Remote monitoring of speech in HD using mobile devices

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on behalf of **DOMINO-HD consortium**

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Speech in Huntington's disease

DOMINOHD

Speech impairment can be widely present in HD. In a previous study (40 participants with HD), some degree in speech impairment was detected in 93% of the cohort[1].
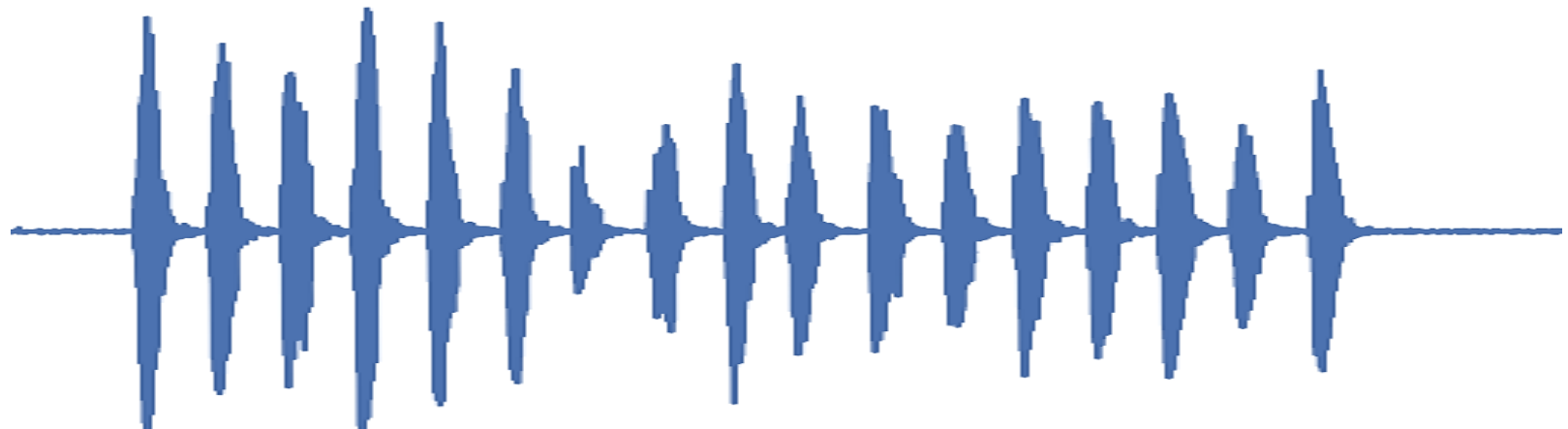
Below are commonly analysed acoustic measures/features in HD[1,2,3] that will be addressed in this study.

	Fundamental frequency and its standard deviation	Jitter and five-point perturbation	Shimmer	Harmonics-to-noise-ratio
Features				
Abbreviation	f0 and f0_std	j%, PPQ5	s%	HNR
Description	Frequency of vocal fold vibration and its variation[2,3]	Variability of f0 in consecutive intervals and across five cycles[2,3]	Variability of maximum amplitude within each vocal cycle[2,3]	Ratio of tonal components of speech and the noise due to incomplete vocal fold closure [2,3]
References	[1] Rusz, Jan, et al. *Journal of Neural Transmission* (2014) [2] Rusz, Jan, et al. *PloS one* (2014) [3] Riad, Rachid, et al. *arXiv preprint arXiv:2006.05365* (2020)			

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Aims

1. Investigate accuracy of acoustic voice features estimated from data recorded using mobile devices when compared with data recorded using laboratory gold standard equipment.

