

# Ambulatory Voice Monitoring of a Muslim Imam During Ramadan

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## Purpose

Occupational voice users include **religious leaders** who often exhibit symptoms of voice disorders due to prolonged voice use, challenging room acoustics, far speaking distances, etc. This study describes the **high degree of voice use** by an imam who chants extended prayer cycles during the month of Ramadan. Acoustic, aerodynamic, and endoscopic assessments complement **ambulatory voice monitoring** data obtained over 12 days.

## Prolonged Voice Use During Ramadan

**Ramadan** is a month where Muslims fast from dawn to sunset, refraining from both eating and drinking. The purpose of this holy month is to dedicate one's time to worshipping, purifying the soul, and practicing self-sacrifice.



**Imams** lead and chant prayers in Islamic places of worship (mosques), hold leadership positions within the Muslim community, and provide religious services and guidance. During Ramadan, imams chant **lengthy prayer cycles** that may lead to increased vocal effort and fatigue.

Imams recite the Holy Qur'an using **specific linguistic rules**—*Tajweed* and *Tarteel*—that specify syllable durations, rhythm, vocal timbre, and pronunciation. Reciting the Qur'an may be treated similar to the **vocal performance** of professionally trained singers.

## Methods

**Participant:** 26-year-old part-time imam who chanted the extended *Taraweeh* prayer for 2 hours after sunset (~10:00 pm to midnight). He led prayers using a microphone for amplification in a mid-sized room with the audience seated directly behind him.

### Ambulatory Assessment (12 days)



Smartphone-based **voice health monitor**<sup>1</sup> yielded traditional measures of voice use and vocal dose<sup>2</sup>:

- Sound pressure level (dB SPL)
- Fundamental frequency (Hz)
- Phonation time (%)
- Cycle dose (number of vocal fold oscillations)
- Distance dose (distance traveled by vocal folds)

### Laboratory Assessment (First and last week)



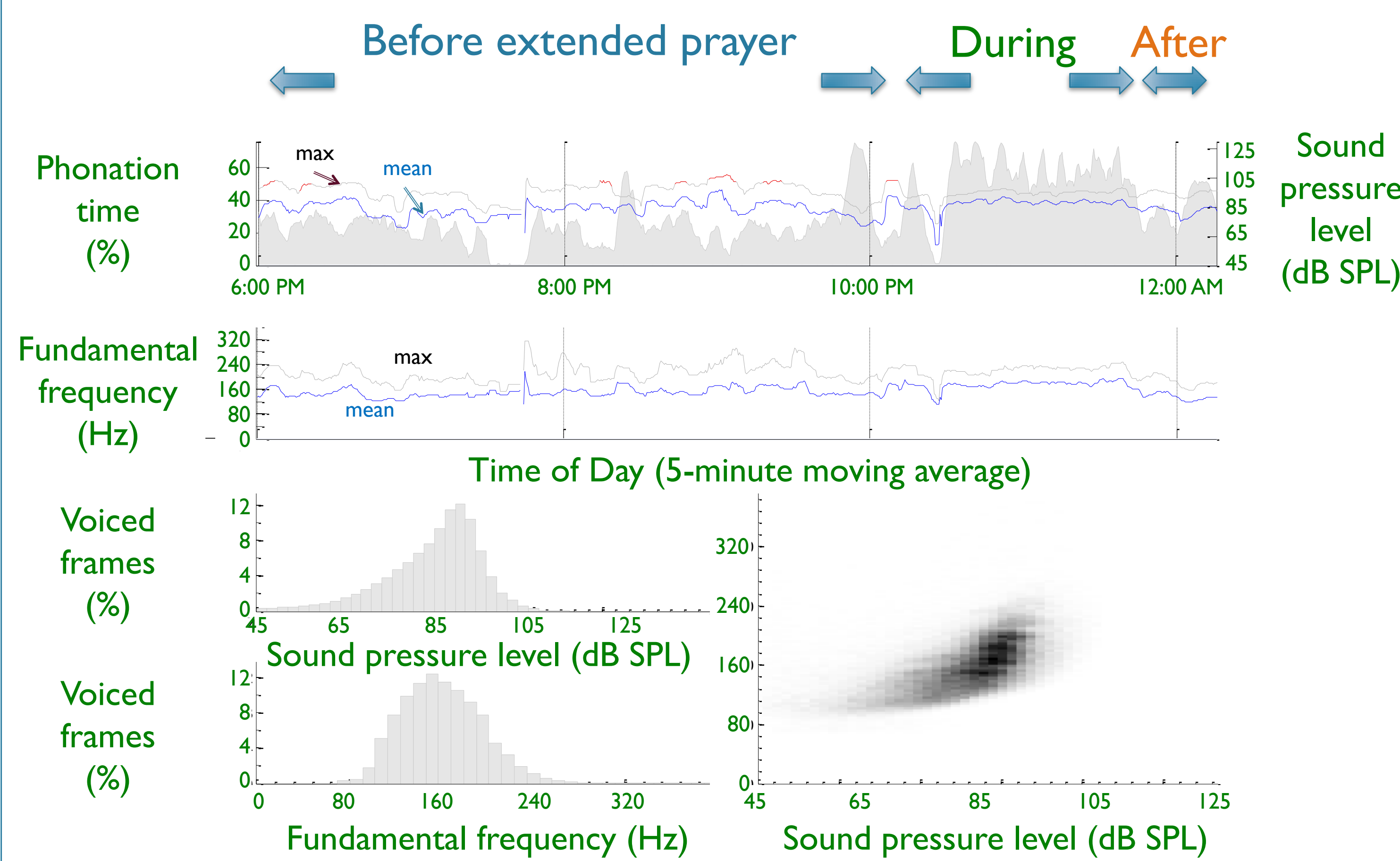
Pneumotachograph mask yielded clinical assessment of voice and speech on **8th and 29th day** of Ramadan:

