

Quantitative Analysis of White Matter Hyperintensities as a Predictor of One-year Risk for Ischemic Stroke Recurrence

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Table e-1 Magnetic Resonance Sequences Parameters

Scanner	Sequence	TR (ms)	TE (ms)	Thickness (mm)	Spacing (mm)	FOV (mm*mm)	Matrix
MR 1	Axial T1WI	2259	25.4	5	1.5	240 *240	256*192
	Axial T2WI	5582	111	5	1.5	240 *240	256*192
	Axial Flair	8589	88.8	5	1.5	240 *240	256*192
	Axial DWI	3203	83.9	5	1.5	240 *240	96*96
MR 2	Axial T1WI	2048	11.96	5	1.5	230 *230	288*192
	Axial T2WI	4107	88.2	5	1.5	230 *230	288*192
	Axial Flair	7500	96.66	5	1.5	230 *230	288*192
	Axial DWI	2800	75.4	5	1.5	230 *230	128*128

TR: repetition time, **TE:** echo time, **FOV:** field of view,

MR 1: EXCITE HD 1.5 T MRI; GE Healthcare, **MR2:** uMR780 3.0 T MRI; United Imaging Healthcare

Table e-2 WMHs volume and number of WMHs clusters in different topography distributions.

	Variable	Hazard Ratio	95%CI		P value
			Lower	Upper	
WMHs Volume (PDL strategy)	wholeBrainWMHvol_mm ³	2.00	1.18	3.39	0.010
	PV-WMHvol_mm ³	1.78	1.05	3.05	0.034
	D-WMHvol_mm ³	1.79	1.05	3.05	0.033
	Lfrontal_WMHvol_mm ³	2.11	1.24	3.58	0.006
	Rfrontal_WMHvol_mm ³	2.05	1.20	3.50	0.008
	Ltemporal_WMHvol_mm ³	0.14	0.05	0.38	0.000
	Rtemporal_WMHvol_mm ³	1.62	0.98	2.67	0.060
	Lparietal_WMHvol_mm ³	1.89	1.13	3.15	0.015
	Rparietal_WMHvol_mm ³	1.81	1.07	3.04	0.027
	Loccipital_WMHvol_mm ³	1.51	0.80	2.84	0.198
	Roccipital_WMHvol_mm ³	1.46	0.78	2.74	0.243
	Lcerebellum_WMHvol_mm ³	1.51	0.91	2.50	0.112
	Rcerebellum_WMHvol_mm ³	2.14	0.67	6.83	0.199
	Brainstem_WMHvol_mm ³	1.39	0.77	2.53	0.275
WMHs Volume (the arterial strategy)	lAAH_WMHvol_mm ³	1.89	1.14	3.12	0.014
	rAAH_WMHvol_mm ³	85947073.56	0.00	Inf	0.995
	lMAH_WMHvol_mm ³	1.94	1.15	3.27	0.013