2. Examine differences between acoustic voice features recorded in participants with Huntington's disease and control volunteers.
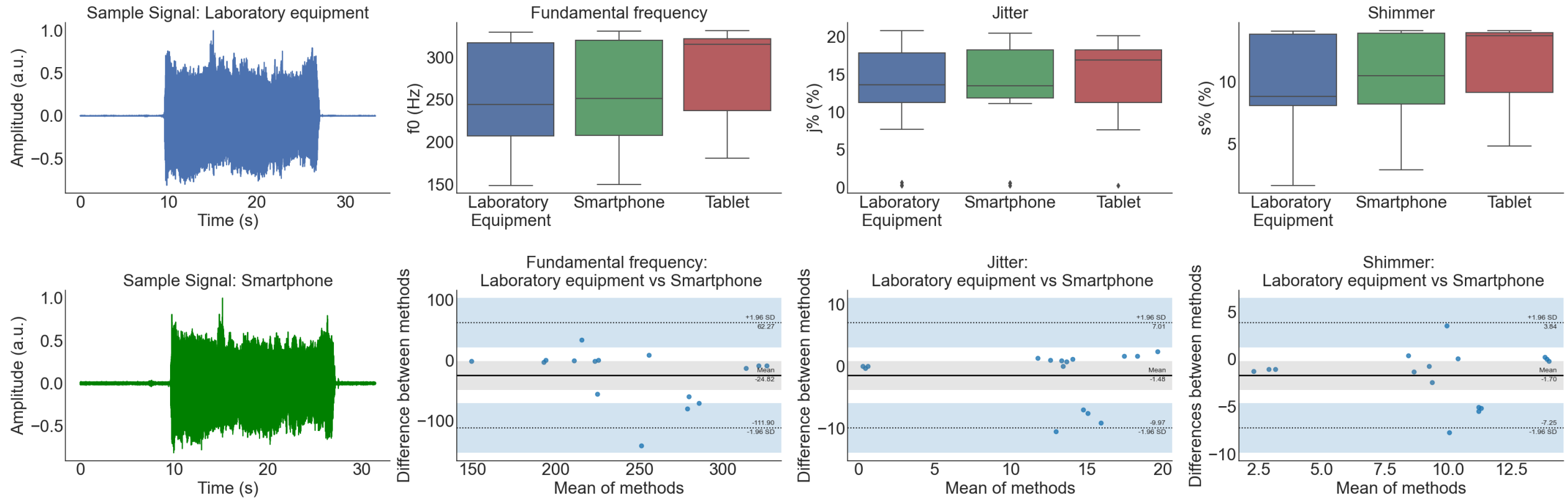
Methods

Methods

1. Consistency of protocol was ensured across site locations by controlling the audio recording mobile application, the sampling rate and format of the audio files.

2. Recruitment was done according to the below criteria.

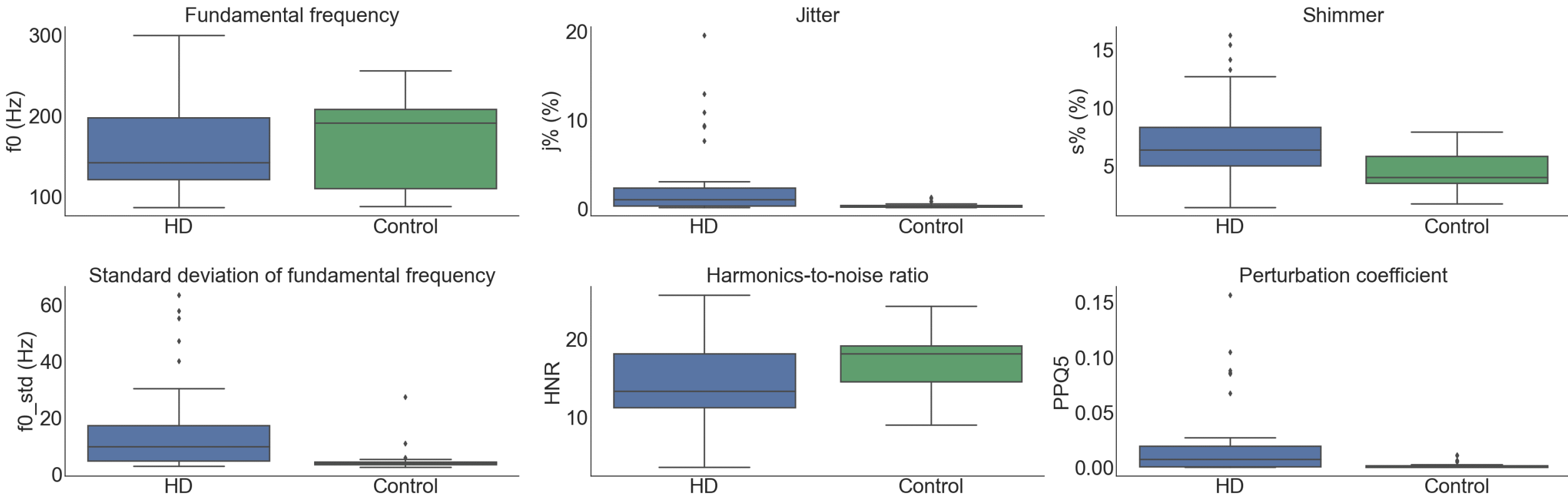| Participants	Inclusion criteria	Exclusion Criteria
Control group	Above the age of 18	• Neurological illness • Physical impairment that would prevent to complete the study
Participants with HD	• Diagnosis of HD confirmed by genetic testing. • Above the age of 18. • Pre-motor (late prodromal) or motor manifest HD • Diagnostic confidence level (DCL) 3 and 4. • Self-ambulatory. • A participant (current or newly enrolled) in the Enroll-HD study (with a preference for those who have been genotyped in GWAS3-5 or are to be genotyped in GWAS6).	• Diagnosis of juvenile onset HD. • History of co-morbid neurological conditions such as multiple sclerosis or stroke. • Acute (within 1 month) orthopaedic conditions e.g. ankle sprain or fracture. • Severe medical conditions such as unstable or progressive heart disease, uncontrolled diabetes, severe liver, kidney or thyroid dysfunction or similar medical conditions. • Unable to tolerate long-term wear of activity monitor. • Inability or unwillingness of participant to give written informed consent. • No access to a smartphone. • Not willing to allow the research team to install Apps on their smartphone related to the study.

