ADNI Alzheimer's Disease Neuroimaging Initiative

FDG PET Processing Methods

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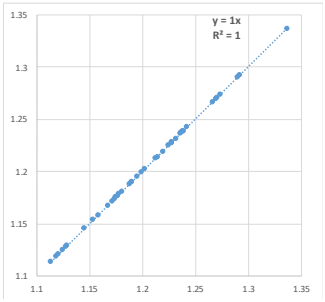
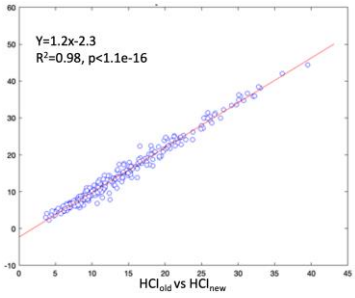
Summary

For fluorodeoxyglucose (FDG) positron emission tomography (PET) scans, we provide two global indices. The first, referred to as the hypometabolic convergence index (HCI), characterizes the Alzheimer's disease (AD) related cerebral hypometabolism of glucose, integrating voxel-wise information into a single measurement. It reflects the extent to which the pattern and magnitude of hypometabolism in a person's FDG PET image corresponds to that in patients with the clinical diagnosis of AD[1]. HCI is of cross-sectional. In contrast, the second FDG-PET based global index, the statistical region of interest (sROI), was established to optimally track changes of cerebral metabolic rate for glucose (CMRgl) longitudinally though operationally sROI can be computed for each visit. It was cross-validated using ADNI data [2] and was used in a recent clinical trial[3]. The AD sROI ($sROI_{AD}$) defined global CMRgl is the standard uptake value ratio between a set of regions affected by AD and a set of regions spared by AD. Similarly, we have $sROI_{MCI.}$ Again, these regions were determined in terms of optimally tracking the glucose uptake decline over time.



sROI comparison:
SPM5 vs SPM12

For sROI, we assessed the use of SPM12 instead of SPM5 which was used originally. Based on FDG-PET data from 234 ADNI subjects, we confirmed the identical sROI results using SPM5 or SPM12, as shown in the plot above. And our new sROI results are SPM12 based. The new HCI values computed in the new server environment are also highly correlated with the ones we obtained previously (R^2=0.98, see plot on the right). We plan to recompute the HCI based on the new implementation in the near future. For current use, one can convert the HCI values we previously uploaded via the linear relation HCI_{new}=1.2*HCI_{old}-2.3.



Methods

All images downloaded from LONI were fully processed by Dr. Koeppe's team at University of Michigan. The images were then spatially normalized to the SPM template using SPM (Wellcome Trust Center for Neuroimaging, UCL, UK) in MATLAB (Mathworks, Natwick, MA). The in-house developed procedures were used to calculate the HCI and sROI for each FDG-PET scan. For detailed description about HCI computation, please see references listed below.

Recommendation: sROI was first introduced for the longitudinal changes of FDG-PET measured glucose metabolism over two visits. For many projects (including the design of clinical trials),

FDG-PET measurements can be from more than two visits. Though additional studies are needed to justify the use of sROI, its further optimization or alternatives, our sROI pipeline can be used for any number of visits. For illustration, we performed statistical power analysis using the same approach reported in [4] for all subjects who had 2, 3, 4 or more visits within AD, MCI and normal control groups separately based on the baseline diagnosis. Using $sROI_{AD}$, 80% power, two-tailed type-I error of 0.05 and assumed the 25% treatment effect, we estimated the sample sizes of 138, 412 or 716 completers per arm for a trial in AD, MCI or normal controls separately. Though it is of cross-sectional, HCI can be used similarly for sample size estimation for future trials. Both indices can be used, as an option, in studies which needs to involve univariate global CMRgl measures.

Uploaded data:

We have HCI, $sROI_{AD}$ and $sROI_{MCI}$ values for new FDG PET scans included in this update in addition to the ones we uploaded previously. They are up to date as of 01/2020. We will provide frequent future updates when new images become available and analyzed.

Version Information

This is the document submitted from Banner Alzheimer Institute regarding the HCI and sROI calculation for FDG PET image analysis. For florbetapir measures, please see *our florbetapir PET Processing Methods*

Dataset Information

This methods document applies to the current data uploads and future updates to the BAI template based FDG PET analysis results.

About the Authors

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