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The Effect of Personal Face Mask Use on Hearing Sensitivity Awareness

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ABSTRACT

Background and Objectives: The speech information obtained from the acoustic cue alone is not sufficient. The visual component of speech is crucial for speech perception. This study aims to show that individual hearing sensitivity awareness has increased due to the blocking of visual components of speech as a result of the use of personal face masks with the Covid 19 pandemic.

Subjects and Methods: A scale was prepared with questions that measured individuals' ability to use auditory stimuli in various conditions before and after the pandemic. The scale prepared consists of two sections and a total of 15 items. The questions in the first section are about pre-pandemic hearing loss awareness, and the second section is about post-pandemic hearing loss awareness. The age average of 1046 people included in the study was 49.47 ± 11.06.

Results: Those who do not feel the need to repeat what was spoken in face-to-face meetings before the pandemic need to repeat what was spoken significantly after the pandemic ($p<0.001$). The findings show the increased need to repeat spoken words in individuals who wear face masks. Also, people have trouble recognizing speech in noisy environments is due to the absence of visual speech cues, compared to the absence of such trouble before the pandemic.

Conclusion: The use of personal face masks in the post-pandemic period has changed the awareness of individual hearing sensitivity due to the disappearance of the visual element of speech.

Keywords: Covid-19, Hearing Loss, Mask

Kişisel Yüz maskesi kullanımının İşitme Hassasiyetine Etkisi

ÖZET

Amaç: Konuşma algısı için, akustik ipuçlarından elde edilen konuşma bilgisi tek başına yeterli değildir. Konuşmanın görsel bileşenleri de konuşma algısı için çok önemlidir. Covid 19 pandemisi nedeni ile kişisel maske kullanımı zorunlu hale gelmiştir. Bu çalışma, kişisel yüz maskelerinin konuşmanın görsel bileşenlerinin engellenmesi nedeniyle bireysel işitme duyarlılığı farkındalığının arttığını göstermeyi amaçlamaktadır.

Gereç ve Yöntemler: Pandemi öncesi ve sonrasında bireylerin çeşitli durumlarda işitsel uyaranları kullanma becerilerini ölçen sorulardan oluşan bir ölçek hazırlanmıştır. Hazırlanan ölçek iki bölüm ve toplam 15 maddeden oluşmaktadır. Birinci bölümdeki sorular pandemi öncesi işitme kaybı farkındalığı ile ilgili, ikinci bölümde ise pandemi sonrası işitme kaybı farkındalığı ile ilgili sorular yer almaktadır. Araştırmaya dahil edilen 1046 kişinin yaş ortalaması 49.47 ± 11.06'dır.

Bulgular: Pandemi öncesinde yüz yüze yapılan görüşmelerde konuşulanları tekrar etme ihtiyacı hissetmeyenler, pandemi sonrasında önemli ölçüde konuşulanları tekrarlatma ihtiyacı duymaktadır ($p<0,001$). Bulgularımız, maske takan kişiler konuştuğunda, dinleyicilerin kelimeleri tekrar etme ihtiyacının arttığını göstermektedir. Ayrıca, katılımcılar pandemi öncesinde gürültülü ortamlarda konuşmayı tanımada güçlük çekmezken, pandemi sonrasında problem yaşadıklarını bildirmişlerdir. Bu durum görsel konuşma ipuçlarının maske ile engelleniyor olmasından kaynaklanmaktadır.

Sonuç: Pandemi sonrası dönemde kişisel yüz maskelerinin kullanılması, konuşmanın görsel unsurunun ortadan kalkması nedeniyle bireysel işitme duyarlılığı farkındalığını değiştirmiştir.

Anahtar Kelimeler: Covid-19, İşitme Kaybı, Maske

Hearing loss is gradually progressed and is linked to aging, as in presbycusis, and therefore, not easily noticed. Since the information received from auditory stimuli decreases due to hearing loss, communication skills are maintained by other pragmatic properties of language and visual speech cues (i.e., lip reading) (1). Most individuals are not even aware of this process.