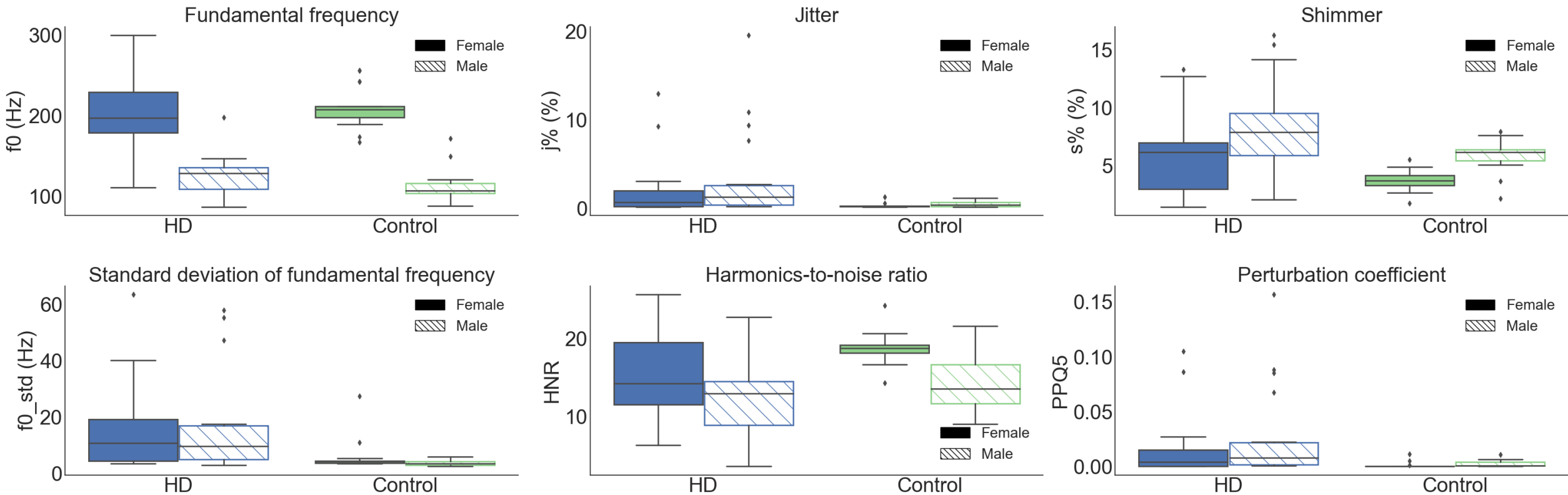# Results

1. Laboratory equipment vs mobile devices

P>0.05 for all calculated features.

