Speech measures associated with the course of symptoms severity in patients with MDD

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Methodological Issue

Evaluating treatment effects in psychiatry often relies on subjective assessments, like questionnaires, which can introduce bias and limit diagnostic accuracy—particularly in clinical trials and personalized treatment contexts. Objective measures are needed to enable a more accurate, transdiagnostic approach to mental health. Automated speech analysis shows promise as a non-invasive, objective tool for tracking affective and behavioral changes. However, developing scalable and sensitive speech measures that reliably capture subtle fluctuations in symptom severity remains a challenge but are crucial for enhancing clinical trials and supporting their use in relapse prevention, monitoring, and treatment assessment, ultimately paving the way for broader adoption in psychiatric practice.

Background/Aims

This study aimed to evaluate the potential of speech measures to monitor short-term changes in depressive symptoms in individuals with Major Depressive Disorder (MDD), compared to healthy controls. Specifically, we sought to determine whether certain speech features reflect symptom fluctuations over time and distinguish individuals with increasing versus decreasing symptom severity. This approach could indicate whether speech biomarkers could be employed for tracking symptom progression and treatment response, with potential applications in early relapse detection in clinical practice.

Table 1: Demographic and clinical information of the sample

	Non-decliners	Decliners	*p* value
N	31 (13 F)	13 (9 F)	
Age	42.29 (12.07)	35.69 (13.57)	0.12
Education	11.26 (1.59)	12.23 (1.01)	0.04
BDI at T0	15.00 (12.86)	8.31 (11.97)	0.11
BDI at T1	9.77 (11.70)	12.23 (15.76)	0.42

Methods

Participants included 22 individuals with MDD and 22 healthy controls, recruited at the Karl-Jaspers Clinic of Psychiatry, University Hospital Oldenburg, Germany. Depressive symptoms were assessed using the Beck Depression Inventory (BDI) at two points, two weeks apart. Based on BDI changes, participants were grouped as "decliners" (higher BDI scores at the second time point, n=13) and "non-decliners" (lower or unchanged BDI scores, n=31). Automated speech analysis was conducted on recordings from both time points, examining specific speech features. Participants completed three storytelling tasks (positive, neutral, and negative) and a Diadochokinetic Task. This task is frequently and validly used to assess articulatory imprecision in movement disorders such as Parkinson's Disease [1]. It involves rapid repetition of the syllables "pa-ta-ka" for 10 seconds. The primary analysis focused on detecting significant differences in speech characteristics between decliners and non-decliners, assessing speech biomarkers' sensitivity to short-term symptom changes. Group differences were evaluated using the non-parametric Kruskal-Wallis test, with Benjamini-Hochberg correction applied to p values.

Conclusion

These findings suggest that temporal features from the PaTaKa task are more sensitive to short-term changes in depressive symptoms than storytelling-based features. This heightened sensitivity may stem from the task's focus on motor coordination and speech timing, which directly reflect psychomotor slowing—a core symptom of depression.

Table 2: Results of Kruskal-Wallis tests to compare differences in speech characteristics between decliners/non decliners groups.

	X^2	Adj. *p* value	Non-decliners vs. decliners
Duration	9.69	0.006	>
Pause rate	9.61	0.006	<
Utterance durations sum	11.44	0.006	>
Speech ratio	8.83	0.007	>
Pause durations sum	6.82	0.018	<

By isolating rhythm and articulation speed, the PaTaKa task captures subtle psychomotor changes that more complex tasks may miss. The observed pause features may further indicate difficulties in motor planning, reduced movement efficiency, and fatigue. Additionally, psychomotor symptoms might respond more sensitively to treatment than other symptoms such as anhedonia. These results highlight the importance of task selection in developing speech biomarkers for monitoring MDD.

Results

The change in BDI between T0 and T1 was significant within the groups of decliners ($p<0.001$) and non-decliners ($p=0.01$). After adjusting for multiple comparisons, no significant group differences were found in storytelling-based speech features between the two groups. However, significant differences were observed between decliners and non-decliners in temporal features derived from the PaTaKa task (see Table 2). Furthermore, we found significant correlations between several speech features derived from the PaTaKa task and singular BDI items: items 3 (Past Failure), 5 (Guilty Feelings), 7 (Self-Dislike), 10 (Crying), 16 (Sleeping Patterns), 19 (Concentration Difficulty), and 20 (Tiredness/Fatigue).

Disclosure

FM, EM, JT, and AK are employed by the speech biomarker company ki:elements. JT and NL hold shares in ki:elements. The remaining authors have nothing to disclose.

Reference

[1] Karlsson, F., & Hartelius, L. (2019). How Well Does Diadochokinetic Task Performance Predict Articulatory Imprecision? Differentiating Individuals with Parkinson's Disease from Control Subjects. Folia Phoniatrica et Logopaedica, 71(5–6), 251–260. https://doi.org/10.1159/000498851