Reference segmentations of white matter hyperintensities from a subset of 20 subjects scanned three consecutive years

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Summary

This dataset contains structural magnetic resonance imaging (MRI)-derived data from 20 participants enrolled in the Alzheimer’s Disease Neuroimaging Initiative (ADNI) project. These data are probabilistic estimates maps of cerebrospinal fluid, grey matter and normal-appearing white matter, and binary masks of white matter hyperintensities (WMH), all obtained from MRI acquired at three consecutive study visits spaced 12 months apart.

Sample characteristics

The data correspond to 20 patients scanned 3 consecutive years (data from 60 MRI scans in total). Age, gender and general cognitive information from this sample are given in Table 1.

Table 1. Age, gender and cognitive information from the sample

<table>
<thead>
<tr>
<th>SAMPLE</th>
<th>Parameter</th>
<th>Cognitive status</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>CN</td>
<td>EMCI</td>
</tr>
<tr>
<td>Age</td>
<td>Mean Age (SD)</td>
<td>79.4(2.23)</td>
<td>68.66 (4.49)</td>
</tr>
<tr>
<td>Gender</td>
<td>Males</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Females</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Mean Cognitive Scores (SD) at Year 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>MMSE</td>
<td>28.5(2.12)</td>
<td>27.83(1.75)</td>
</tr>
<tr>
<td></td>
<td>GDS</td>
<td>1.0(1.41)</td>
<td>1.17(1.19)</td>
</tr>
<tr>
<td></td>
<td>CDR</td>
<td>0.0(0)</td>
<td>0.38(0.23)</td>
</tr>
<tr>
<td></td>
<td>FAQ</td>
<td>0.0(0)</td>
<td>2.17(3.88)</td>
</tr>
</tbody>
</table>

Legend: CN= cognitively normal, EMCI= early mild cognitive impairment, LMCI= late mild cognitive impairment, CDR= Clinical Dementia Rating, MMSE= Mini Mental State Examination score, FAQ= Functional Assessment Questionnaire scores

Data structure

Each folder’s name has the following format:

ADNI contributor centre identification (ID) number – S – Patient’s ID number – Year the scan was acquired

For example: 002_S_0413_2012 means that these are the data from patient 413 scanned on the Centre 2 in 2012.
Each folder has the following files inside:

1) **CSF.nii, GM.nii and NAWM.nii** → Probability estimates maps of cerebrospinal fluid, grey matter and normal-appearing white matter respectively, all in **NIfTI-1 format**.

2) **WMH.obj** → Object map of the white matter hyperintensities (WMH). This is in the object map format of Analyze™ 11.0. For cases that have a stroke lesion as well, this file has the name Lesions.obj instead.

3) **WMH.hdr/img** → WMH binary mask in Analyze 7.5 format, obtained semi-automatically using the region-growing algorithm from the ROI tool in Analyze.

Some folders have the files WMH_2.obj and WMH_2.hdr/img that correspond to a second WMH segmentation, obtained in the same way as the first one and by the same image analyst, blind to the first result, used for intra-observer reliability analysis.

**Methods for obtaining the data**

The base image for these segmentations is the original T2-FLAIR sequence acquired at each scanning session and downloadable from the Alzheimer’s Disease Neuroimaging Initiative (ADNI) database (adni.loni.usc.edu). The MPRAGE (i.e. T1-weighted) sequence acquired at the same scanning session was registered to the T2-FLAIR sequence using FSL FLIRT [1], a linear registration tool from the **FMRIB Software Library** (v 5.0).

The probability estimates of cerebrospinal fluid, grey matter and normal-appearing white matter were generated from the MPRAGE sequence, after this being rigidly aligned to the T2-FLAIR sequence (as per above), using FSL-FAST [2]. The voxel values of these maps represent the probability of each belonging to one of these three classes.

