

Driving speed across multiple roadway types among older adult drivers with and without elevated amyloid burden



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Anu M. Kumar¹, Yi Lu Murphey², Amanda Cook Maher^{1,3}, Carol C Persad^{1,3}, Robert A. Koeppe^{1,3}, and Bruno Giordani^{1,3}

¹University of Michigan, Ann Arbor, MI, USA

²University of Michigan - Dearborn, Dearborn, MI, USA

³University of Michigan Medical School, Ann Arbor, MI, USA

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BACKGROUND

- Subtle alterations in performance on complex, cognitively demanding activities such as driving can emerge early in cognitive decline and Alzheimer's disease (AD). Variations in driving speed may be an early indicator of these changes [1].
- Elevated brain amyloid burden ($A\beta$) is a biomarker of AD that is detectable years before the onset of clinical symptoms, even among cognitively normal older adults.
- This study examines driving speed on various roadway types among consensus-diagnosed cognitively normal older adults with and without elevated $A\beta$ burden during a fixed course drive.

DATASET

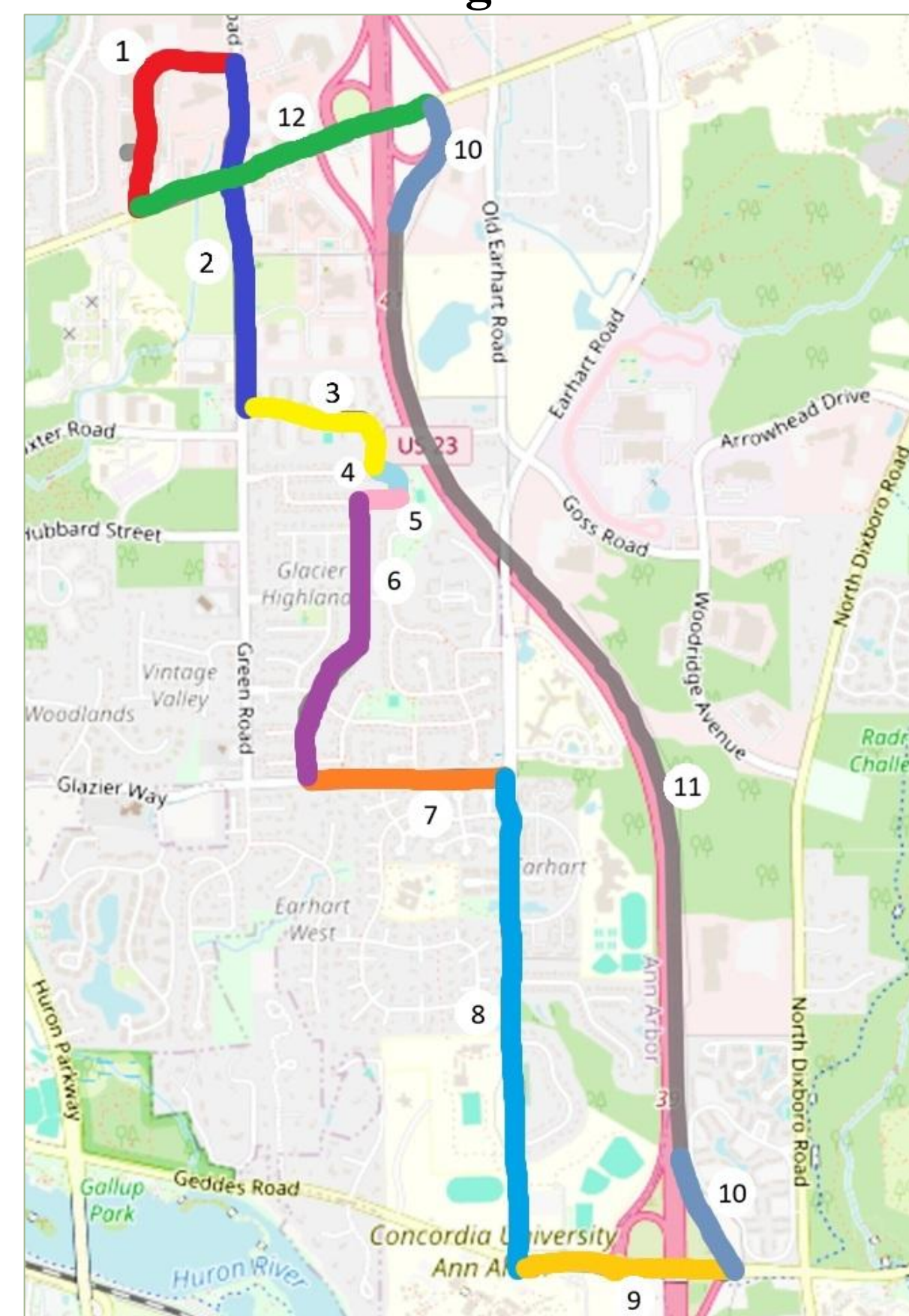
- We analyzed data from 54 older volunteers, aged 65+, who were determined to be cognitively normal via Michigan ADRC consensus conference.
- All participants completed the following:
 - Amyloid PET scan
 - Fixed course drive (all participants followed the same route)
 - Additional neuropsychological testing
- Amyloid positivity was determined via PiB PET scan [2]:
 - Amyloid positive ($A\beta+$) (n=26): centiloid value ≥ 20
 - Amyloid negative ($A\beta-$) (n=28): centiloid value ≤ 10
- Global positioning system (GPS) and driving speed data were recorded during the fixed course driving trip using a DL1 CLUB Data Logger, in participants' own vehicles.

