Original Article

Maximum phonation time in Pakistani adults with normal voice

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Objective: To find Maximum phonation time (MPT) for normal Pakistani adults falling within the age range of 21-50 years and to examine interactions between trials of MPT, age, and gender.

Methodology: Two-stage sampling was employed. First, convenience sampling was used for approaching suitable participants, followed by purposive sampling. Participants were recruited from the students, staff and faculty of the University of the Punjab, Lahore, Pakistan, their families and the families of the clients consulting to the University Clinic for clinical services.

The subjects were divided into three age groups; 21-30 years, 31-40 years, and 41-50 years. The screening was done for any vocal/laryngeal disorder and only non-smokers or the ones who had quit smoking for more than five years were selected. After demonstrating an abbreviated model of Maximum Phonation Duration (MPD), at least three valid trials were recorded for each participant. Praat software was used for the recording and calculation of MPT. Repeated measures ANOVA was used for exploring MPT, as a function of gender, age, and trials.

Results: Out of 71 subjects, 34 were male and 37 female. Mean age was 33.9±8.20 years. No significant interactions were found between MPT trials, age, and gender. However, normal values of MPT for each age group and gender were obtained. The MPT values for men were found to be slightly higher as compared to women.

Conclusion: These results may be used as normal data during clinical voice assessment and treatment for Pakistani adults. (Rawal Med J 202;45:423-426).

Keywords: Maximum Phonation Time, MPT, Glottal efficiency, Praat.

INTRODUCTION

Maximum phonation time (MPT) is an important and most widely used clinical tool for glottal efficiency assessment. Due to its non-invasive nature and easy application, it has been widely adopted as an essential part of the assessment process of vocal disorders. Speech constitutes of voice as its most important auditory component, which is produced by the larynx. The process of sound production is called phonation, found to be the most advanced sensorimotor system in humans. It is carried out through the high-level organization of certain muscles, bones, cartilages, and other associated structures.[1] The vocal folds open and close rapidly, during the process of speech production or phonation.

The ability to easily bringing the vocal folds together, throughout their length, is very important for the production of good quality voice. The vibration of vocal folds occurs about 100 and 200 times per second, for adult males and females, respectively, during the phonation of voiced speech sounds.[2] The ability of closing (adduct) the vocal folds efficiently, is important both for normal healthy phonation, as well as for protecting the air passage from foreign particles. It is also necessary for the closure needed for a strong cough. This whole function is referred to as glottal efficiency.[2] The longest duration an individual can sustain of a vowel sound (typically /a:/), is called MPT.[3]

MPT is used to assess laryngeal function in different populations: normal healthy individuals,[3] patients with vocal nodules[4] and dysphonia.[5] MPT may be different between the people living in different countries and may also show age and gender differences.[6-8] Clinicians in Pakistan typically use general MPT ranges of 25-35 seconds and 15-25 seconds,[2] for adult men and women, respectively. This research was aimed to study the normal values of MPT in Pakistan adults aged between 21 to 50 years.

METHODOLOGY

This study was conducted in the acoustic lab of Centre for Clinical Psychology, University of the Punjab, Lahore. To recruit the study participants, two-stage sampling was used. First, convenience sampling was used to approach the prospective participants and then purposive sampling was employed. The individuals who volunteered to participate in the study were screened according to the following criteria: non-smoker/or the ones who did not smoke for at least 5 years; and must be able to phonate a vowel for a minimum of 10 seconds. Exclusion criteria were set to be having a recent voice problem/ disorder, taking any medication that may affect vocal programming, having any mouth, throat, or laryngeal anomaly and having received any formal vocal training, previously.

Seventy-one participants falling within the age range of 21-50 years were included in this study from the University students, staff, and faculty, researcher's family, friends, and acquaintances and the family members/caretakers of clients visiting clinical services of Center for Clinical Psychology, University of the Punjab. A health-related questionnaire developed by Goy et al[8] was also used to screen for any health problem. Permission was taken from the original author of the health-related questionnaire before starting the data collection.

All participants signed a consent form before starting the screening process. The first author asked the questions from the participants to fill the inclusion-exclusion sheet and the health-related questionnaire. The participants were requested to visit the acoustic lab for the voice sample recording. During the final data collection session, the first author demonstrated the task through an abbreviated model of MPD. The demonstration included how to phonate and sustain /a:/ for few seconds and the ending of phonation. Selected participants were instructed to stand upright and inhale maximum air and then phonate and sustain the vowel as long as possible at their normal volume even if their voice got strained. At least, three valid trials were recorded for each participant. During trials, water and time for vocal rest were provided.

This study was conducted as a part of an academic project and the recordings were done on the same equipment used in collective data collection procedure i.e. Dell Inspiron laptop and Praat software.[10] For each trial, the starting and ending points of the sound wave were identified and used to calculate MPT using Prat.

Statistical Analysis: For the data analyses, SPSS version 21 was used. Repeated measures analysis of variance (ANOVA) was employed, to explore MPT as a function of gender, age, and trials. Means and standard deviations of MPT were also found.

RESULTS

Table 1 presents the means and standard deviations of age in years across all the subgroups based on both gender and age groups. Table 2 shows the mean MPT values for adults within the age range of 21-30 years (M=14.68 sec.), 31-40 years (M=13.95 sec.), and 41-50 years (M=13.85 sec.). Men showed a mean MPT of 16.46 seconds for the age range of 21-30 years, 15.10 seconds for 31-40 years, and 14.83 seconds for 41-50 years. The mean values exhibited by women were 13.89 seconds for 21-30 years, 11.84 seconds for 31-40 years, and 13.42 seconds for 41-50 years. The mean values of trials 1, 2, and 3 were 14.20, 14.47 and 14.13 seconds, respectively. None of the interactions were found to be statistically significant ($p > 0.05$).