- Vowel /a/ at typical/loud levels
- Rainbow Passage
- Laryngeal videostroboscopy
- Acoustic measures of voice quality
- Aerodynamic assessment of airflow and subglottal pressure

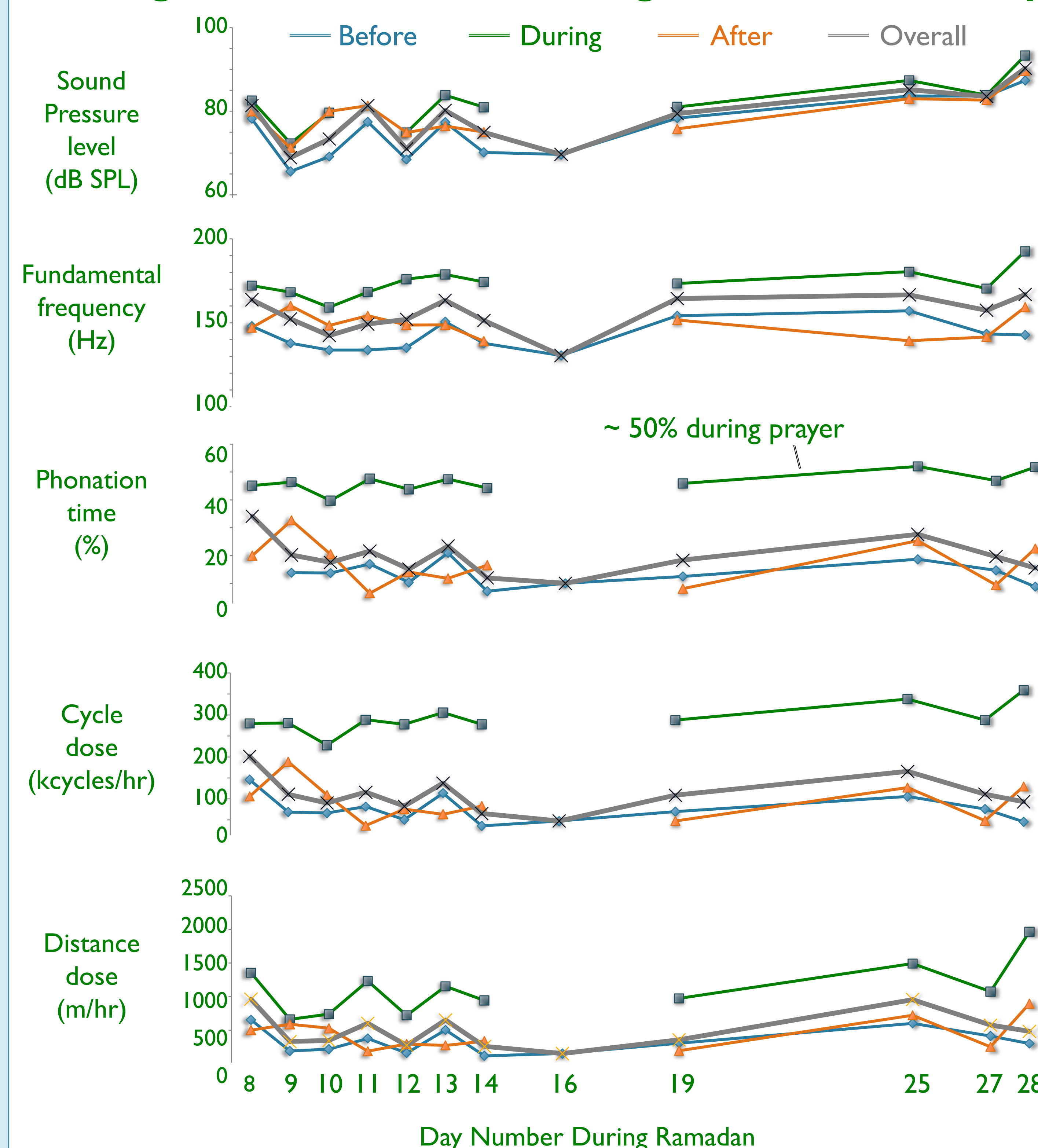
## Results: Ambulatory Assessment

### Example Voice Use Profile on 25<sup>th</sup> Day of Ramadan

Total duration	6 hr 22 min 12 s
Phonation time	27.63%
Fundamental frequency mode	152.0 Hz
Fundamental frequency mean	166.6 Hz
Sound pressure level mean	85.2 dB SPL re 15 cm
Cycle dose	1,055,695 cycles
Distance dose	6,085 meters



### Average Voice Use Before, During, After Extended Prayer



## Results: Laboratory Assessment

### Acoustic Measures

	Normative range <sup>3</sup>	Day 8	Day 29
<b>Sustained Vowel /a/</b>			
Jitter (%)	≤ 1.04	0.22	0.20
Shimmer (%)	≤ 3.81	1.69	1.48
Noise-to-harmonics ratio	≤ 0.19	0.12	0.10
Cepstral/Spectral Index of Dysphonia		-6.8 (normal)	-20.3 (normal)
<b>Rainbow Passage</b>			
Average F0 (Hz)		161.6	148.3
Standard deviation of F0 (Hz)		33.5	26.6
Highest F0 (Hz)		299.1	251.7
Lowest F0 (Hz)		74.3	69.9
Cepstral/Spectral Index of Dysphonia		-33.5 (normal)	-34.7 (normal)

### Aerodynamic Measures

	Normative range	Day 8	Day 29
<b>Typical Speaking Voice</b>			
Air Flow (L/sec)	0.07–0.33	0.26	<b>0.34</b>
Air Pressure (cm H <sub>2</sub> O)	≤ 8.76	7.43	<b>12.92</b>
