

## EFFECT OF FACIAL SURGICAL MASKS ON VOCAL PRODUCTION: UNIVERSITY LECTURERS VERSUS UNIVERSITY WORKERS

### CERRAHİ MASKELERİN SES ÜRETİMİNE ETKİSİ: ÖĞRETİM ELEMANLARI İLE ÜNİVERSİTE ÇALIŞANLARININ KARŞILAŞTIRILMASI

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#### ÖZET

**Giriş:** Yüz maskesi kullanımı salgının başlangıcından bu yana yeni bir alışkanlık oldu. Bu yeni alışkanlık, insanları gerçek hayattaki iletişimde zorluklarla karşı karşıya bırakabilir. Bu çalışmanın amacı, cerrahi maskelerin Üniversite öğretim görevlileri (Akademik Personel) ve üniversite çalışanlarının (Akademik Personel) konuşma anlaşılabilirliği üzerindeki olası etkisini karşılaştırmaktır.

**Yöntemler:** Katılımcı olarak bir özel üniversitenin Akademik Personeli ve Akademik Personeli seçilmiştir (n = 32). Katılımcılara ses kullanımı ve maske kullanımına ilişkin anketler sunulmuş ve PRAAT ses analiz yazılımı ile akustik ses analizi yapılmıştır.

**Bulgular:** Her iki grupta da yalnızca HNR oranı ile nefes alma ve ses koordinasyonunda anlamlı fark gözlemlendi. Diğer parametreler anlamlı derecede farklı bulunmamıştır.

**Sonuç:** Yüz maskesi kullanımı solunum ve ses üretiminde koordinasyon bozukluğuna neden olabilir ancak akustik parametrelere etkisi olmamıştır.

**Anahtar Kelimeler:** Akustik analiz, COVID, ses, cerrahi maskeler, solunum ve ses, konuşma, vokal efor

#### ABSTRACT

**Introduction:** Use of facial masks have been a new habit since the beginning of pandemic. This new habit may lead people the to face difficulties in real life communication. The objective of this study to compare the possible effect of surgical masks on speech intelligibility of University lecturers (Academic Staff) and university workers (Academic Personnel).

**Methods:** Academic Staff and Academic Personnel of a private university were chosen as participants, (n = 32) . Questionnaires about vocal use and mask use were presented to participants and acoustic voice analysis by PRAAT voice analyser software was conducted.

**Results:** Only significant difference was observed in both groups was HNR ratio and breathing and vocal coordination. Other parameters were not significantly different.

**Conclusion:** Use of facial mask may cause incoordination in respiration and voice production, but they did not have an effect on acoustic parameters

**Keywords:** Acoustical analysis, COVID, voice, surgical masks, respiration and voice, speech, vocal effort

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#### INTRODUCTION

The COVID disease, which first emerged in China in 2019, has caused a great burden to the health system in the world. So far, the disease has been known to have an impact on different systems of human body including respiratory, neurological, cardiovascular systems, (1). Many studies from different health disciplines have revealed new observations of COVID related problems.

Since the pandemic began, many countries have mandated the use of facial surgical masks to keep the disease under control and prevent new infections. Body secretions and droplets from infected patients cause the infectious diseases like Sars-Cov2 to spread out faster and more, (2). Use of

medical face masks restrains the transmission of disease by preventing the dispersal of droplets in the air, (3).

With the use of facial masks, some changes in our daily communication also have occurred. The changes in the voice quality, related to the use of masks, have been believed to effect speech intelligibility. In a study (3), In one study, the voice parameters of workers using masks regularly during the pandemic were compared with workers working at home at the same period and it was observed that the group with masks had significantly higher vocal fatigue, lower speech intelligibility and breathing and voice production coordination scores. In another study by Mckenna et al (4) healthcare

workers reported vocal fatigue symptoms related to the use of masks and their acoustical measurements revealed an increase in harmonics to noise ratio (HNR) and vocal intensity and a decrease in the fundamental frequency.

A regular use of masks during a speech may lead talkers to increase loudness of their speech or vocal intensity (3, 5). As the vocal adjustment may not function correctly for every talker, a potential risk of vocal abuse due to extensive muscle tension may be higher during the use of masks, (6 – 9).

In order to assess vocal parameters, scientists utilize from objective and subjective methods, (10). The aim of this study is to compare acoustic measurements and self-reported voice quality results of the administrative personnel (AP) and academic staff (AS) in a university.