	rMAH_WMHvol_mm ³	2.36	1.41	3.94	0.001
	lAAML_WMHvol_mm ³	2.42	1.19	4.90	0.015
	rAAML_WMHvol_mm ³	3.25	1.81	5.81	0.000
	lAAC_WMHvol_mm ³	2.34	1.36	4.03	0.002
	rAAC_WMHvol_mm ³	2.10	1.26	3.49	0.004
	lMALL_WMHvol_mm ³	1.20	0.68	2.12	0.531
	rMALL_WMHvol_mm ³	2.33	1.40	3.89	0.001
	lPATMP_WMHvol_mm ³	1.31	0.60	2.88	0.499
	rPATMP_WMHvol_mm ³	2.61	0.82	8.32	0.106
	lPAH_WMHvol_mm ³	1.54	0.93	2.57	0.096
	rPAH_WMHvol_mm ³	4.08	1.28	13.03	0.018
	lPAC_WMHvol_mm ³	1.26	0.75	2.14	0.384
	rPAC_WMHvol_mm ³	2.10	0.29	15.15	0.462
The total number of WMHs clusters (PDL strategy)	wholeBrain_WMKnoc_total	0.39	0.09	1.58	0.186
	PV_WMKnoc_total	0.52	0.32	0.87	0.012
	D_WMKnoc_total	5.50	2.00	15.18	0.001
	Lfontal_WMKnoc_total	0.49	0.19	1.21	0.123
	Rfontal_WMKnoc_total	0.57	0.33	0.98	0.041
	Ltemporal_WMKnoc_total	0.46	0.23	0.91	0.025
	Rtemporal_WMKnoc_total	0.52	0.30	0.90	0.020
	Lparietal_WMKnoc_total	0.39	0.22	0.69	0.001
	Rparietal_WMKnoc_total	3.89	1.22	12.42	0.022
	Loccipital_WMKnoc_total	1.39	0.69	2.83	0.358
	Roccipital_WMKnoc_total	1.74	0.86	3.54	0.124
	Lcerebellum_WMKnoc_total	1.33	0.80	2.19	0.271
	Rcerebellum_WMKnoc_total	0.49	0.12	2.02	0.326
	Brainstem_WMKnoc_total	4.44	1.61	12.23	0.004
The total number of WMHs clusters (the arterial strategy)	lAAH_WMKnoc_total	0.50	0.30	0.83	0.007
	rAAH_WMKnoc_total	0.61	0.28	1.34	0.216
	lMAH_WMKnoc_total	0.46	0.26	0.81	0.007
	rMAH_WMKnoc_total	0.50	0.30	0.85	0.010
	lAAML_WMKnoc_total	0.67	0.39	1.16	0.152
	rAAML_WMKnoc_total	0.80	0.43	1.51	0.496
	lAAC_WMKnoc_total	0.63	0.37	1.08	0.090
	rAAC_WMKnoc_total	0.36	0.19	0.70	0.002
	lMALL_WMKnoc_total	0.59	0.36	0.99	0.044
	rMALL_WMKnoc_total	2.49	0.90	6.87	0.077
	lPATMP_WMKnoc_total	2.05	0.50	8.38	0.319
	rPATMP_WMKnoc_total	2.73	0.86	8.72	0.089
	lPAH_WMKnoc_total	0.56	0.34	0.92	0.023