Efficiency (dB/cm H <sub>2</sub> O)	≥ 8.6	11.35	<b>7.19</b>
<b>Loud Speaking Voice</b>			
Air Flow (L/sec)	0.07–0.37	<b>0.45</b>	<b>0.55</b>
Air Pressure (cm H <sub>2</sub> O)	≤ 13.66	11.08	<b>16.18</b>
Efficiency (dB/cm H <sub>2</sub> O)	≥ 6.1	8.23	<b>6.05</b>

(**Bolding** = value out of normative range)

## Conclusion

### Elevated daily voice use exhibited

Initial results indicated **phonation time as high as 50%** during prayer chanting periods lasting approximately two hours. This vocal load is similar to or higher than vocal doses reported for teachers and vocalists during periods of occupation-related voice use.<sup>4</sup>

Sound pressure level, fundamental frequency, phonation time, cycle dose, and distance dose were **elevated during prayer chanting** compared with daytime vocal dose levels.

### Laboratory measures outside normative ranges

Whereas vowel perturbation measures were normal, **air flow, subglottal pressure, and vocal efficiency ratios** yielded values outside normative ranges at the end of the month, suggesting increased vocal effort due to extended periods of vocal demand.

In both endoscopic assessments, the imam's vocal folds exhibited **mild fibrovascular changes** consistent with heavy voice use.

## References

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