**MESA Exam 6 Ancillary Study 253 Data Set Variable Guide**

Brain MRI – WMH Volume

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| **Data Set name :** | MESAe6as253\_BMRIWMHV\_20240108 |
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**MESA Ancillary study #253, Atrial Fibrillation Study**

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See ancillary study publications1,2 in the Reference list for information on ancillary study methods and for examples of how to analyze the brain MRI data. Please acknowledge the Atrial Fibrillation Ancillary Study funding in all publications that use these brain MRI data: R01 HL127659 from the National Heart, Lung, and Blood Institute.

MESA participants from all six field centers who participated in the Atrial Fibrillation ancillary study3,4 at Exam 6 were invited to complete a brain MRI a median (IQR) of 18 (16, 20) months after the Exam 6 visit. This data set contains one record per ancillary study participant (n=1062) who had a brain MRI in March 2018 through August 2019 as part of the Atrial Fibrillation ancillary study. The Brain MRI Reading Center at the University of Pennsylvania provided this WMH (white matter hyperintensity) Volume dataset. The terms WMH, white matter lesion (WML), and leukoaraiosis are all used in the literature and refer to the same brain findings. WMH volume was measured from inhomogeneity corrected and coregistered fluid attenuated inversion recovery (FLAIR) and T1-weighted images using a deep learning-based segmentation method5 and reported for MUSE ROIs6,7.

QC codes:

The variable qc\_code contains information on quality control issues. The values and their explanations are as follows:

L1 incidental findings detected in initial manual reading; structural brain lesion was present that should not affect regional volumes, either normal or abnormal

L2 incidental findings detected in initial manual reading; structural brain lesion was present that should not affect normal regional volumes, but abnormal volumes may be affected

L3 incidental findings detected in initial manual reading; structural brain lesion was present that may affect both normal and abnormal regional volumes.

QC\_I\_FL\_1 image quality issues on FLAIR

QC\_I\_T1\_1 or QC\_I\_T1\_2 image quality issues on T1, such as “missing parts of brain” and “moderate motion”

QC\_P\_WML\_1 WMH processing failed

NA no qc issues

Comments regarding the qc\_code value are found in qc\_note.

Exclusions: for analysis of WMH volumes, analysts must exclude scans with the following qc\_codes:

L2 (n=2)

L3 (n=15)

QC\_I\_FL\_1 (n=1)

QC\_I\_T1\_1 (n=1)

QC\_I\_T1\_2 (n=1)

QC\_P\_WML\_1 (n=2)

For these 22 participants, the variable wmh\_exclude is set to 1 and all volumes have been set to missing.

Recommended adjustments: All brain MRI analyses in MESA should be adjusted for field center. Analyses of brain MRI volumes should generally be adjusted for total intracranial volume, which is a measure of head size (icv, found in the separate ROI\_Vol dataset).

All volumes are expressed in microliters (µl). Analysts and authors may prefer to convert some volumes to ml.

Abbreviation:

dc diencephalon

**References**

1. Austin TR, Nasrallah IM, Erus G, Desiderio LM, Chen LY, Greenland P, Harding BN, Hughes TM, Jensen PN, Longstreth WT, Jr., et al. Association of Brain Volumes and White Matter Injury With Race, Ethnicity, and Cardiovascular Risk Factors: The Multi-Ethnic Study of Atherosclerosis. *Journal of the American Heart Association*. 2022;11:e023159. doi: 10.1161/JAHA.121.023159

2. Austin TR, Jensen PN, Nasrallah IM, Habes M, Rashid T, Ware JB, Chen LY, Greenland P, Hughes TM, Post WS, et al. Left Atrial Function and Arrhythmias in Relation to Small Vessel Disease on Brain MRI: The Multi-Ethnic Study of Atherosclerosis. *Journal of the American Heart Association*. 2022;11:e026460. doi: 10.1161/JAHA.122.026460

3. Heckbert SR, Austin TR, Jensen PN, Floyd JS, Psaty BM, Soliman EZ, Kronmal RA. Yield and consistency of arrhythmia detection with patch electrocardiographic monitoring: The Multi-Ethnic Study of Atherosclerosis. *J Electrocardiol*. 2018;51:997-1002.