The Corona Virus Pandemic Infection 'COVID-19' was first reported in Wuhan, Chi-na, in December 2019. On March 11th, 2020, the World Health Organization (WHO) declared COVID-19 a pandemic (2). The COVID-19 pandemic has caused severe effects on public health on a global scale. In line with the recommendations of the World Health Organization, each country has introduced its own public health measures in order to bring the pandemic under control. The most contagion of COVID-19 is known to be respiratory transfer. Therefore, the most effective protection method is the use of personal face masks. As of April 3rd, 2020, restrictions im-posed in Turkey also included a prohibition on going out without wearing a face mask (3).

It is known that hearing loss increases social isolation, and therefore those with hearing loss communicate less with other individuals. People with hearing loss are able to maintain communication with the support of speech cues such as visual cues and lip-reading (4,5). During the pandemic period, individuals with age-related hearing loss have become more socially isolated due to the quarantine restrictions and social dis-tance precautions introduced after the outbreak. In addition, the use of personal face masks has also increased the communication problems of these individuals.

This study aims to suggest that as a result of personal face mask use, the visual com-ponent of the speech is inhibited, and since the speech information derived from acoustic cue on its own is not sufficient, the hearing sensitivity awareness of individu-als has been on the increase since the COVID-19 pandemic period.

SUBJECTS AND METHODS

The study has been approved by Ethics Committee meeting no 2020/20 with the deci-sion number 2020-20/10 on the date of September 17th, 2020.

In this study, a questionnaire was designed with a number of questions measuring individuals' ability to use auditory stimuli in various conditions before and after the pandemic. The questionnaire consisted of two sections and a total of 15 items. The questions in the first section are about pre-pandemic hearing loss awareness, and the second section is about post-pandemic hearing loss awareness.

The study sample group consisted of voluntary individuals between the ages of 40-99. The questionnaire was transmitted to individuals face-to-face and in question-and-answer form or by providing answers to the digital version of the questionnaire through the application of WhatsApp via Google Forms. In order to ensure the anonymity of the study, demographic information was not included; however, only age and gender were questioned for statistical analysis.

Statistical Method

The descriptive statistics of the data are given as frequency (percentage) for categori-cal data, while for the numeric variables, it has been given as average ± standard devi-ation. The McNemar test was used to evaluate the difference between categorical de-pendent variables, and Pearson Chi-Square test was used to determine the difference between categorical independent variables. All statistical analyses were examined and reported at α=0.05 significance level in IBM SPSS Statistics 22.0.

RESULTS

The age average of 1046 people included in the study was found to be 49.47 ± 11.06. It was found that 624 (59.7%) people were female, and 422 (40.3%) people were male.

According to the Kuder Richardson-20 (KR-20) method used in the evaluation of Test Measurement Reliability, the reliability coefficient was found to be 0.86. Accord-ing to this coefficient, the measurement tool is reliable.

The questions used in the measurement tool were given in Figure-1, and the statistical frequency distribution of all questions applied was given in Figure-2.

The results of the statistical evaluation of 4 dependent questions pre-pandemic and pan-demic periods are presented below.

Answers to the questions regarding the need to turn on the TV volume or hearing phone and/or doorbell ringing (indoor questions) are similar in pre-pandemic and pandemic periods. (p=1)

