Objective and Subjective Aspects of Voice in Pregnancy

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Summary: Objective. This study aimed to evaluate vocal changes in pregnancy according to trimesters both objectively and subjectively.

Methods. Fifty pregnant women and 15 nonpregnant women were included in the study. Eighteen of the 50 pregnant women were in the first trimester, 17 in the second trimester, and 15 in the third trimester of their pregnancies. The fundamental frequency (F0), jitter, shimmer, noise-to-harmonics ratio (NHR), and minimum and maximum pitch were determined during acoustic voice analysis. Laryngologic examination was evaluated via reflux finding score (RFS). Voice Handicap Index 10 (VHI-10) was used for subjective analysis.

Results. Maximum phonation time (MPT), VHI-10, and RFS were the parameters that differed significantly. MPT was significantly shorter in the third trimester. Acoustic analysis revealed that F0, jitter, shimmer, NHR, and minimum and maximum pitch values were not significantly different in any groups. RFS was higher in the first and third trimesters than the second trimester and control groups. VHI-10 scores were significantly higher in the third trimester.

Conclusions. Our results showed that MPT is decreased during the third trimester, although acoustic parameters did not differ. VHI-10 results deteriorated in the third trimester significantly.

Key Words: Pregnancy–Voice–Acoustic analysis–Aerodynamic–Voice Handicap Index–Quality of life.

INTRODUCTION

Voice is one of the main tools in human communication and social life.[1] The development of the human voice does not differ between the genders until puberty. The onset of puberty causes differentiation of the human larynx and voice under the influence of sex hormones. Females have shorter vocal cords, lesser transverse and sagittal infraglottic diameters, and lesser vital capacity in comparison with males. In addition, the angle between thyroid laminas is wider in females. These differences result in a higher fundamental frequency (F0) in females.[2] Besides the macroscopic changes, sex steroid hormones have effects on vocal folds via receptors in the cytoplasm and nucleus of vocal folds, and there are differences in the distribution of the receptors depending on age and sex.[3]

Studies on vocal changes related to hormone levels during the menstrual cycle showed that the best voice quality was obtained during the ovulatory phase, which represents the highest estrogen levels.[4] On the other hand, the premenstrual period, which has the lowest estrogen levels, causes a huskier voice, vocal fatigue, and loss of higher tone.[4–6]

Several studies of vocal changes during pregnancy, which is characterized by higher sex steroid levels, have been published so far,[7–10] but none of these studies compared the objective and subjective aspects of vocal changes during pregnancy according to trimesters in groups. Cassiraga et al[9] and Hamdan et al[10] studied only the third trimester. Other studies were longitudinal studies with only one pregnant woman.[7,8] In addition, none of the previous studies evaluated subjective aspects of the issue.

This study aimed to evaluate vocal changes in pregnancy according to trimesters both objectively and subjectively.

MATERIALS AND METHODS

Institutional review board approval was obtained from the Okmeydanı Training and Research Hospital Ethical Committee. Fifty healthy pregnant women and 15 healthy nonpregnant women were included in the study. Eighteen of the 50 pregnant women were in the first trimester, 17 in the second trimester, and 15 in the third trimester of their pregnancies. Fifteen women who had no complaint with their voices and no history of previous laryngologic disease were included in the study as control group. Voice professionals and women who had education for use of voice were not included to study to avoid bias. Women with upper respiratory tract infection, a history of laryngeal surgery or pathology, pulmonary problems, a history of head and neck radiotherapy, a history of rheumatologic disorders, smoking, or endocrinologic problems were excluded. In addition, women who had diagnosis of dysphonia, laryngeal organic pathology, or complaints related to voice before pregnancy were excluded. None of the pregnant women had polycystic ovary. All the pregnant women had single baby and none of them had cardiovascular problem or hypertension. Five pregnant women in the first trimester, four in the second trimester group, and 10 in the third trimester group had gastroesophageal reflux. Nausea was common in the first trimester: 14 women had nausea and eight of them had vomiting problem.