4. Heckbert SR, Austin TR, Jensen PN, Chen LY, Post WS, Floyd JS, Soliman EZ, Kronmal RA, Psaty BM. Differences by race/ethnicity in the prevalence of clinically detected and monitor-detected atrial fibrillation: MESA. *Circulation Arrhythmia and electrophysiology*. 2020;13:e007698. doi: 10.1161/CIRCEP.119.007698

5. Doshi J, Erus G, Habes M, Davatzikos C. DeepMRSeg: A convolutional deep neural network for anatomy and abnormality segmentation on MR images. *arXiv preprint arXiv*. 2019;1907.02110.

6. Doshi J, Erus G, Ou Y, Gaonkar B, Davatzikos C. Multi-atlas skull-stripping. *Academic radiology*. 2013;20:1566-1576. doi: 10.1016/j.acra.2013.09.010

7. Doshi J, Erus G, Ou Y, Resnick SM, Gur RC, Gur RE, Satterthwaite TD, Furth S, Davatzikos C, Alzheimer's Neuroimaging Initiative. MUSE: MUlti-atlas region Segmentation utilizing Ensembles of registration algorithms and parameters, and locally optimal atlas selection. *Neuroimage*. 2016;127:186-195. doi: 10.1016/j.neuroimage.2015.11.073

