shown in Table 6.

In the RUSP parameters, peak inspiratory airflow was the only parameter that differed between the groups (p=0.002). It is seen that peak inspiratory airflow was higher in male drama students. In addition, expiratory volume was found to be numerically higher in group 1 with a relevant clinically valuable significant value, which was 0.065.

DISCUSSION

In speech breathing, the timing of inspiratory and expiratory phases, the volumes of air inhaled and exhaled, and the muscular

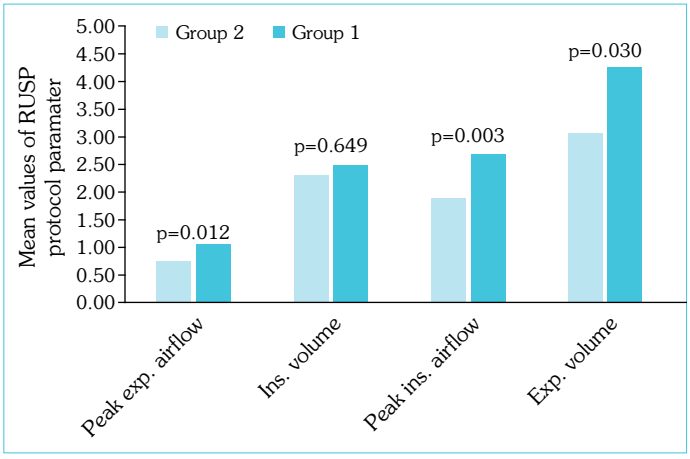

Figure 1. Comparison of the RUSP protocol parameters (peak expiratory airflow, inspiratory volume, peak ins. airflow and expiratory volume) between the groups in female participants

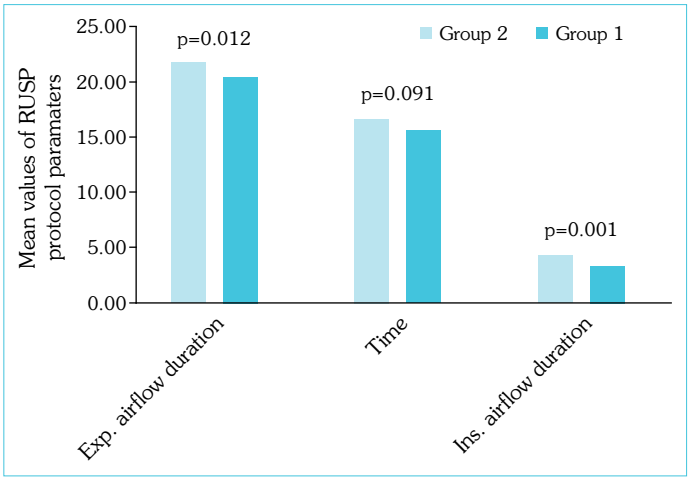

Figure 2. Comparison of the RUSP protocol parameters (expiratory airflow duration, inspiratory airflow duration, and time) between the groups in female participants

activity are found to be different compared with breathing at rest (14). Speech at normal loudness and effort levels usually starts at approximately 55% vital capacity (VC) level and terminates at approximately 35% VC level. In singing and theatrical speech, lung volume requirements were often found to be much greater, sometimes closer to 100% VC in long phrases or very loud productions (4). In the literature, data regarding speech breathing of theater actors are very limited with only respiratory kinematics methodology using indirect air volume measures. To the best of our knowledge, this is the first study searching the phonatory-aerodynamic characteristics of theater actors; thus, findings of each protocol are summarized and compared with the common findings in the literature.

According to the findings of the present study in the CSPH protocol, it is clearly seen that comfortable phonation time was found to be longer for female drama students than for lay talkers. Female drama students also used more expiratory volume during sustained vowel production. The results of this protocol implied that female drama students used greater percentage of VC while producing vowels. Similarly, male drama students in the present study were found to use greater percentage of VC than lay talkers. Findings of this protocol for female participants should be commented carefully since the longer comportable phonation duration in drama speakers may have affected the other parameters, such as higher expiratory air volume may have arisen from the longer phonation durations.

In the VOEFF protocol, it was pointed out that mean peak air pressure and maximum peak air pressure values were higher than the norms in healthy female lay talkers (7). In addition, in this protocol, airflow through the phonation was found to be higher in female drama students. These findings indicated that female drama students used greater percentage of VC while producing syllables [papapapapa].

As for the RUSP protocol, it was seen that both groups' participants completed reading in similar duration, but female drama students inspirated faster, and they needed lesser number of inspirations. Conversely, peak expiratory airflow values were higher. In male drama students, peak inspiratory airflow and expiratory volume differed clinically significantly compared with lay talkers. This difference may be as a result of passive and active force balance mechanisms used in drama students (14).

