

Test-retest variability of relative tracer delivery rate as measured by [¹¹C]PiB

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Introduction

- Reductions in CBF are characteristic for Alzheimer's disease (AD) and could be used as proxy for disease severity or progression.^{1,2}
- Moderate-to-high correlations have been reported between [¹¹C]PiB PET derived R_1 (relative tracer delivery rate) and [¹⁵O]H₂O CBF, thus, it has been suggested that R_1 could be used as proxy for relative CBF³
- Longitudinal PET studies become more common in AD, therefore it is important to understand the variability of R_1 to determine what magnitude of change signifies an actual change.

Purpose

Assess precision of [¹¹C]PiB R_1 through retrospective analysis of a test-retest data-set

Methods

- Subjects & Image acquisition**
 - 12 participants from a test-retest (TRT) study (Table 1)⁴
 - Dynamic [¹¹C]PiB PET 90 minutes and T1 MR scans
- Image processing and analysis**
 - The simplified reference tissue with fixed k_2' (SRTM2) was used (with cerebellar gm reference region) to derive R_1 values for a global cortical and smaller cortical regions
- Statistics**
 - Test-retest variability was calculated (equation 1) for all regions

$$TrT \text{ variability (\%)} = \frac{|T-R|}{0.5 \cdot |T+R|} \cdot 100 \quad (1)$$

- Correlation, Linear Mixed Effects Models (LME) and Bland-Altman analysis were used to assess the correlations and variability between test and retest measures.

Results

TABLE 1. Subject demographics

	CU (N= 5)	MCI (N=1)	AD (N=6)
Age	64.6 ±6.4	71.0	61.0 ±3.0
Females	60%	100%	17%
VR positive	20%	0%	100%
MMSE	29.8 ±0.4	28.0	20.7 ±2.0

VR: Visual read, MMSE: Mini Mental State Examination, Values are depicted as Mean±SD, unless indicated otherwise

- Relative tracer delivery R_1 was significantly lower in AD dementia patients compared with cognitively unimpaired participants ($p < 0.01$), Table 2.
- TRT variability was low for a global cortical region (1.70%), while the range of regional TRT variability was slightly higher (1.5-5.8%).

TABLE 2. Relative tracer delivery values by diagnostic group

Diagnostic groups	SRTM2 derived- R_1	
	Test	Retest
CN (N=5)	0.93 ± 0.04	0.91 ± 0.03
MCI (N=1)	0.91	0.91
AD (N=6)	0.82 ± 0.04	0.82 ± 0.03

Values are depicted as Mean±SD

- Test and retest R_1 values were strongly correlated and the slope was not significantly different from 1 ($R^2=0.92$, slope=0.98 C.I.[0.94-1.01], $p < 0.001$).
- Bland-Altman analysis showed a negligible bias (0.69±3.07%) between test and retest R_1 (Figure 1).

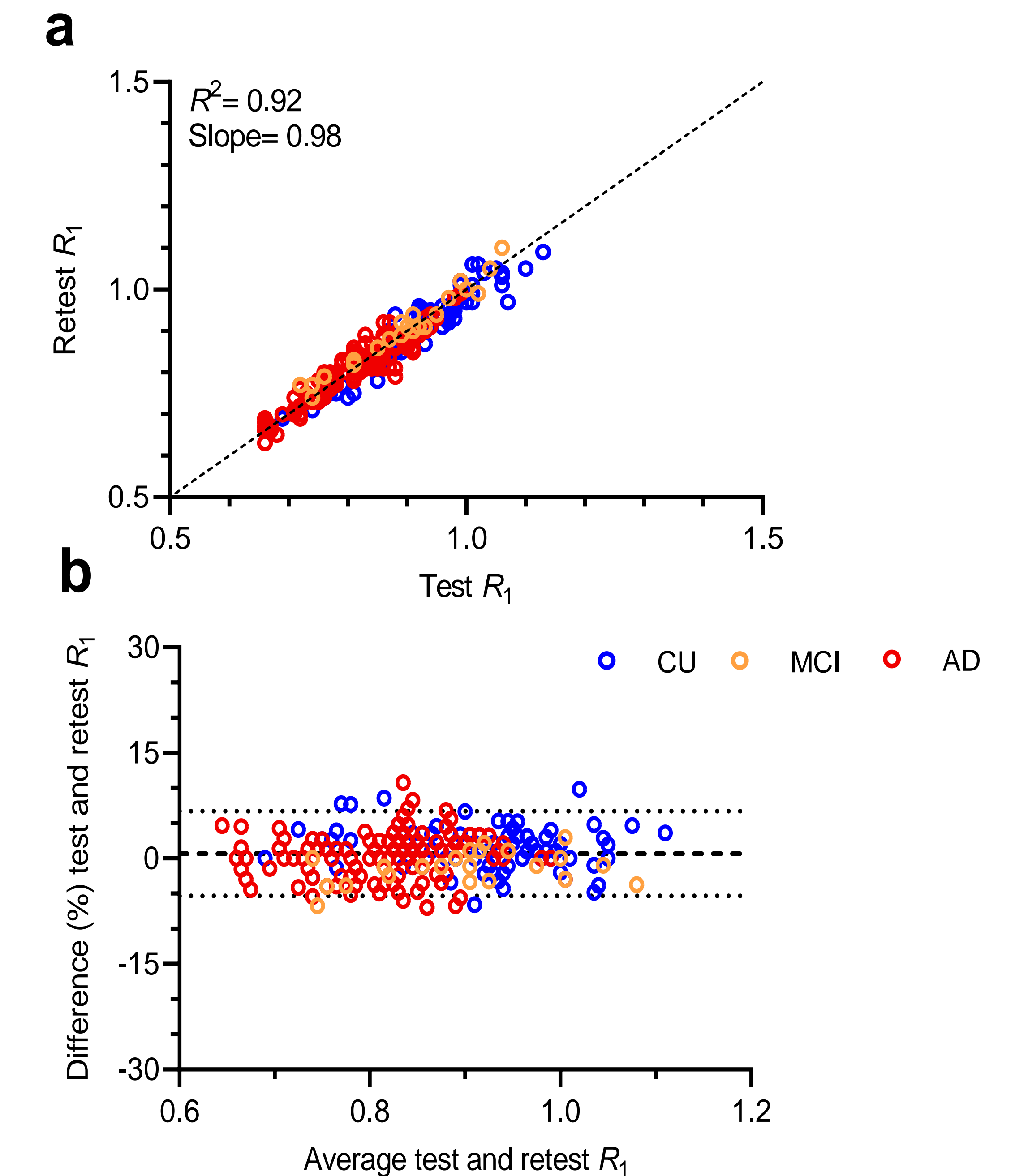


Figure 1. Relationship between SRTM2-derived test and retest R_1 (a) The correlation between R_1 test and retest measures, with R^2 and slope parameters corresponding to the LME analysis and (b) a Bland-Altman plot, which indicates the bias between the two measures.

Conclusion

- ✓ [¹¹C]PiB relative tracer delivery rate R_1 showed high global and regional precision in participants covering the AD spectrum. Therefore, [¹¹C]PiB R_1 appears to be a stable parameter for measuring cross-sectional differences and longitudinal changes in relative CBF.

1. Ottoy et al. (2019) *Alzheimers&Dement* 2. Wierenga et al. (2014) *J Alzheimers Dis.* 42:S411-S419. 3. Chen et al. (2015) *J. Nucl Med* 56(8): 1199-1205. 4. Tolboom et al. (2009) *Eur J Nucl Med Mol Imaging*;36:1629-1638.

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