The number of WMHs clusters with punctuate size (PDL strategy)	rPAH_WMHNoc_total	0.54	0.30	0.97	0.038
	lPAC_WMHNoc_total	0.88	0.49	1.58	0.669
	rPAC_WMHNoc_total	0.00	0.00	Inf	0.995
	wholeBrain_WMHNoc_punctuate	0.43	0.26	0.71	0.001
	PV_WMHNoc_punctuate	0.53	0.32	0.88	0.014
	D_WMHNoc_punctuate	0.49	0.29	0.81	0.006
	Lfrontal_WMHNoc_punctuate	0.59	0.35	1.00	0.048
	Rfrontal_WMHNoc_punctuate	0.64	0.39	1.06	0.085
	Ltemporal_WMHNoc_punctuate	4.96	1.55	15.85	0.007
	Rtemporal_WMHNoc_punctuate	0.63	0.36	1.11	0.111
	Lparietal_WMHNoc_punctuate	0.42	0.25	0.70	0.001
	Rparietal_WMHNoc_punctuate	0.52	0.31	0.86	0.011
	Loccipital_WMHNoc_punctuate	0.61	0.36	1.01	0.056
	Roccipital_WMHNoc_punctuate	1.56	0.77	3.17	0.217
	Lcerebellum_WMHNoc_punctuate	3.27	1.19	9.01	0.022
	Rcerebellum_WMHNoc_punctuate	0.00	0.00	Inf	0.996
	Brainstem_WMHNoc_punctuate	2.42	0.76	7.72	0.136
The number of WMHs clusters with punctuate size (the arterial strategy)	lAAH_WMHNoc_punctuate	0.49	0.29	0.83	0.008
	rAAH_WMHNoc_punctuate	0.51	0.31	0.84	0.009
	lMAH_WMHNoc_punctuate	0.47	0.26	0.84	0.011
	rMAH_WMHNoc_punctuate	0.56	0.33	0.96	0.036
	lAAML_WMHNoc_punctuate	0.60	0.37	1.00	0.050
	rAAML_WMHNoc_punctuate	0.60	0.29	1.27	0.180
	lAAC_WMHNoc_punctuate	0.59	0.32	1.09	0.092
	rAAC_WMHNoc_punctuate	0.38	0.17	0.84	0.017
	lMALL_WMHNoc_punctuate	0.50	0.30	0.84	0.009
	rMALL_WMHNoc_punctuate	1.55	0.62	3.87	0.349
	lPATMP_WMHNoc_punctuate	2.05	0.50	8.38	0.319
	rPATMP_WMHNoc_punctuate	0.74	0.45	1.22	0.243
	lPAH_WMHNoc_punctuate	0.54	0.30	0.96	0.037
	rPAH_WMHNoc_punctuate	0.58	0.35	0.96	0.034
	lPAC_WMHNoc_punctuate	0.85	0.43	1.68	0.643
	rPAC_WMHNoc_punctuate	0.75	0.36	1.57	0.442
The number of WMHs clusters with focal size (PDL strategy)	wholeBrain_WMHNoc_focal	0.48	0.28	0.82	0.008
	PV_WMHNoc_focal	4.94	1.79	13.63	0.002
	D_WMHNoc_focal	0.40	0.22	0.72	0.003
	Lfrontal_WMHNoc_focal	0.50	0.18	1.38	0.183
	Rfrontal_WMHNoc_focal	2.00	0.95	4.21	0.068
	Ltemporal_WMHNoc_focal	0.62	0.37	1.02	0.061
	Rtemporal_WMHNoc_focal	1.78	0.93	3.42	0.083
	Lparietal_WMHNoc_focal	0.38	0.22	0.65	0.000
	Rparietal_WMHNoc_focal	1.65	0.91	3.00	0.099
	Loccipital_WMHNoc_focal	2.08	0.51	8.53	0.307
	Roccipital_WMHNoc_focal	1.25	0.54	2.90	0.607
	Lcerebellum_WMHNoc_focal	0.00	0.00	Inf	0.995
	Rcerebellum_WMHNoc_focal	1.63	0.74	3.58	0.223
	Brainstem_WMHNoc_focal	1.80	0.86	3.79	0.121
The number of WMHs clusters with focal size (the arterial strategy)	lAAH_WMHNoc_focal	0.61	0.35	1.05	0.073
	rAAH_WMHNoc_focal	1.54	0.80	2.97	0.192
	lMAH_WMHNoc_focal	0.30	0.17	0.53	0.000
	rMAH_WMHNoc_focal	0.60	0.36	1.01	0.053
	lAAML_WMHNoc_focal	0.00	0.00	Inf	0.996
	rAAML_WMHNoc_focal	1.42	0.20	10.28	0.725
	lAAC_WMHNoc_focal	0.00	0.00	Inf	0.996
	rAAC_WMHNoc_focal	NA	NA	NA	NA
	lMALL_WMHNoc_focal	0.58	0.35	0.95	0.032
	rMALL_WMHNoc_focal	6.67	1.63	27.33	0.008
	lPATMP_WMHNoc_focal	1.57	0.49	5.01	0.446
	rPATMP_WMHNoc_focal	2.00	0.73	5.51	0.180
	lPAH_WMHNoc_focal	0.63	0.38	1.06	0.084