Results

1. Control group vs participants with HD

Effect of jitter, shimmer and perturbation coefficient for vowel phonation between groups.
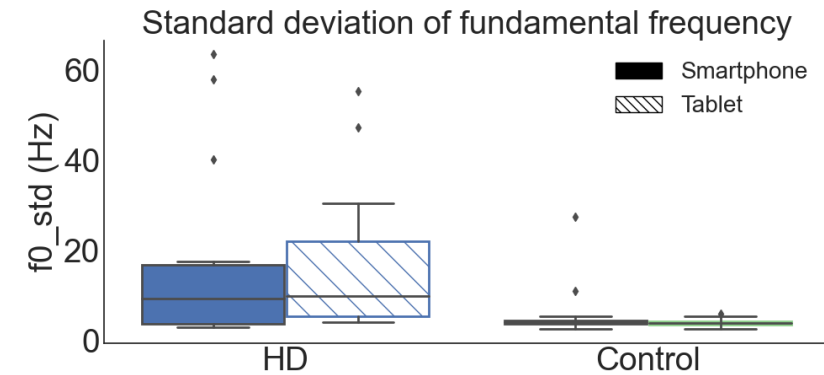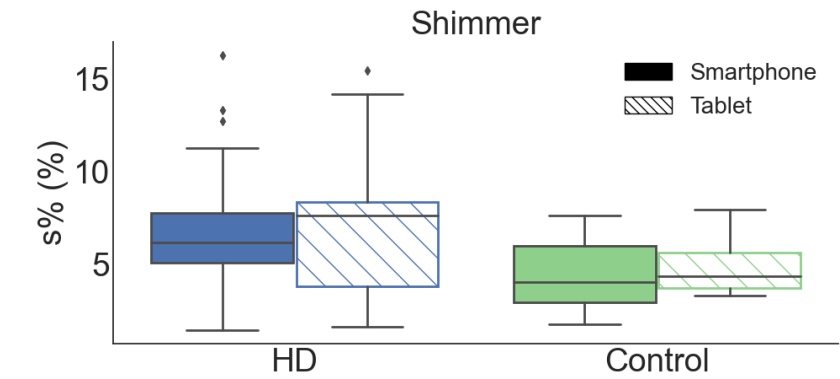
Results

1. Control group vs participants with HD: effect of biological sex

Effect of biological sex between groups.