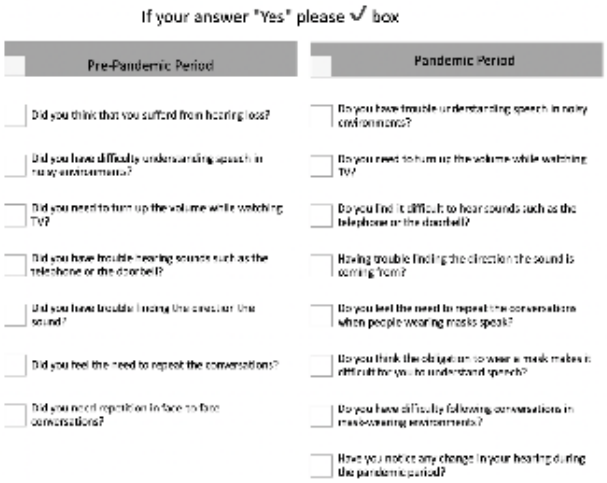

Figure 1: Auditory Sensitivity Awareness Questionnaire Form

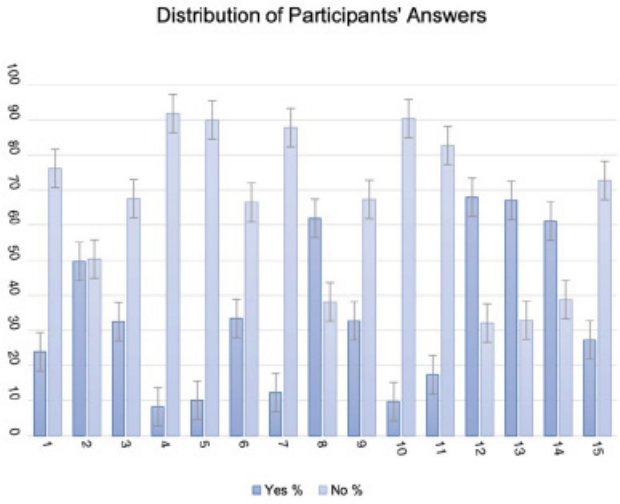

Figure-2: Distribution of Questions in the Measuring Instrument
** Data is described in frequency (percentages).*

The number of individuals who did not assume to have a hearing loss problem in the pre-pandemic period and found it hard to speech discrimination in noisy environments (outdoor questions) in the pandemic period is statistically significant when compared to individuals who thought to have a hearing problem in the pre-pandemic period (p<0.001).

While individuals who found it trouble to find the direction of sounds in the pre-pandemic period continued to have trouble in the pandemic period, 8,8% of individu-als who didn't have trouble in the pre-pandemic period reported having trouble find-ing the sound directions in the pandemic period (p<0.001) (Table 1).

Correlations between the independent questions asked in pre-pandemic and pandemic periods were evaluated. It was concluded that individuals began to have difficulty in speech recognition in noisy environments with the introduction of a personal face mask even though they did not think that they had hearing loss after the pandemic (p<0.001) (Table 2).

The need for asking individuals wearing a face mask to repeat spoken words during the pandemic period was statistically significant in individuals who did not have trou-ble in identifying the direction of the sound pre-pandemic period compared to those with such trouble (p<0.001) (Table 3).

The percentage of individuals who thought that the requirement for wearing a face mask after the pandemic made it difficult to recognize speech was found to be signif-icantly higher in individuals who did not have trouble in identifying the direction of sound pre-pandemic period as compared to those having trouble in identifying the direction of sound (p<0.001) (Table 4).

The need to repeat the conversations when people spoke with masks pandemic period was found significantly higher in individuals who didn't need to repeat the conversstions in the pre-pandemic period than those who felt the need to repeat the conversa-tions before the pandemic period. (p<0.001) (Table 5).

The percentage of individuals who thought that there were some changes in their hear-ing after the pandemic was significantly higher for individuals who did not feel the need for the repetition of spoken words during face-to-face conversations before the pandem-ic as compared to those who needed such repetition (p<0.001) (Table 6).

