# Home-Based Activity Changes Associated with MCI

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## Objective

To determine if variability in motor function assessed in the home environment characterizes persons with MCI.

## Background

Changes in motor function precede cognitive decline up to a decade before symptoms appear, a conclusion primarily derived from brief clinical measures of motor function such as walking speed. We hypothesized that if these measures were predictive of MCI, before they declined in absolute magnitude, there would be a period where the measure would first show increased variability.

## Design/Methods

In 113 non-demented ISAAC (Intelligent Systems for Assessing Aging Change) cohort (Kaye, 2008) seniors living independently (mean age 84; CDR ≤ 0.5) multiple daily walking episodes were unobtrusively recorded as subjects traversed a line of passive infra-red motion sensors placed strategically in their home (figure 1) for a mean of 319 ± 127 days. Daily walking speeds (Hayes, 2008; Hagler, 2009) and the variance in these measures over time were calculated and compared to conventional single visit stop-watch derived speed recordings in subjects with and without MCI. Trajectory analysis using the coefficient of variation (COV) in weekly walking speeds was applied to assess differences in variability over time among subjects with and without MCI.
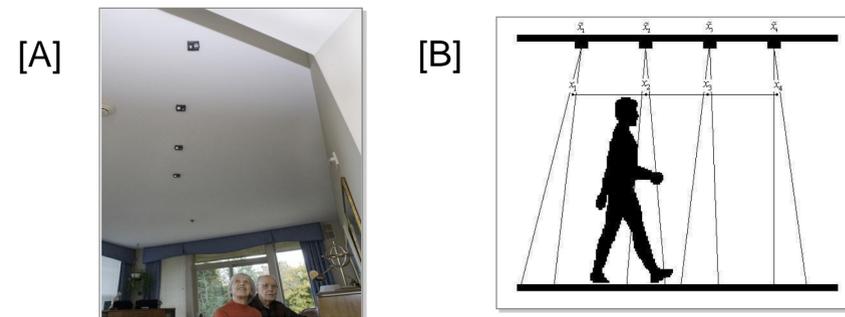
[A]   [B]

**Figure 1:** [A] A home sensor line in place; [B] Schematic of a person walking through a sensor line containing four sensors with their fields of view shown. Sources: [A] Julie Keefe, the New York Times, Nov 7, 2009; [B] Hagler et al. 2009.

## Results



**Stopwatch Derived Walking Speed**

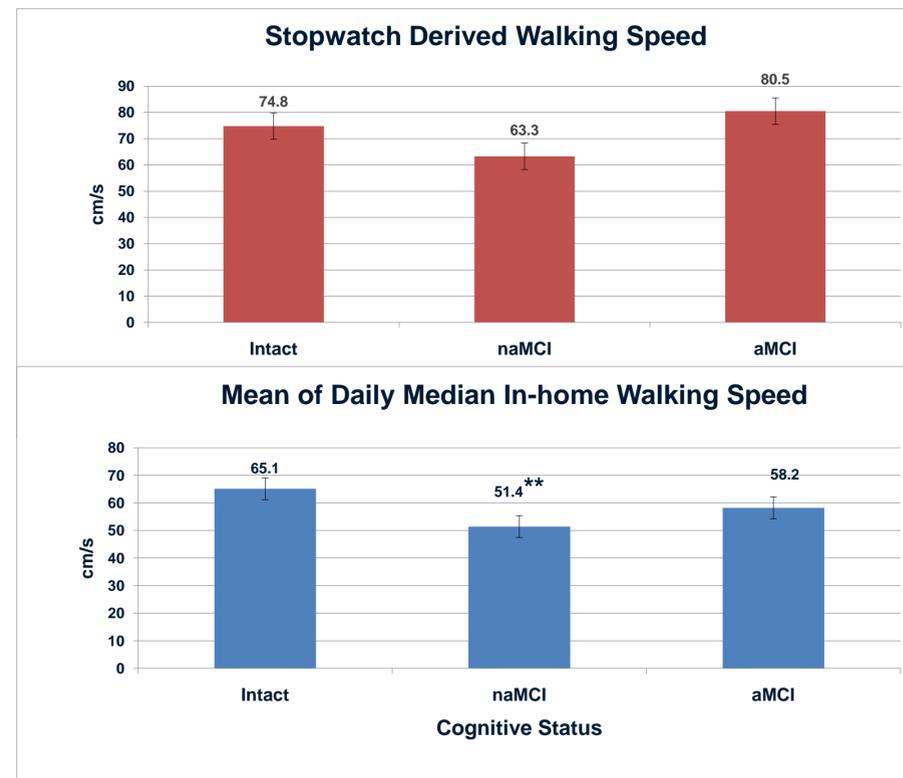**Mean of Daily Median In-home Walking Speed**

**Figure 2:** Continuous home acquired walking speed is significantly different (p < .01) in naMCI (non-amnestic MCI) compared to intact subjects. Single stop-watch measure does not distinguish groups.
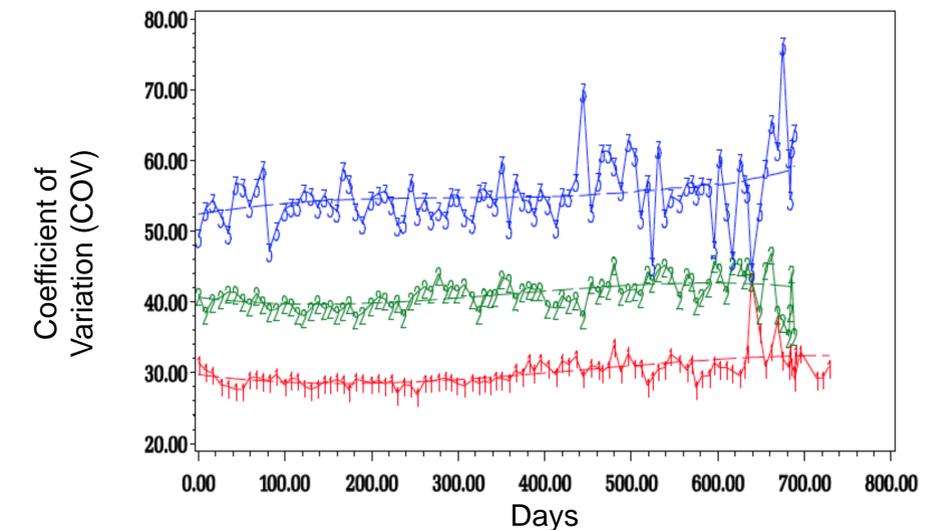


**Figure 3:** Three trajectories best described walking speed COV. MCI subjects were more likely to be in the high variability at baseline and increasing over time group (Blue trajectory; OR = 1.41; p = 0.012).

## Conclusions/Relevance

- Continuous unobtrusive home monitoring may identify activity changes (walking speed and variability) that are early markers of cognitive decline.
- Home-based continuous assessment metrics for discerning subtle early change may provide new measures of early change not currently accessible through conventional methodologies

## References

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2. Hayes T, Abendroth F, Adami A, et al. Unobtrusive assessment of activity patterns associated with mild cognitive impairment. Alzheimer's & Dementia 4(6): 395-405, 2008
3. Hagler S, Austin D, Hayes TL, Kaye J, Pavel M. Unobtrusive and Ubiquitous In-Home Monitoring: A Methodology for Continuous Assessment of Gait Velocity in Elders. IEEE Transactions on Biomedical Engineering, 2009..