## METHODS

### Participants

The study included a total of 32 participants (20 academicians and 12 administrative personnel) of a private university between the ages of 22-65 (mean: 42.6; SD: 7.4) and carried out between March and May 2022. The gender distribution among the participants was heterogeneous. Exclusion criteria of the study were as following:

Suffering from vocal disorders before the pandemic

Existence of upper respiratory tract infection or COVID in 3 months before the onset of the research.

All participants confirmed that they only used surgical face masks. Study has been proved by the Ethical Committee of the university by the protocol number 22-15.

### Questionnaire

In this study, voice quality of the participants was examined by a questionnaire consisting of 26 questions. Questionnaire included the inquiries about general knowledge on vocal hygiene (average time of vocal use in a workday, smoking habits, average intake of water during the day, etc.) and self-reported observations about their average time of wearing a facial mask and voice use. A Likert scale was used both quantitative and qualitative scores.

### Acoustic Measurement

The voice recordings of the participants were recorded with the Audacity recording program. It was utilized from a sustained vocalization of /a/, /i/ and /u/ phonemes for recording. Carbon Premium Condenser Microphone (EM Series Carbon) with a frequency response of 20 -20000 Hz. was used for recording. Participants were seated with their mouths 15 cm away from the microphone All voice samples were recorded in a sound proof room (Istinye University Topkapi Campus No. 3B04 Sound Analysis Laboratory).

Voice recordings of both groups were analysed by the use of PRAAT voice analyse program (PRAAT version 6.2.23). Investigated parameters of the acoustical analysis were fundamental frequency (FF or f0), jitter, shimmer and noise to harmonics ratio (HNR).

### Statistical analysis

Questionnaire scores and acoustic measurement averages were analysed with SPSS (IBM SPSS Statistics 24.0 ) program with the use of Mann – Whitney U test as the distribution is non parametric.

## RESULTS

While the mean age of academic staff in the study was 39.2, it was 37.6 in administrative personnel group. Average scores of self-reported responses of both groups about their vocal hygiene may be seen in Table 1.

Based on the data in Table 1, there was no significant difference between AS and AP group in average time of voice use in both populations, ( $p \leq 0.43$  for males,  $p \leq 0.16$  for females). When the average water intake scores of two groups were compared, AS group was significantly consumed more, ( $p \leq 0, 018$ ). There was no significant difference between AS and AP group in average smoking consumption, ( $p \leq 0, 16$ ).

In Table 2, average scores about the use of facial masks and their possible effect on the voice were presented. Based on the results, mean mask using time did not differ significantly between two groups, ( $p \leq 0.10$ ). No significant difference was found about opinions of participants on the vocal problems due to possible effect of wearing a mask, ( $p \leq 0.35$ ). Average opinion on speech intelligibility also did not differ among the groups when both genders were compared. But for the male groups AD group had significantly more problems with the use of facial masks than the AS group ( $p \leq 0.9$ ). There is a significant difference on average opinion of participants about mask related voice effort problems, ( $p \leq 0.04$ ).

## DISCUSSION

The results indicated that both AS and AP group actually did not differ as their opinions on mask related voice problems. The most observed problem in both groups were the coordination of respiration and voice production. Both groups pointed out that they felt out of breath when they talk. Surprisingly, although the time with mask use was less, the rate of mask related problems was higher in the AP group. As the study was conducted after three years of mandatory surgical facial mask rules, we believe that people have been adapted to speak through a mask.

Acoustical measurements of two groups revealed a fact that wearing a mask did not have an impact on laryngeal muscle coordination or mechanism. Fundamental frequency, jitter and shimmer values of both group did not differ significantly, which may be interpreted that the time spent with a facial mask did not have a great impact on voice use. Results from different studies are also in competence with our findings (11 – 14).