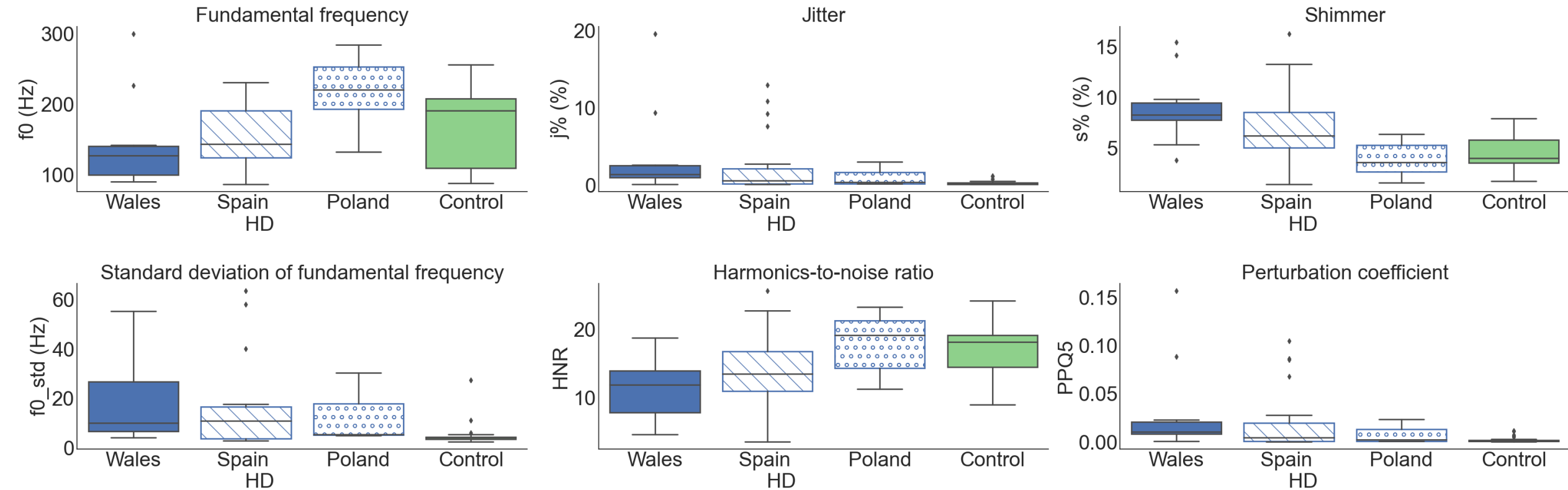# Results

1. Control group vs participants with HD: effect of device
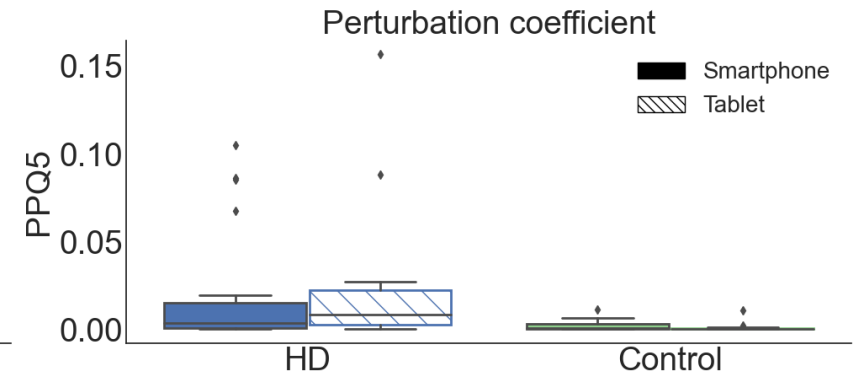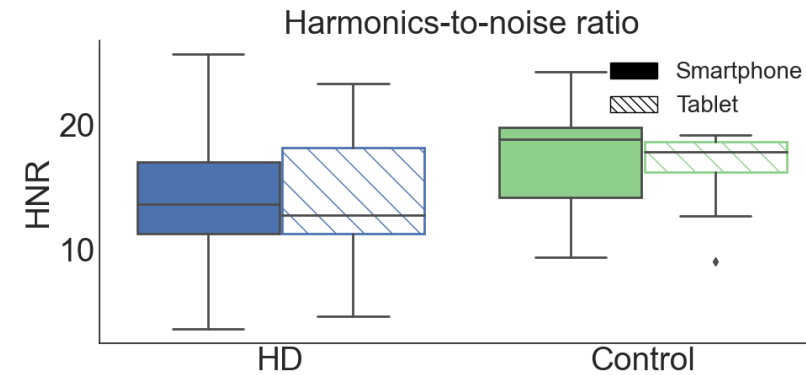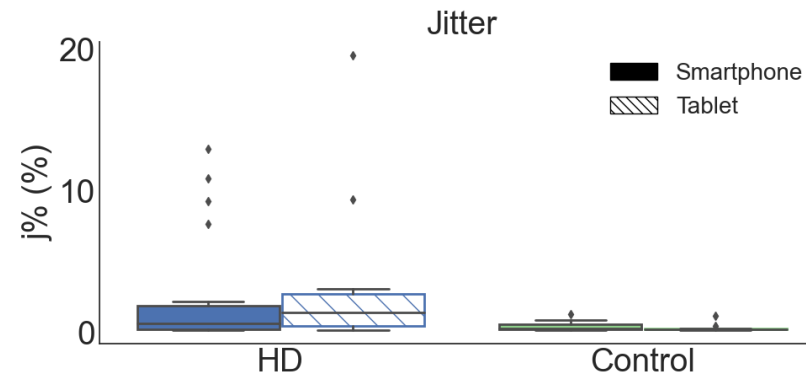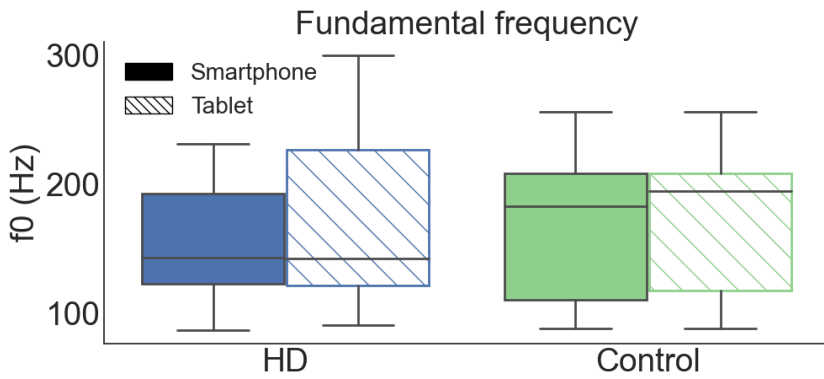
Results

1. Control group vs participants with HD: location

Conclusion

Mobile devices can be used to accurately record speech for estimation of acoustic voice features provided sampling rate is of 44.1 kHz or higher and the file is stored in an uncompressed format.

Preliminary data indicate the potential clinical use of mobile devices for objectively measuring speech in HD.

Significant effect of biological sex observed. Differences were observed in acoustic voice features (jitter, shimmer and perturbation coefficient) between control group and participants with HD for sustained vowel phonation.

Data collection ongoing to match control group with participants with HD based on age, biological sex and native language.

Thank you

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