| **Order** | **Variable** | **Variable Description** |
| --- | --- | --- |
| 1 | idno | MESA Participant ID |
| 2 | agebrainmri6c | Age at Exam 6 Brain MRI (years) |
| 3 | brainmri\_tt6c | Time from baseline to Exam 6 brain MRI (days) |
| 4 | qc\_code | QC Code for WMH dataset:  L1 = Incidental findings, level 1  L2 = Incidental findings, level 2  L3 = Incidental findings, level 3  QC\_I\_FL\_1 = Quality control issue at image level  QC\_I\_T1\_1 = Quality control issue at image level  QC\_I\_T1\_2 = Quality control issue at image level  QC\_P\_WML\_1 = Quality Control issue at Processing Pipeline level |
| 5 | qc\_note | MRI Reader Note explaining QC code |
| 6 | wmh\_exclude | 0 = Include in analysis of WMH volume  1 = Exclude from analysis of WMH volume based on QC Code |
| 7 | wmh\_wm | Total White Matter (µl) Hemisphere: Both Tissue Segment: white matter |
| 8 | wmh\_wm\_l | White Matter (µl) Hemisphere: Left Tissue Segment: white matter |
| 9 | wmh\_wm\_r | White Matter (µl) Hemisphere: Right Tissue Segment: white matter |
| 10 | wmh\_corpus\_callosum | Corpus callosum (µl) Hemisphere: Both Tissue Segment: white matter |
| 11 | wmh\_deep\_wm | Deep white matter (µl) Hemisphere: Both Tissue Segment: white matter |
| 12 | wmh\_frontal\_wm | Frontal white matter (µl) Hemisphere: Both Tissue Segment: white matter |
| 13 | wmh\_occipital\_wm | Occipital white matter (µl) Hemisphere: Both Tissue Segment: white matter |
| 14 | wmh\_parietal\_wm | Parietal white matter (µl) Hemisphere: Both Tissue Segment: white matter |
| 15 | wmh\_temporal\_wm | Temporal white matter (µl) Hemisphere: Both Tissue Segment: white matter |
| 16 | wmh\_deep\_wm\_l | Deep white matter (µl) Hemisphere: Left Tissue Segment: white matter |
| 17 | wmh\_frontal\_wm\_l | Frontal white matter (µl) Hemisphere: Left Tissue Segment: white matter |
| 18 | wmh\_occipital\_wm\_l | Occipital white matter (µl) Hemisphere: Left Tissue Segment: white matter |
| 19 | wmh\_parietal\_wm\_l | Parietal white matter (µl) Hemisphere: Left Tissue Segment: white matter |
| 20 | wmh\_temporal\_wm\_l | Temporal White Matter (µl) Hemisphere: Left Tissue Segment: white matter |
| 21 | wmh\_deep\_wm\_r | Deep white matter (µl) Hemisphere: Right Tissue Segment: white matter |
| 22 | wmh\_frontal\_wm\_r | Frontal white matter (µl) Hemisphere: Right Tissue Segment: white matter |
| 23 | wmh\_occipital\_wm\_r | Occipital white matter (µl) Hemisphere: Right Tissue Segment: white matter |
| 24 | wmh\_parietal\_wm\_r | Parietal white matter (µl) Hemisphere: Right Tissue Segment: white matter |
| 25 | wmh\_temporal\_wm\_r | Temporal white matter (µl) Hemisphere: Right Tissue Segment: white matter |
| 26 | wmh\_rightcerebellumwhitematter | Right cerebellum white matter (µl) Hemisphere: Right Tissue Segment: white matter |
| 27 | wmh\_leftcerebellumwhitematter | Left cerebellum white matter (µl) Hemisphere: Left Tissue Segment: white matter |
| 28 | wmh\_rightventraldc | Right ventral dc (µl) Hemisphere: Right Tissue Segment: white matter |
| 29 | wmh\_leftventraldc | Left ventral dc (µl) Hemisphere: Left Tissue Segment: white matter |
| 30 | wmh\_frontallobewmright | Frontal lobe wm right (µl) Hemisphere: Right Tissue Segment: white matter |
| 31 | wmh\_frontallobewmleft | Frontal lobe wm left (µl) Hemisphere: Left Tissue Segment: white matter |
| 32 | wmh\_occipitallobewmright | Occipital lobe wm right (µl) Hemisphere: Right Tissue Segment: white matter |
| 33 | wmh\_occipitallobewmleft | Occipital lobe wm left (µl) Hemisphere: Left Tissue Segment: white matter |
| 34 | wmh\_parietallobewmright | Parietal lobe wm right (µl) Hemisphere: Right Tissue Segment: white matter |
| 35 | wmh\_parietallobewmleft | Parietal lobe wm left (µl) Hemisphere: Left Tissue Segment: white matter |
| 36 | wmh\_temporallobewmright | Temporal lobe wm right (µl) Hemisphere: Right Tissue Segment: white matter |
| 37 | wmh\_temporallobewmleft | Temporal lobe wm left (µl) Hemisphere: Left Tissue Segment: white matter |
| 38 | wmh\_fornixright | Fornix right (µl) Hemisphere: Right Tissue Segment: white matter |
| 39 | wmh\_fornixleft | Fornix left (µl) Hemisphere: Left Tissue Segment: white matter |
| 40 | wmh\_anteriorlimbinternalcapsuler | Anterior limb of internal capsule right (µl) Hemisphere: Right Tissue Segment: white matter |
| 41 | wmh\_anteriorlimbinternalcapsulel | Anterior limb of internal capsule left (µl) Hemisphere: Left Tissue Segment: white matter |
| 42 | wmh\_postlimbofintcapscerebpedrig | Posterior limb of internal capsule inc. cerebral peduncle right (µl) Hemisphere: Right Tissue Segment: white matter |
| 43 | wmh\_postlimbofintcapscerebpedlef | Posterior limb of internal capsule inc. cerebral peduncle left (µl) Hemisphere: Left Tissue Segment: white matter |
| 44 | wmh\_corpuscallosum | Corpus callosum (µl) Hemisphere: Both Tissue Segment: white matter |
| 45 | bmri\_wmh\_vol\_exam | Exam of ancillary AS253 brain MRI |