

Literature Overview of Voice Parameters in Parkinson's Disease for Use as Biomarkers.

Abstract

Introduction: Biomarkers are of interest for use in research and the identification of the most valuable voice parameters. The identified biomarkers should be objectively measurable and serve as indicators of normal biological activities, disease-related processes, or responses to therapeutic treatments.

Method: The results are based on 2 literature searches performed by The Royal Society of Medicine Library (UK).

Material: The 2 searches gave 430 results, of which 98 were related to Parkinson's Disease. The 98 papers were based on 7.561 patients (23 papers without numbers) and 1.513 controls (58 without numbers) from 2013 to 2023 (minus 5 reviews on non-AI, and 2 reviews on AI).

Results: Between 2013 and 2019, 47 papers were related to voice parameters in Parkinson's Disease, of which 4 included Artificial Intelligence (AI). Between 2019 and 2023, 51 papers were related to voice parameters in Parkinson's Disease, of which 20 included AI.

The most used voice parameters in non-AI papers related to Parkinson's Disease with the number of papers in parenthesis: Fundamental Frequency + standard deviation (40), Jitter, absolute and percent (29), Shimmer, absolute and percent (23), Harmonics-to-Noise Ratio (23), Voice Handicap Index (25), and Intensity measurement (24). Other parameters are mentioned between 1-14 times: Signal-to-Noise Ratio, Maximum Phonation Time, Spectrography, Cepstrum analysis, Voice Range Profile, and GRBAS test. 5 reviews conducted between 2018 and 2021 on voice parameters in Parkinson's Disease showed great heterogeneity between studies.

24 of the 98 papers included AI, with 6.488 patients and 531 controls, using between 2-453 features to identify voice parameters. 2 reviews on data sets, recording protocols, and signal analysis from 2022 and 2023 showed issues with limited, unbalanced, and large differences between data sets.

Discussion: Well-defined features and data sets are essential in the future to measure quantitative deviations of voice in Parkinson's Disease. Quantitative validation of the single voice parameters can be done by comparing early, moderate, and heavy Parkinson's Disease to healthy controls, but at best, also to other disorders.

Conclusion: Non-AI shows effective, clear differences in the measured parameters compared to healthy controls and also to treatment effect. Mostly the studies are not comparable. The results were not quantitatively compared to other disorders, like e.g. Alzheimer's Disease. The Artificial Intelligence studies had a large variety, especially of features (parameters). 9 of the 24 papers used deep learning for analysis of features.