Table 1. Mean age (in Years).

	Age Groups	M	SD
Men	21-30	25.00	3.20
	31-40	35.36	2.17
	41-50	45.40	3.44
Women	21-30	25.65	1.77
	31-40	33.70	2.91
	41-50	44.10	3.18
Total	21-30	25.42	2.36
	31-40	34.67	2.58
	41-50	44.75	3.29
	21-50	33.99	8.30

Note. M = Mean; *SD* = Standard Deviation

Table 2. Means of MPT (in seconds) as a function of gender, age and trial.

Gender	Age Group	Trial 1	Trial 2	Trial 3	*M*	*SD*
Men (N = 34)	21-30	16.65	16.24	16.50	16.46	1.81
	31-40	15.72	15.14	14.44	15.10	1.58
	41-50	14.72	15.50	14.25	14.83	1.03
	Total	**15.70**	**15.57**	**14.99**	**15.42**	**0.87**
Women (N = 37)	21-30	13.53	14.43	13.71	13.89	1.65
	31-40	11.48	11.77	12.26	11.84	1.53
	41-50	12.98	13.52	13.75	13.42	1.01
	Total	**12.83**	**13.46**	**13.33**	**13.21**	**0.90**
Both (N = 71)	21-30	14.68	15.10	14.75	14.84	1.24
	31-40	13.95	13.73	13.53	13.74	1.15
	41-50	13.85	14.51	14.00	14.12	0.72
	Total	**14.20**	**14.47**	**14.13**	**14.27**	**0.64**
By Trials	*M*	14.20	14.47	14.13	14.27	
	SD	0.68	0.72	0.64	0.10	

Note. M = Mean; *SD* = Standard Deviation

Table 3. Normative Values for MPT (in seconds) bases of age and gender.

Men		Women		Total
Age	MPT	Age	MPT	MPT
21-30	16.46 ± 5.71	*21-30*	13.89 ± 6.80	
31-40	15.10 ± 5.91	*31-40*	11.84 ± 4.82	
41-50	14.83 ± 3.25	*41-50*	13.42 ± 3.19	
21-50	15.42 ± 5.10	*21-50*	13.21 ± 5.45	14.27 ± 5.36

Table 3 presents the normal values of MPT for men and women within the age groups of 21-30, 31-40, and 41-50 years. Values for the overall study age group i.e. 21-50 years are presented for both genders, separately and in combination. The MPT declined with age in men, whereas in women, MPT was lower in 31-40 years age group and higher for the other two groups. Also, the MPT was found to be slightly higher in men across all age groups as compared to that of women.

DISCUSSION

The present study found considerably lower mean values of MPT (M= 15.42 sec.; W= 13.21 sec.) as compared to the mean values reported for Taiwanese (M= 28.0 sec.; W= 22.6 sec.)[7] and Iranian adults (M= 26.30 sec.; W= 18.56 sec.).[6] This could be due to the difference between the glottal efficiency of Pakistani males as compared to Taiwanese and Iranians. MPT is estimated on the longest phonation on a vowel /a:/ on a rather comfortable phonation.

The effect of age and gender on MPT was seen to be non-significant in the present study. This result concurs with the studies conducted on the Iranian and Taiwanese populations.[6,7] Goy et al[8] reported that men had similar MPT over the ages (18-28 years & 63-86 years), however, older women (63-86 years) exhibited higher MPT values, as compared to the younger women (18-28 years). The difference in finding can probably be because of the reason that our study did not include participants older than 50 years, whereas, Goy et al[8] older participant group was within the age range of 63-86 years.

Dehqan et al[6] and Wang and Huang[7] reported that men had significantly higher MPT as compared to women. Pakistani men were found to have reduced MPT (15.42 sec.) as compared to the other populations (Taiwanese Men= 28.0 sec.; Iranian Men= 26.30 sec.). This may be the reason why Pakistani men and women's MPT values were not significantly different. Current MPT values are also different from the ranges that have been used by Pakistani clinicians i.e. 25-35 seconds for men and 15-25 seconds for women. Our results show this range to be 15.42±5.10 seconds for men and 13.21±5.45 seconds for women. The high variability of MPT depends on many factors e.g. the lung capacity, height, weight, etc. As we did not collect the height and weight data, we could not investigate the reason for such a significant difference in the MPT of Pakistani adults as compared to previously provided general MPT ranges.

It is assumed that MPT can be sustained for a longer time duration by men, as compared to women, due to their greater vital capacity.[3] Although statistically insignificant, our study showed higher MPT means (M) for men, as compared to women and supports this assumption.

As the main outcome of this research, normal values of studied acoustic parameters are generated for Pakistani men and women. We suggest that future research should be conducted with a larger sample size to validate these findings. Until then, these findings should be used carefully for the comparison of clinical data for voice assessment. Future

longitudinal studies should be designed to more specifically examine the age-related changes in MPT. One of the study limitations is a relatively smaller sample size. A study with a larger sample size might have produced more authentic results, thus, more clearly presenting the interactions between study variables. The number of trials required for the elicitation of MPT has been an important question. Most researchers have agreed that after providing clear instructions and demonstration, three trials are sufficient for this purpose.[4,5]

CONCLUSION

This study is one of the foremost voice projects in Pakistan, providing the normal values of MPT for the Pakistani adult population and extending the literature regarding normal MPT in different populations. The differences of MPT values over the age groups and gender were found to be statistically non-significant however, the mean values for MPT were also found to be stable over three trials.

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