Table-1: Evaluation of Pre-Pandemic & Post-Pandemic Dependent Questions in the Ques-tionnaire					
Pre-Pandemic			**Post-Pandemic**		**p-value**
			Yes	**No**	
Difficulty understanding speech in noisy environments	**Yes**	**n**	467	46	**p<0.001**
		%	72.6%	11.7%	
	No	**n**	176	346	
		%	27.4%	88.3%	
The need to turn up the volume while watching TV	**Yes**	**n**	292	45	1
		%	86.40%	6.40%	
	No	**n**	46	655	
		%	13.60%	93.60%	
Trouble hearing sounds such as the telephone or the doorbell	**Yes**	**n**	72	11	**0.009**
		%	72%	1.20%	
	No	**n**	28	922	
		%	28%	98.80%	
Trouble finding the direction the sound	**Yes**	**n**	97	6	**p<0.001**
		%	54.20%	0.70%	
	No	**n**	82	848	
		%	45.80%	99.30%	
**p-value is the one found in McNemar's test.*					

Table-2: Evaluation of the Correlation Between Perceived Hearing Loss Before the Pandemic and Experiencing Difficulty in Speech Recognition in Noisy Environments After the Pandemic					
Pre-Pandemic			**Do you have any difficulty in understanding conversations in noisy environments after the pandemic?**		**p-value**
			Yes	**No**	
Do you think you have any hearing loss?	**Yes**	**n**	227	17	**p<0.001**
		%	35.7%	4.3%	
	No	**n**	409	377	
		%	64.3%	95.7%	
**p-values are those found in Pearson's chi-squared test*					

Table-3: Evaluation of the Correlation Between Experiencing Difficulty in Identifying the Direction of Sound Before the Pandemic and the Need for the Repetition of Conversations by Individuals Wearing a Face Mask After the Pandemic					
			Do you feel the need for the repetition of conversations by individuals wear-ing a face mask after the pandemic?		**p-value**
			Yes	**No**	
Did you have trouble finding the direction the sound?	**Yes**	**n**	90	13	**p<0.001**
		%	12.8%	3.9%	
	No	**n**	612	319	
		%	87.2%	96.1%	
**p-values are those found in Pearson's chi-squared test*					

Table-4: Evaluation of the Correlation Between Experiencing Difficulty in Identifying the Direction of Sound Before the Pandemic and Experiencing Difficulty in Speech Recognition Due to the Requirement for Wearing a Face Mask After the Pandemic

			Do you think that the requirement for wearing a face mask after the pandemic has made it more difficult for you to understand conversations?		p-value
			Yes	No	
Did you have trouble finding the direction the sound?	Yes	n	83	19	p<0.001
		%	11.9%	5.6%	
	No	n	612	323	
		%	88.1%	94.4%	

*p-values are those found in Pearson's chi-squared test

Table-5: Evaluation of the Correlation Between the Need for the Repetition of Conversations Before the Pandemic and Experiencing Difficulty in Speech Recognition Due to the Requirement for Wearing a Face Mask After the Pandemic

			Do you feel the need for the repetition of conversations by individuals wearing a face mask after the pandemic?		p-value
			Yes	No	
Did you need repetition in face-to-face conversations before the pandemic?	Yes	n	300	44	p<0.001
		%	42.9%	13.3%	
	No	n	399	288	
		%	57.1%	86.7%	

*p-values are those found in Pearson's chi-squared test

Table-6: Evaluation of the Correlation Between the Need for the Repetition of Conversations During Face-to-Face Conversations Before the Pandemic and Perceived Change in Hearing After the Pandemic

			Have you noticed any change in your hearing during the pandemic?		p-value
			Yes	No	
Did you need repetition in face-to-face conversations before the pandemic?	Yes	n	58	70	p<0.001
		%	20.6%	9.3%	
	No	n	223	682	
		%	79.4%	90.7%	

*p-values are those found in Pearson's chi-squared test

DISCUSSION

Hearing losses are mainly characterized by gradual progression and are irreversible in many cases. However, as age-related changes are frequently observed, individuals often wait until older to undergo auditory assessments. In addition, visual speech cues have been removed due to the requirement for wearing a personal face mask after the outbreak of the COVID-19 pandemic.

The lack of visual speech cues is therefore con-sidered the main reason for the change in the perceptions of individuals regarding their auditory sensitivity and an increase in their awareness of hearing loss. The objec-tive of this study is to conduct a statistical evaluation of the change in such individual awareness.