METHODS

- Using the longitude and latitude coordinates, the fixed course route was segmented by road name and categorized according to:
 - Curvature classification: determined through visual inspection of each road on a map
 - Posted speed limit: low ≤ 25 mph; moderate 26-55 mph; high > 55 mph
 - Traffic load: derived from Michigan Annual Average Daily Traffic (AADT) data (low $< 5,000$; medium 5,000-10,000; high $\geq 10,000$)

Road Segment	Road Segment Description
R ₁	Low-speed, low-traffic, with curves
R ₂	Moderate-speed, high-traffic, connector road, with slight curves
R ₃	Low-speed, low-traffic, with curves
R ₄	Low-speed, low-traffic, with curves
R ₅	Low-speed, low-traffic, straight
R ₆	Low-speed, with curves
R ₇	Moderate-speed, low-traffic, straight
R ₈	Moderate-speed, medium-traffic, straight
R ₉	Moderate-speed, high-traffic, multiple roundabouts
R ₁₀	Freeway entry and exit ramp, medium-traffic, with curves
R ₁₁	Freeway, medium-traffic, with curves
R ₁₂	Moderate-speed, high-traffic, straight

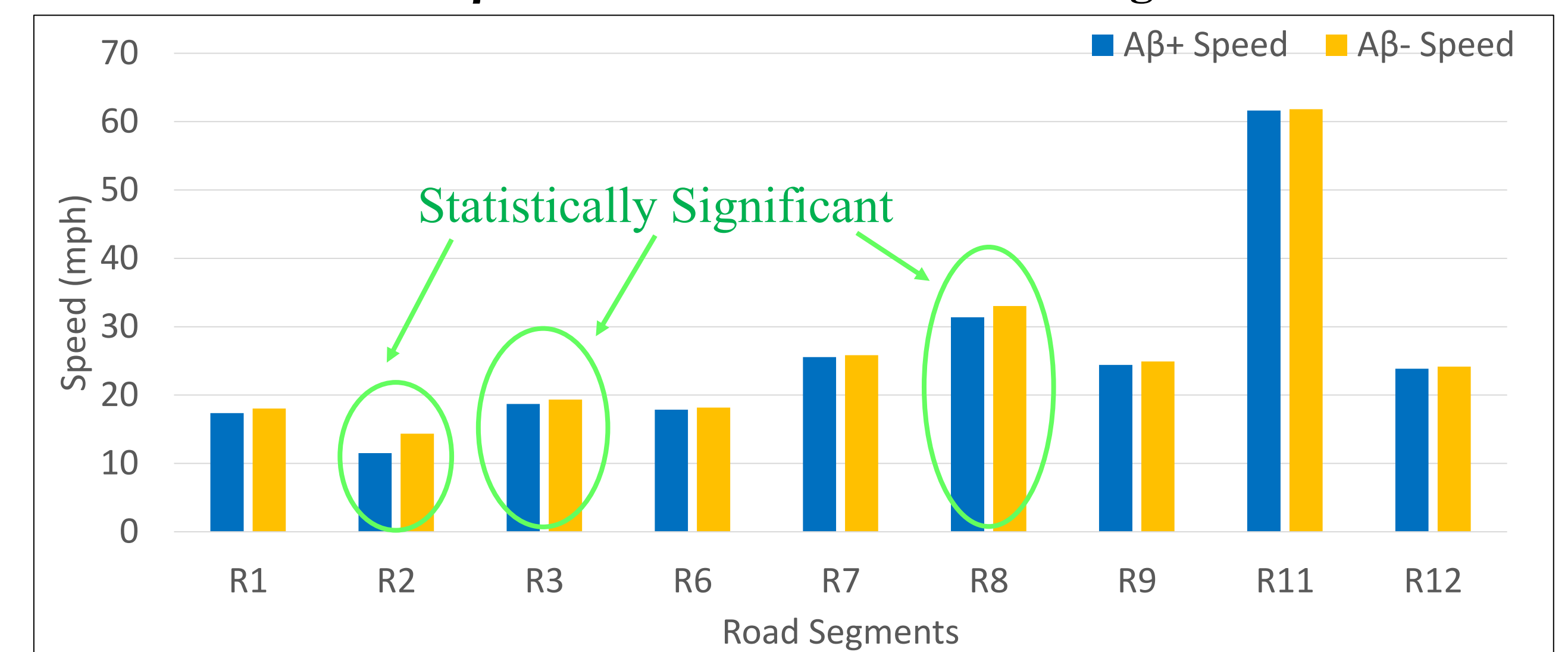
Figure 1. Segmented Fixed course driving route



RESULTS

- Independent-samples t-tests evaluated group differences in driving speed for each of the 12 road segments between $A\beta+$ and $A\beta-$ drivers.
- $A\beta+$ drivers showed a consistent pattern of driving at slower speeds than $A\beta-$ peers across the fixed course route (p 's < 0.05).
- $A\beta+$ drivers drove significantly slower than $A\beta-$ on roadway sections with lower or moderate speed limits, non-freeway environments, and road geometry requiring greater continuous speed regulation (e.g., curved segments, variable traffic; all p 's < 0.05).
- No significant group differences were observed on freeway segments or high-speed, less demanding road types.

Figure 2. Mean driving speed comparison between $A\beta+$ and $A\beta-$ drivers across select road segments



CONCLUSION

- On average, $A\beta+$ cognitively normal older drivers drove more slowly than $A\beta-$ peers on roadway segments with lower or moderate speed limits and geometries requiring continuous speed control.
- The largest speed differences appear on curved local roads, moderate-speed major collectors with variable traffic, and straight moderate-traffic segments, suggesting a compensatory or cautious driving pattern in $A\beta+$ drivers.
- Driving speed on naturalistic road segments may reveal subtle attentional and decision-making differences associated with $A\beta$ status, supporting its use as an early ecologically valid marker of AD risk.

REFERENCES

[1] Chetelat et al. (2013) NeuroImage: Clinical, vol. 2, pp.356–365; [2] Amadoru et al. (2020) Alzheimer's Res Ther. 12(1):22

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