**Table 1.** Questionnaire scores on vocal hygiene inquiries.

	Academic Staff (AS)			Administrative personell (AD)		
	Male (n=10)	Female (n=10)	Total	Male (n=6)	Female (n=6)	Total
Average time of voice use	4.4 hours	4.3 hours	4.35 hours	4.3 hours	4.8 hours	4.55 hours
Average water intake (perday)	1.9 lt	2.5 lt	2.2 lt	1 lt	1.8 lt	1.4 lt
Average smoking consumption (perday)	6 cigarettes	7 cigarettes	6.5 cigarettes	13.3 cigarettes	9.1 cigarettes	11.1 cigarettes

**Table 2.** Average scores of questions about use of facial masks and their possible effects.

	Academic Staff (AS)			Administrative personell (AD)		
	Male (n=10)	Female (n=10)	Total	Male (n=6)	Female (n=6)	Total
Average time of mask use	3.3 hours	4 hours	3.7 hours	1.8 hours	3.1 hours	2.5 hours
Average opinion about mask and voice problems	2.1	2.9	2.5	3.2	2.2	2.7
Average opinion about speech intelligibility problems	2.3	2.8	2.55	3.7	2.7	3.2
Average opinion about difficulty in breathing and voice coordination	2.4	3.6	3	3.8	3.8	3.8

**Table 3.** Acoustic Measurements of Two Groups for /a/, /e/, /i/ phonemes.

	Male			Female		
	AS group (n=10)	AP group (n=6)	p (z score)	AS group (n=10)	AS group (n=6)	p (z score)
<b>Mean Fundamental Frequency (F0) (Hz)</b>						
/a/	141,485	119,940	0.4	207,397	211,220	0.72
/e/	135,348	120	0.21	194,307	210,105	0.48
/i/	139,117	121,971	0.29	204,207	199,078	0.67
<b>Jitter</b>						
/a/	0,325	0,527	0.21	0,512	0,567	0.43
/e/	0,413	0,556	0.67	0,404	0,419	0.72
/i/	0,233	0,344	0.14	0,424	0,374	0.35
<b>Shimmer</b>						
/a/	4.112	3.808	1	4.365	5.132	0.35
/e/	3.705	4.175	0.4	4.398	4.220	0.67
/i/	2.913	3.067	0.4	3.831	4.324	0.48
<b>Harmonics to Noise Ratio (HNR)</b>						
/a/	20.816	18.921	0.33	20.077	17.664	0.15
/e/	19.893	17.866	0.10	19.724	17.299	0.10
/i/	24.220	20.673	*0.04	20.538	20.222	0.64

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Acoustical measurements of two groups revealed a fact that wearing a mask did not have an impact on laryngeal muscle coordination or mechanism. Fundamental frequency, jitter and shimmer values of both group did not differ significantly, which may be interpreted that the time spent with a facial mask did not have a great impact on voice use. Results from

different studies are also in competence with our findings (11 – 14).

Only difference was found in the HNR ratio of /i/ phoneme. Note that although the p values of other parameters was very close to each other, p values about HNR parameters were much different and very close to significant difference limits. As HNR is a parameter about the noise in the voice production, it may be a sign of incoordination about the breathing discomfort with a mask. These results may support opinions of participants about the respiration and vocalization difficulties. Karagkouni 2021 (15) also found a similar finding and noted that participants of the study mostly suffered from voice and breathing coordination while they were talking.

Speaking with a mask in front of the mouth is an experience of filter effect. The decreases exhalation effect creates a

phenomenon of reduced intensity for voice users, (16). As for the majority of people in the world speaking through a mask has been a new experience since the beginning of the mandatory rules, the vocal adjustment by user may not be achieved well. An increased vocal effort may lead to secondary behavioural voice abuse if the vocal adjustment may not function well (17). Fiorella et al, 2021 (13) found out that using a mask did not have an effect on a particular speech sound characteristic but as an individual level it decreased the speech intensity. In another study by Nyugen et al (18) also compared the possible effect of KN95 and surgical masks on speech spectrum and claimed that there was a decrease in the speech intensity at about 5.2 dB for KN95 and 2 dB for surgical masks. Similarly, Knowles and Badh (19); noted that speech characteristics were significantly had a lower energy specifically in the mid frequencies while the talker were wearing a surgical mask. All these findings are consistent with the increased vocal effort and abnormal HNR results of our study.

### CONCLUSION

Although the study revealed that there is no statistically significant relation between speech characteristics and mask use, acoustic analysis confirmed abnormal results in HNR ratio and the majority of participants reported breathing and speech incoordination. Longitudinal follow-up of these individuals is important to prevent a possible voice problem to be occurred in the future.

**Ethics Committee Approval:** The study was conducted in accordance with the Helsinki Declaration and approved by İstinye University Human Studies Ethical Comitee with protocol number 22-15 in February, 2022. Written informed consents were taken from each participants.

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