The questionnaire was administered to individuals between the ages of 40 and 99 by taking into consideration the fact that hearing loss is associated with aging and inherently characterized by gradual progression. The reliability coefficient was calculated as 0.86 based on KR-20 analysis. This value is considered reliable for psychometric questionnaire studies. The survey included questions such as "Need to turn up the volume while watching TV and have difficulty hearing certain sounds such as phone ringing, doorbell," which were not related to wearing a face mask but related to in-door conditions. In addition, dependent questions for this pre-pandemic and pandem-ic period were evaluated as a preliminary assessment. As expected, no significant change was observed in the answers provided by participants to these questions. However, statistically significant changes were identified in the answers provided to the questions related to speech recognition in noisy environments (outdoor conditions) and the identification of the direction of the sound. Such changes are anticipated as a result of face mask use. The results obtained from dependent questions are in line with the expectation and demonstrate that participants' answers are consistent.

The link between suspected hearing loss in the pre-pandemic period and understand-ing speech in pandemic noise was investigated.

They reported that although the participants had no suspected hearing loss in the pre-pandemic period, their ability to distinguish in noisy environments was impaired dur-ing the pandemic period.

Participants who did not feel the need to repeat spoken words in face-to-face conver-sations before the pandemic reported that their need for repetition increased significantly after the pandemic (if the speaker was wearing a face mask), and they felt im-paired speech. Auditory and visual speech signals are produced through the vocal ap-paratus of the speaker. Time-dependent variations in phonetic and kinematic patterns are strongly correlated. People use these visual and auditory correlations to decode the message more effectively during face-to-face conversations (6-10).

Speech perception has been researched through the use of various methods over the years. Speech perception is inherently a multimodal form of perception (9). Such type of perception is established by a combination of various visual, auditory, and sensory stimuli and cues. As in the McGurk effect, acoustic information is not reliable on its own without the visual components of the speech (11). Visual speech may increase the comprehensibility of auditory speech, especially in cases where the speech contains complex messages. With the McGurk effect, auditory information is improved by tactile stimuli and the articulating face. Observable speech cues have an effect on the manner of hearing the speech (12).

The findings suggest that the increased need for the repetition of spoken words by individuals wearing a face mask and having trouble in speech recognition in noisy environments after the pandemic compared to the absence of such difficulty before the pandemic result from the lack of visual speech cues (13-17).

As mentioned in the results of the study by Jaekl et al., it is evident that dynamically- structured facial information increases the comprehensibility of speech in terms of audio-visual speech perception (18). Face mask use leads to the presentation of only the isolated acoustic content of the speech information. Individuals who did not have any difficulty in identifying the direction of sound before the pandemic reported that they felt an increased need for the repetition of spoken words by individuals wearing a face mask in addition to experiencing greater difficulty in speech recognition after the pan-demic. This finding is an indication that such individuals were unable to adequately analyze isolated auditory information in environments where people have to wear a face mask. This may have resulted from two main reasons: (i) the absence of visual components in speech and (ii) decreased acoustic transmission (19). Presuma-bly, such individuals were those who thought that their hearing abilities were quite normal before the pandemic. As demonstrated in this study, increased difficulty in speech recognition in noisy environments after the pandemic can be explained by the lack of visual speech cues resulting from the use of face masks by individuals in such environments. Similarly, individuals who did not have any difficulty identifying the direction of sound before the pandemic felt an increased need for the repetition of spoken words by people wearing a face mask after the pandemic indicates that such individuals had increased awareness of their hearing losses. The increased demand for hearing aids after the pandemic is another indication of this awareness (20).

CONCLUSION

According to the analysis conducted, it was concluded that the hearing-related prob-lems of those who did not

have any hearing-related complaints in the pre-pandemic period have significantly increased after the pandemic with the constant use of per-sonal face masks.

The questionnaire designed for this study is intended to contribute to the awareness of auditory sensitivity and allow for the regular recording of statistics.

DECLARATIONS

Conflict of Interest

The authors declare that they have no conflict of interest.

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