All subjects in all groups underwent complete head and neck examinations and acoustic and aerodynamic analysis. A rigid 70° telescope was used for endoscopic examination which was performed by Karl Storz Telecam DX II (Tuttlingen, Germany). Reflux finding score (RFS) was used for the assessment of examination. Voices were recorded using an AKG D5 dynamic microphone (AKG, Vienna, Austria) kept at a distance

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TABLE 1.
Demographic Data of the Pregnant and Nonpregnant Women

	1st Trimester (n = 18), Mean ± SD	2nd Trimester (n = 17), Mean ± SD	3rd Trimester (n = 15), Mean ± SD	Control (n = 15), Mean ± SD	*P*
Age	30.16 ± 7.43	27.47 ± 7.03	26.40 ± 6.75	28.60 ± 7.39	0.477
Weight gain (kg)	1.17 ± 0.68	4.18 ± 1.13	10.6 ± 2.2		

Abbreviation: SD, standard deviation.

of 15 cm from the lips. After a deep inspiration, the subject tried to say the vowel "ah" for as long as she could and repeated it three times, and the longest recording time was accepted as the maximum phonation time (MPT). Additionally, subjects were asked to read a phonetically balanced passage from a famous Turkish story titled "Diyet" for 40 seconds in a relaxed voice for acoustic analysis. The *Praat* software (Version 4.4.13; Boersma and Weenink, University of Amsterdam, Amsterdam, The Netherlands) was used for acoustic analysis. The F0, jitter, shimmer, noise-to-harmonics ratio (NHR), minimum and maximum pitch were determined during acoustic voice analysis. Subjective evaluation was performed using the Voice Handicap Index 10 (VHI-10). The Turkish version of VHI-10 was validated by Kılıç et al.[11] VHI-10 comprises 10 questions and is scored between 0 (never) and 4 (always). It has emotional, functional, and physical subscales with four, three, and three questions, respectively.

Statistical analysis of the data was conducted using *SPSS* Version 17.0 (IBM, USA). Data were analyzed using descriptive statistical methods (mean and standard deviation). The analysis of variance test was used for intergroup comparisons of data that were normally distributed, and post hoc Tukey honest significant difference test was used to determine from which group the difference arose. Results were evaluated using 95% confidence intervals, and the level of significance was set at $P < 0.05$.

RESULTS

The mean age of the pregnant study participants in their first, second, and third trimesters was 30.16 ± 7.43, 27.47 ± 7.03, and 26.40 ± 6.75 years. The mean age of the control group was 28.60 ± 7.39 years. Age did not differ significantly between groups (Table 1). Weight gain of the women is given at Table 1.

None of the women had subjective complaint about their voices. RFS results were 8.83 ± 2.00, 6.29 ± 1.96, 9.13 ± 1.55, 5.13 ± 1.92, respectively, in the first, the second, the third trimester, and the control group. Endoscopic larynx examination revealed that there was a significant difference in RFS scores ($P < 0.01$). Erythema/hyperemia score was higher in the first and third trimester groups that resulted in higher RFS scores in the first and the third trimester. Second trimester and control group were not different. None of the women had any structural or functional laryngologic pathology. Results of acoustic and aerodynamic analysis are summarized in

TABLE 2.
Results of Acoustic and Aerodynamic Analysis and Voice Handicap Index 10 of Pregnant and Nonpregnant Women

	1st Trimester (n = 18), Mean ± SD	2nd Trimester (n = 17), Mean ± SD	3rd Trimester (n = 15), Mean ± SD	Control (n = 15), Mean ± SD	df (Between Groups, Within Groups)	†*P*
F0	196.72 ± 17.21	200.05 ± 14.70	204.29 ± 14.34	198.23 ± 14.34	(3, 61)	0.532
Jitter	1.41 ± 0.23	1.40 ± 0.18	1.44 ± 0.17	1.40 ± 0.17	(3, 61)	0.904
Shimmer	0.33 ± 0.11	0.34 ± 0.10	0.34 ± 0.09	0.35 ± 0.09	(3, 61)	0.967
NHR	0.51 ± 0.14	0.49 ± 0.20	0.48 ± 0.15	0.49 ± 0.19	(3, 61)	0.967
MPT*	20.72 ± 2.85	19.12 ± 3.14	15.73 ± 3.11	21.13 ± 2.95	(3, 61)	>0.001
VHI-10*	5.67 ± 3.66	5.71 ± 3.60	9.87 ± 3.46	6.07 ± 3.54	(3, 61)	0.004
Pitch min	96.72 ± 8.10	97.94 ± 9.32	97.67 ± 12.24	97.13 ± 11.77	(3, 61)	0.986
Pitch max	434.78 ± 40.11	424.29 ± 35.86	410.27 ± 51.90	420.80 ± 39.43	(3, 61)	0.421
RFS*	8.83 ± 2.01	6.29 ± 1.96	9.13 ± 1.55	5.13 ± 1.92	(3, 61)	0.000

Abbreviations: SD, standard deviation; df, degrees of freedom; F0, fundamental frequency; NHR, noise-to-harmonics ratio; MPT, maximum phonation time; VHI-10, Voice Handicap Index 10; Pitch min, minimum pitch; Pitch max, maximum pitch; RFS, reflux finding score.
Pregnant and nonpregnant women degrees of freedom.
* $P < 0.05$.
† Analysis of variance.