WMH object maps were created semi-automatically by thresholding the FLAIR images using the region-growing algorithm in the Object Extractor tool of Analyze™ software (ver 11.0), simultaneously guided by the co-registered T1- and T2-weighted sequences, all acquired at the same scanning session. Each brain scan was processed independently, blind to any clinical, cognitive or demographic information and to the results of the WMH segmentations from the same individual at different time points.

**Note:** The MRI data from which these data were derived were obtained in Analyze 7.5 format from the Alzheimer’s Disease Neuroimaging Initiative (ADNI) database (adni.loni.usc.edu). The ADNI was launched in 2003 as a public-private partnership, led by Principal Investigator Michael W. Weiner, MD.

The primary goal of ADNI has been to test whether serial magnetic resonance imaging (MRI), positron emission tomography (PET), other biological markers, and clinical and neuropsychological assessment can be combined to measure the progression of mild cognitive impairment (MCI) and early Alzheimer’s disease (AD).

As such, the investigators within the ADNI contributed to the design and implementation of ADNI and/or provided MRI data but did not participate in generating the content of this collection. A complete listing of ADNI investigators can be found at:


**Intra-observer reliability**
A second WMH segmentation mask was obtained from 10/60 images randomly chosen. The graphs below show the results of the Bland-Altman plots. The mean difference between the measurements is 0.7 (SD 1.8) ml and the mean volume of the average measurements is 4.9 (SD 4.5) ml. The mean Dice coefficient is 0.6 (SD 0.2).

Figure 1. Results of the intra-observer reliability tests. Left: Bland-Altman plot showing in the vertical axis the difference between the volumes of the WMH and in the horizontal axis the mean between the volume of both measurements (volumes are given in mm$^3$). Right: Modified Bland-Altman plot showing in the vertical axis the Dice coefficient between the two WMH masks and in the horizontal axis the mean between the volume of both WMH measurements (in mm$^3$).

**Observation**

As the WMH masks were generated with Analyze software, and this software can read sequences in NIfTI-1 format, but cannot give output in such format, all WMH masks are in Analyze 7.5 format. If converted to NIfTI-1, care must be taken on the orientation and origin.

**References**


**Acknowledgements**

This work has been funded by Row Fogo Charitable Trust.

The assemblage of the primary data (i.e. MRI scans) for this work was funded by the Alzheimer’s Disease Neuroimaging Initiative (ADNI) (National Institutes of Health Grant U01 AG024904) and DOD ADNI (Department of Defense award number W81XWH-12-2-0012). ADNI is funded by the National Institute on Aging, the National Institute of Biomedical Imaging and Bioengineering, and through generous contributions from the following: AbbVie, Alzheimer’s Association; Alzheimer’s Drug
Discovery Foundation; Araclon Biotech; BioClinica, Inc.; Biogen; Bristol-Myers Squibb Company; CereSpir, Inc.; Cogstate; Eisai Inc.; Elan Pharmaceuticals, Inc.; Eli Lilly and Company; Eurolimmun; F. Hoffmann-La Roche Ltd and its affiliated company Genentech, Inc.; Fujirebio; GE Healthcare; IXICO Ltd.; Janssen Alzheimer Immunotherapy Research & Development, LLC.; Johnson & Johnson Pharmaceutical Research & Development LLC.; Lumosity; Lundbeck; Merck & Co., Inc.; Meso Scale Diagnostics, LLC.; NeuroRx Research; Neurotrack Technologies; Novartis Pharmaceuticals Corporation; Pfizer Inc.; Piramal Imaging; Servier; Takeda Pharmaceutical Company; and Transition Therapeutics. The Canadian Institutes of Health Research is providing funds to support ADNI clinical sites in Canada. Private sector contributions are facilitated by the Foundation for the National Institutes of Health (www.fnih.org). The grantee organization is the Northern California Institute for Research and Education, and the study is coordinated by the Alzheimer’s Therapeutic Research Institute at the University of Southern California. ADNI data are disseminated by the Laboratory for Neuro Imaging at the University of Southern California.