Introduction

Since the start of COVID-19, healthcare professionals have been required to wear face masks (simple surgical, N95, etc.)

Masks negatively impact acoustic (spectral information) [1] and visual information (facial expressions and lip-reading) conveyed during speech.

Little information is available on how face masks add to the communication challenges of the speaker, especially in those with high occupational vocal demands.

Purpose: (1) Summarize frequency of self-perceived communication problems and vocal symptoms; (2) Compare voice acoustics before and after occupational voice loading; (3) Assess self-perceptual ratings of dyspnea and vocal effort before and after occupational vocal loading.

Hypothesis: Mask-wearing occupational voice users would show evidence of vocal fatigue – quantified as acoustic manifestations of increased vocal effort and laryngeal muscle tension – over a single workday.

Methods

Participants: 18 adult English speaking healthcare workers (11 cisgender female, 7 cisgender male, M= 33.72 years, SD = 8.30) wearing face masks > 6 hours/day. On the day of the evaluation, participants reported working an average of 9.1 hours/day using verbal communication throughout the day.

Protocol: Participants completed two sessions during the study. One session occurred prior to the beginning of the work-day (“pre-workday”) and the second session occurred immediately following the work-day (“post-workday”). During each session, acoustic and perceptual data were collected from participants. During the first session, participants answered Likert rating scale questions to assess their speech, voice, and communication while wearing a face mask. Acoustic data were collected via a headset microphone and handheld recorder with the participant’s mask off. Following recordings, perceptual ratings of vocal effort (100-mm visual analog scale) and dyspnea (modified Borg rating scale for dyspnea) [2] were made.

Data Processing: The measurements extracted from the acoustic signal included: spectral and cepstral measures, relative fundamental frequency (RFF) offset cycle 10 and onset cycle 1, vowel acoustics (HNR (dB), vocal intensity (dB SPL)), and formant-based estimates of vocal tract length (VTL). Perceptual measures were degree of vocal effort and dyspnea following speech readings.

Statistical Analysis: Mixed-effect models were performed to analyze each acoustic and perceptual measure separately. Two-way interactions were examined between fixed effects (session, sex, and mask type).

Results

Summary Statistics: Participants rated their experiences of mask-based communication and voice. Overall, participants rated questions pertaining to their personal communication and vocal health a 3 (“Sometimes”) on a Likert Rating Scale from 1 (“Never”) to 5 (“Always”).

Statistical Results: Acoustic – Main effect of session was significant for vocal intensity with greater intensities exhibited post-workday (M= 84.67 dBSPL) compared to pre-workday (M= 83.00 dBSPL). Likewise, a significant increase in HNR was noted post-workday (M= 19.53 dB) compared to pre-workday (M= 18.53 dB). Two-way interaction effects were found for RFF offset 10; participants who wore N95 masks exhibited a significant reduction in RFF offset 10 post-workday compared to pre-workday. Perceptual – Impact of session was significant for vocal effort with an increase in effort ratings post-workday (M = 27mm) compared to pre-workday (M = 10mm).

Conclusion: We found a significant increase in self-rated vocal effort post-workday with further report of feeling increased vocal effort at a frequency of “almost always.” Self-reports were consistent with post-workday acoustic changes, including a significant reduction in RFF offset 10, increase in HNR, and increase in vocal intensity.

Acknowledgements: This work was supported by the National Center for Advancing Translational Sciences of the National Institutes of Health (UL1TR001425-05A1). This work is in press at the Journal of Voice.

We would like to acknowledge Renee Gustin, M.S., CCC-SLP and Rebecca Howell, M.D., for their contributions to this work.

Citations