To summarize the findings of the present study in the three different speech tasks (sustained phonation, syllable, and reading

Table 6. Comparison of the RUSP protocol parameters between the groups in male participants

Variable	Group 1			Group 2			p
	Mean±SD	Median	Range	Mean±SD	Median	Range	
No. of insp.	5.50±1.51	6.00	2.00–7.00	5.87±2.64	6.00	2.00–9.00	0.505
Time	14.37±0.97	14.49	12.68–15.47	15.25±1.58	14.91	13.83–18.53	0.382
Exp. airflow duration	19.91±1.18	19.68	18.48–21.69	19.68±2.03	19.04	17.50–24.11	0.505
Ins. airflow duration	3.86±1.15	3.64	2.78–6.53	3.53±1.39	3.93	1.57–5.07	0.878
Exp. volume	4.89±1.66	5.54	1.41–6.51	3.82±0.54	3.96	2.86–4.46	0.065
Peak ins. airflow	2.89±0.31	2.93	2.46–3.40	2.13±0.70	2.33	0.46–2.73	0.002*
Ins. volume	3.18±0.72	3.00	2.64–4.89	2.53±1.43	3.05	0.10–4.01	0.720
Peak exp. airflow	1.39±0.44	1.24	0.81–2.02	1.06±0.23	0.99	0.84–1.49	0.195

n: Number; cm: Centimeter; SD: Standard deviation; exp.: Expiratory; insp.: Inspiratory; s: Second; L: Liter; *p<0.025

paragraph), female drama students showed great differences compared with lay talkers. For male participants, data available were not enough to make a precise comment; however, changes imply that the same respiratory–phonatory balance differences may be also valid for male participants. All these findings were thought to be compatible with the reports in the literature that suggested subglottal pressure needed for singing and other vocal performance activities was higher and more varied than that for typical conversational speech, such as louder speech of a reading task demands for a larger lung volume, with the speech limb starting at the higher lung capacity levels and sometimes finishing at lower levels than typical normal speech (4). In that study, the findings were related to the relative rib cage contribution to volume displacement, mean breathing frequency, and mean tidal volume expressed in percentage of VC. Theater actors who participated in the present study had voice and speech classes in each semester of their curriculums. In those classes, they learned techniques mainly on voice and breathing (15). In addition, during their rehearsals and stage performances, they were frequently exposed to prosodic, pitch, and intensity requirements that may have led to changes in their speech breathing mechanisms.

As a limitation of the present study, it can be stated that although drama students with similar educational background and similar age–gender were enrolled, some variables were not controlled. Body type, cognitive-linguistic factors, and style of breathing were the uncontrolled variables (12, 16). In the literature, it was thought that speech breathing characteristics were not different for male and female participants (9, 17). Lewandowski et al. (18) showed that phonatory airflow rates are higher for male participants; this difference is thought to be due to larger airway diameters. However, in the experimental study done via respiratory inductance plethysmography in healthy female participants, it was found that lung volumes showed great variability between the subjects and intersubjects over time during connected speech; however, the inspiratory location was relatively stable (8). It is thought that physical characteristics of male participants may have shown greater variability in the present study. Therefore, a higher number of participants may help to reach to validate these results. By also taking reported wide intra- and intervariability ranges of speech breathing characteristics into account (8), future studies including more male participants should be planned. In the cognitive-linguistic aspect, it was observed that drama students were more motivated to do their best. In addition, in reading speech, although they were not instructed, they were more prone to speak in a way such as they were on stage. In the linguistic aspect, the other factor was thought to be the speech task used. It was shown that reading speech and spontaneous speech tasks displayed different results in means of duration in healthy adults (19). Therefore, in future studies, the phonatory-aerodynamic characteristics during spontaneous speech or reading a real theatrical passage may be searched.

In conclusion, findings of the present study indicated that the phonatory-aerodynamic characteristics of drama students are different compared with those of lay talkers predominantly for female participants. The present study's results may serve clinicians' basic objective data regarding the speech breathing characteristics of theater actors. This data might be important especially on the rehabilitation and treatment process of voice professionals.

Acknowledgements: The authors declare that the study group participants were composed of drama students included in the previous study of the authors.

Ethics Committee Approval: All study procedures were approved by the ethical committee of the University of Hacettepe (project no. GO 19/237).

