



Speech Changes In Depression And Differential Effects Across Depression Dimensions In ADRC Participants: An Update



Carolyn Zhu ¹, Nadia Ramsingh ¹, Sunghye Cho ², Arash Kia ¹, Naomi Nevler ³, Faye Sheppard ¹, Judith Neugroschl ¹, Jimmy Akrivos ¹, Maria Loizos ¹, Margaret Sewell ¹, Ramit Ravona-Springer ⁴, Michal Schnaider Beerli ⁵, Mark Liberman ², Mary Sano ¹, Laili Soleimani ¹

¹ Icahn school of Medicine at Mount Sinai, New York, NY, USA; ² Linguistic Data Consortium, University of Pennsylvania, Philadelphia, PA, USA; ³ Digital Science Lab, Abbvie Inc., North Chicago, IL, USA; ⁴ Sheba Medical Center, Ramat Gan, Israel; ⁵ Rutgers New Jersey Medical School, Newark, NJ, USA

INTRODUCTION

- Depression, is common in Alzheimer’s disease and related dementias (ADRD) and a potentially reversible contributor to dementia.¹
- Depression-related changes in cognitive, affective, and motor function may be detectable through speech, making it a potential biomarker.²
- Increasingly accessible speech technologies may provide objective and quantifiable measures for cognitive and neuropsychiatric presentations.
- Here, we investigated the relationship between speech biomarkers and self-reported depression phenotypes in participants from Mount Sinai Alzheimer’s Disease Research Center (ADRC).

METHODS

- **Participants (n= 212):** Cognitively Normal (CN=105), Mild Cognitive Impairment (MCI= 60), and Alzheimer’s Disease and related disorders (ADRD = 47)
- **Scales:**
 - Cognition: Clinical Dementia Rating (CDR) ³
 - Depression: Geriatric Depression Scale-15 (GDS-15) ⁴
 - Depression Dimensions: Dysphoria, Apathy, Anxiety, Hopelessness and Subjective Memory Complaint (SMC)
- **Speech Task:** Picture Description Task Cookie Theft (neutral), one negative, and one positive image from International Affective Picture System (IAPS) ⁵
- **Statistical Analysis:**
 - Mixed-effect regression models
 - Covariates: age, sex & education.GDS analyses also controlled for CDR

RESULTS

Table 1. Demographic and Clinical Characteristics

Variable	CN (n=105)	MCI (n=60)	ADRD (n=47)	p-value*
Age, years	75.98 ± 7.22	78.73 ± 7.93	77.87 ± 7.68	0.06
Male, n (%)	39 (37.1)	31 (51.7)	23 (48.9)	0.142
Education, years	16.63 ± 2.72	15.97 ± 2.68	17.15 ± 2.45	0.066
CDR sum	0.05 ± 0.19	1.28 ± 0.83	4.30 ± 2.04	<0.001
MMSE	28.32 ± 1.55	25.39 ± 3.64	22.33 ± 4.33	<0.001
GDS score†	2.42 ± 2.82	2.96 ± 3.07	2.55 ± 2.45	0.352
Race (number, %)				0.272
Hispanic	9 (8.6)	6 (10.0)	2 (4.3)	
White	70 (66.7)	40 (66.7)	39 (83.0)	
Black/African American	27 (25.7)	15 (25.0)	5 (10.6)	
Other race	8 (7.6)	5 (8.3)	3 (6.4)	

* p-values from Kruskal–Wallis (continuous) and Pearson χ^2 tests(categorical) variables.
† GDS available for 105 CN, 57 MCI, and 44 dementia participants

Table 2. Association between the total GDS and Speech Variables

Speech Variable	b	Effect
Mean pause duration	0.028	↑*
Pause rate	-0.157	↓*
Words per minute	-1.457	↓*

Table 3. Association between GDS-Dimensions and Speech Variables

GDS Domain	Speech Variable	b	Effect
GDS- Apathy	Mean pause duration	0.1	↑*
	Words per minute	-4.87	↓*
GDS-SMC	Tense-inflected verbs	-0.58	↓*
	Age of acquisition	-0.11	↓*

Table 4. Association between GDS-Dimensions, Task and Speech Variables

GDS Dimension	Task	Speech variable	b	Effect
GDS- Dysphoria	Negative	Total syllables	16.469	↑*
	Negative	Pitch range	3.302	↑*
	Negative	Pronouns	0.614	↑*
	Positive	Verbs	0.545	↑*
	Positive	Adverbs	-0.388	↓*
	Positive	Ambiguity	0.01	↑*
GDS- Apathy	Negative	Frequency	0.044	↑*
	Negative	Adpositions	-0.608	↓*
	Positive	Articulation rate	0.127	↑*
GDS-SMC	Positive	Adjectives	0.797	↑*
GDS-Hopelessness	Negative	Pitch range	-6.448	↓*
	Positive	Pause rate	-1.345	↓*

DISCUSSION

- Depression, even at subclinical levels, was associated distinct speech pattern, suggestive of psycho-motor slowing.
- This effect seems to be driven largely by Apathy domain.
- GDS- SMC was associated with a qualitatively different signature, i.e., lexical/grammatical simplification.
- Emotional speech tasks elicited differential effects across depressive symptom dimensions.
- Effect sizes were modest and uncorrected for multiple comparisons; findings are hypothesis-generating, not confirmatory
- Speech may offer a promising non-invasive marker of neuropsychiatric symptoms, but larger, longitudinal samples with corrected multivariate analyses.

REFERENCES



ACKNOWLEDGEMENT

This study is supported by NIA funding to Alzheimer Disease Research Center at Mount Sinai (P30 AG066514), Alzheimer Association to LS (AACSF- 21-852173 and SG-24-1247794) and AARF-21-851126 to SC.

Contact: Laili.Soleimani@mssm.edu