Acoustic and Auditory Effects of COVID-19 Masks on Speech/Voice Communication

Introduction

COVID-19 is a world-wide pandemic that has affected components of everyday living. Amidst this pandemic, The World Health Organization recommends people to “maintain at least a 1-metre distance between yourself and others to reduce your risk of infection when they cough, sneeze or speak.” They also recommend to “make wearing a mask a normal part of being around other people.” Because of this, there is a barrier between speaker and listener(s). This hindrance in speech and several other areas of communication is an issue that can potentially lead to the development of a voice disorder. Speech communication is hindered by Personal Protective Equipment (PPE). PPE includes the use of face masks and shields, which prevent the free flow of air from the mouth and nose during speech. This muffles the individual’s spoken utterances, reduces visual cues such as the movement of the lips, facial expression, and makes inhalation difficult. The absence of visual cues and altered speech put the listener and speaker at a disadvantage. PPE forces speakers to communicate and put more effort into projecting themselves when in conversation. This research seeks to measure the change in speech in spectral characteristics and at the decibel level. Testing the acoustic and auditory changes of speech/voice using these measurements will provide empirical evidence on what listeners may miss during conversation.

Methods

Subjects: Subjects were recruited through advertisements placed within the campus of Lamar University, Beaumont, Texas. Recruited subjects also were recommended by friends and family to participate in this study. Only subjects with a healthy voice were accepted to participate in the study. We were given consent from the subjects to participate in this study and each subject was scheduled a specific time to record the speech sample. A total of 18 subjects were scheduled (10 males, 8 females), however, data that qualified for analysis were from 8 males and 8 females. The age range was between 18-24 years with a mean of 21.2 years. All the subjects were
students. Following COVID-19 protocol, sanitation was done at the end of each session on items that were used by researchers and subjects.

Protocol: All subjects were given the same directions and list of sentences for the speech/voice sample.

Speech sample included the following:

(a) Steady vowel /a/ and /i/

(b) Sentences from CAPE-V form, a form with standard sentences and tasks for clinical voice analysis.

Analysis:

Subjective Analysis: Data from subjects who were perceived to be phono-normal were analyzed.

Objective Analysis: Acoustic and Closed Quotient measures were analyzed for vowel /a/ and the sentence /we were away a year ago/. Acoustic measure reported here is the decibel level in dBSPL measured using Praat 6.0.37 a software frequently used for voice and speech analysis. Closed Quotient, a measure reflecting the contact duration of vocal folds during speech, measured by EFxHist 2.0.

Results

Comparisons were made for the vocal intensity of vowels, sentence reading, and spontaneous speech with and without masks. The closed quotient and decibel levels were recorded for each of these vocal tasks with and without masks. Spontaneous speech was only measured in decibels. A difference greater than 1.5 dB is classified as the criterion for significant change in vocal intensity. The vowel change data shows that 8 out of 16 subjects (3 male and 5 female) increased in vocal intensity in order to project through the face mask, and the remaining subjects projected at a softer vocal intensity or at the same volume as without mask. 4 out of 16 subjects (2 male and 2 female) in the reading task increased in volume as the remaining 12 did not exceed the intensity without mask. However, the spontaneous speech chart shows that 12 out of 16 subjects (6 male and 6 female) showed significant increase in vocal intensity. The increase in subjects projecting with the masks in spontaneous speech may be due to the spontaneity of the subjects’ response, whereas the vowel and reading tasks required more of an experimental sample.
Discussion

Wearing a mask covers the oral and nasal area, which dampens the energy of sound going through the mask. Our subjects were realizing this subconsciously during communication, which increased their vocal effort shown by the increase in vocal intensity and closed quotient. If a subject continues to speak at that increased vocal effort level, it will lead to vocal fatigue and a progressive loss of vocal endurance. Mask usage creates a barrier that hinders voice communication which will increase the chance of a subject to develop a voice disorder. Because of this, communities need to be educated on how to safely use and project voice while wearing face masks.
Professions that rely on vocal communication need to invest in vocal hygiene training in order to decrease the likelihood of voice disorders.

At the beginning of the research, a small Bluetooth speaker playing a triangular wave at 120 Hz was placed at the mouth level of a mannequin head to simulate a scenario of speech communication. A high-fidelity condenser microphone was placed 12 inches away from the head and acted as the listener. A sound level meter was placed at the same level as the microphone to measure sound pressure level in decibels. This was done in order to accurately measure how much sound a face mask blocks from a listener. Praat results indicated a drop in 1 dBSPL during “with mask” condition. Spectral analysis surprisingly showed that sound from the speaker loses higher harmonics without the mask interfering. This means that the face mask is somehow able to project higher levels of harmonics with clarity. Further research needs to be conducted in order to explain this phenomenon.

Acknowledgements

This study was funded by a grant awarded by the Office of Undergraduate Research, Lamar University, Beaumont, Texas.

References