Informed Consent: Written informed consent was obtained from participants who participated in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – EÖ, FEA, AK; Design – FEA, AK; Supervision – EÖ; Materials – FEA, RKS, RÖG; Data Collection and/or Processing – FEA, RKS, RÖG; Analysis and/or Interpretation – FEA, RKS, RÖG; Literature Search – FEA, RKS; Writing – FEA, KS; Critical Reviews – EÖ, AK.

Conflict of Interest: The authors have no conflict of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

REFERENCES

1. Martin S. Voice care for the professional voice user. Freeman M, Fawcus M, editors. Voice Disorders and Their Management. London and Philadelphia: Whurr Publishers; 2000. p. 283.
2. D'haeseleer E, Meerschman I, Claeys S, Leyns C, Daelman J, Van Lierde K. Vocal Quality in Theater Actors. J Voice 2017; 31(4): 510.e7–510.e14. [CrossRef]
3. Rammage L, Morrison MD, Nichol H, Pullan B, editors. Management of the voice and its disorders. 2nd ed. Vancouver, Canada: Singular; 2001.
4. Hixon TJ. Respiratory Function in Speech and Song. 1th ed. Baltimore:Williams & Wilkins; 1987.
5. Hixon TJ, Watson PJ, Maher MZ, eds. Respiratory kinematics in classical (Shakespearean) actors. Hixon TJ, editors. Respiratory Function in Speech and Song. Boston: College Hill; 1987. p.375–400.
6. Hixon TJ, Weismer G, Hoit JD, eds. Preclinical speech science: Anatomy, physiology, acoustics, and perception. 2nd ed. San Diego: Plural Publishing; 2018.
7. Zraick RI, Smith-Olinde L, Shotts LL. Adult normative data for the KayPENTAX Phonatory Aerodynamic System Model 6600. J Voice 2012; 26(2): 164–76. [CrossRef]
8. Winkworth AL, Davis PJ, Ellis E, Adams RD. Variability and consistency in speech breathing during reading: lung volumes, speech intensity, and linguistic factors. J Speech Hear Res 1994; 37(3): 535–56.
9. Hodge MM, Putnam Rochet A. Characteristics of Speech Breathing in Young Women. JSLHR 1989; 32(3): 466–80. [CrossRef]
10. Sezin RK, Özcebe E, Aydinli FE, Köse A, Günaydin RÖ. Investigation of the Effectiveness of a Holistic Vocal Training Program Designed to Preserve Theatre Students' Vocal Health and Increase Their Vocal Performances; A Prospective Research Study. J Voice. 2018 Sep 17. doi: 10.1016/j.jvoice.2018.08.009. [Epub ahead of print]. [CrossRef]
11. Gartner-Schmidt JL, Hirai R, Dastolfo C, Rosen CA, Yu L, Gillespie AI. Phonatory aerodynamics in connected speech. Laryngoscope 2015; 125(12): 2764–71. [CrossRef]
12. Kiliç MA, Okur E, Yildirim I, Oğüt F, Denizoğlu I, Kizilay A, et al. [Reliability and validity of the Turkish version of the Voice Handicap Index]. [Article in Turkish] Kulak Burun Bogaz Ihtis Derg 2008; 18(3): 139–47.
13. Özcebe E, Aydinli FE, Tiğrak TK, İncebay Ö, Yilmaz T. Reliability and Validity of the Turkish Version of the Consensus Auditory-Perceptual Evaluation of Voice (CAPE-V). J Voice 2019; 33(3): 382.e1-382.e10.

14. Behrman A. Speech and voice science. 3rd ed. San Diego: Plural publishing; 2017.
15. Hacettepe University Course Catalog/ECTS Information Package. Available from: URL: http://akts.hacettepe.edu.tr/ders_detay.php?ders_ref=410c62645dbb918f015dbce1b6e401bb&ders_kod=T%DDY129&zs_link=1&prg_kod=481&submenuheader=2.
16. Mitchell HL, Hoit JD, Watson PJ. Cognitive-linguistic demands and speech breathing. J Speech Hear Res 1996; 39(1): 93–104. [CrossRef]
17. Hoit JD, Hixon TJ. Age and speech breathing. J Speech Hear Res 1987; 30(3): 351–66. [CrossRef]
18. Lewandowski A, Gillespie AI, Kridgen S, Jeong K, Yu L, Gartner-Schmidt J. Adult normative data for phonatory aerodynamics in connected speech. Laryngoscope 2018; 128(4): 909–14. [CrossRef]
19. Wang YT, Green JR, Nip IS, Kent RD, Kent JF. Breath group analysis for reading and spontaneous speech in healthy adults. Folia Phoniatr Logop 2010; 62(6): 297–302. [CrossRef]