**BACKGROUND**

**What is relative fundamental frequency (RFF)?**
- Acoustic metric of cycle-by-cycle changes in voice fundamental frequency ($f_0$) during voicing transitions
- Instantaneous $f_0$ of 10 voicing cycles around voiceless consonant
- Allows for within- and across-subject comparisons due to $f_0$ normalization (semitones; ST)

Why is RFF clinically useful?
- Offset cycle 10 and onset cycle 1 (cycles closest to the voiceless consonant) are clinical indicators of vocal effort and laryngeal tension

**PURPOSE**

Despite the clinical utility of RFF, a critical review of the literature has not been completed.

This review aims to:
- describe methods frequently employed to calculate RFF
- provide a summary of findings across specific patient populations
- identify next steps for implementing and interpreting RFF measures in clinical practice

**METHODS**

- Systematic literature search completed across 5 databases in Feb-2020 (updated Apr-2021) [1]
- Eligibility criteria:
  - Inclusion:
    - Human subjects
    - English language
    - Measured RFF (ST)
  - Exclusion:
    - Conference abstracts
    - Case study, single subject design, meta-analysis or review
    - Non-normalized $f_0$ (Hz)
- Two authors extracted study data, including: population, methods for obtaining RFF (speech stimuli, signal processing), and voicing cycle values (offset 10, onset 1)

**RESULTS**

- Only 37 of 5693 articles for review met our inclusion criteria (spanning 1998–2021)
- Speech stimuli:
  - Vowel-consonant-vowel utterances (n=17)
  - Running speech (n=18)
  - Both stimuli (n=2)
- Study populations:
  - Vocally healthy adults (n=29)
  - Muscle tension dysphonia (n=17)
  - Phonotraumatic lesions (n=11)
  - Parkinson’s disease (n=6)
  - Spasmodic dysphonia (n=6)
  - Older adults (n=9)
  - Children (n=3)
- Only 4 of 37 studies tracked therapeutic progress, involving those with muscle tension dysphonia, phonotraumatic lesions, and vocal fatigue
- Inconsistent relationships between RFF and auditory-perceptual metrics
  - Moderate relationships between measures of vocal strain/effort and RFF, with stronger relationships when examined within-subject [2]
  - Whether RFF relates to overall dysphonia severity is still in need of investigation

**DISCUSSION & CLINICAL IMPLICATIONS**

- Open-source algorithms allow for fast, reliable RFF computation
- Measures of RFF from microphones and accelerometers allow for both in-office voice evaluations and ambulatory monitoring initiatives
- As current clinical assessments rely on subjective measures, objective estimates of RFF could reduce clinician interpretation discrepancies

Clinical Implications
- More large-scale treatment studies needed
- Automated RFF extraction needed in widely available software for clinical implementation
- Studies needed to determine viability of algorithmic extraction methods for running speech

**CONCLUSIONS**

Rapid advances in algorithmic RFF extraction is making it a more viable clinical option. More work is needed to understand within-subject clinical tracking for patient applications.