The number of WMHs clusters with medium size (PDL strategy)	rPAH_WMHNoc_focal	2.63	1.05	6.56	0.038
	lPAC_WMHNoc_focal	NA	NA	NA	NA
	rPAC_WMHNoc_focal	NA	NA	NA	NA
	wholeBrain_WMHNoc_medium	0.56	0.24	1.29	0.172
	PV_WMHNoc_medium	0.74	0.42	1.32	0.311
	DV_WMHNoc_medium	1.74	0.24	12.58	0.581
	Lfrontal_WMHNoc_medium	1.61	0.93	2.78	0.092
	Rfrontal_WMHNoc_medium	1.61	0.96	2.71	0.071
	Ltemporal_WMHNoc_medium	0.56	0.14	2.29	0.420
	Rtemporal_WMHNoc_medium	0.63	0.34	1.16	0.136
	Lparietal_WMHNoc_medium	1.19	0.69	2.05	0.525
	Rparietal_WMHNoc_medium	0.00	0.00	Inf	0.995
	Loccipital_WMHNoc_medium	0.00	0.00	Inf	0.995
	Roccipital_WMHNoc_medium	3.99	0.97	16.33	0.054
	Lcerebellum_WMHNoc_medium	NA	NA	NA	NA
	Rcerebellum_WMHNoc_medium	0.00	0.00	Inf	0.995
	Brainstem_WMHNoc_medium	1.16	0.69	1.95	0.564
	lAAH_WMHNoc_medium	2.53	1.15	5.56	0.021
	rAAH_WMHNoc_medium	0.63	0.15	2.59	0.523
The number of WMHs clusters with medium size (the arterial strategy)	lMAH_WMHNoc_medium	0.79	0.48	1.30	0.355
	rMAH_WMHNoc_medium	4.76	1.16	19.48	0.030
	lAAML_WMHNoc_medium	NA	NA	NA	NA
	rAAML_WMHNoc_medium	NA	NA	NA	NA
	lAAC_WMHNoc_medium	NA	NA	NA	NA
	rAAC_WMHNoc_medium	NA	NA	NA	NA
	lMALL_WMHNoc_medium	1.76	0.71	4.40	0.224
	rMALL_WMHNoc_medium	0.75	0.41	1.36	0.345
	lPATMP_WMHNoc_medium	3.17	0.77	12.97	0.109
	rPATMP_WMHNoc_medium	NA	NA	NA	NA
	lPAH_WMHNoc_medium	0.67	0.24	1.86	0.446
	rPAH_WMHNoc_medium	0.00	0.00	Inf	0.995
	lPAC_WMHNoc_medium	NA	NA	NA	NA
	rPAC_WMHNoc_medium	NA	NA	NA	NA
	wholeBrain_WMHNoc_confluent	0.72	0.43	1.20	0.209
	PV_WMHNoc_confluent	2.09	0.95	4.60	0.066
	D_WMHNoc_confluent	0.00	0.00	Inf	0.995
	Lfrontal_WMHNoc_confluent	0.00	0.00	Inf	0.996
	Rfrontal_WMHNoc_confluent	0.46	0.11	1.87	0.277
The number of WMHs clusters with confluent size (PDL strategy)	Ltemporal_WMHNoc_confluent	0.36	0.09	1.47	0.155
	Rtemporal_WMHNoc_confluent	0.85	0.21	3.49	0.825
	Lparietal_WMHNoc_confluent	0.36	0.05	2.63	0.316
	Rparietal_WMHNoc_confluent	1.78	1.07	2.96	0.027
	Loccipital_WMHNoc_confluent	1.44	0.84	2.46	0.180
	Roccipital_WMHNoc_confluent	0.00	0.00	Inf	0.996
	Lcerebellum_WMHNoc_confluent	NA	NA	NA	NA
	Rcerebellum_WMHNoc_confluent	NA	NA	NA	NA
	Brainstem_WMHNoc_confluent	0.51	0.20	1.26	0.144
	lAAH_WMHNoc_confluent	0.74	0.44	1.25	0.260
	rAAH_WMHNoc_confluent	0.79	0.47	1.31	0.356
	lMAH_WMHNoc_confluent	0.81	0.41	1.60	0.544
	rMAH_WMHNoc_confluent	0.59	0.14	2.42	0.466
	lAAML_WMHNoc_confluent	0.83	0.47	1.45	0.512
	rAAML_WMHNoc_confluent	1.34	0.80	2.24	0.262
	lAAC_WMHNoc_confluent	NA	NA	NA	NA
	rAAC_WMHNoc_confluent	NA	NA	NA	NA
	lMALL_WMHNoc_confluent	2.04	0.93	4.49	0.076
	rMALL_WMHNoc_confluent	1.82	0.95	3.50	0.071
The number of WMHs clusters with confluent size (the arterial strategy)	lPATMP_WMHNoc_confluent	1.27	0.74	2.16	0.386
	rPATMP_WMHNoc_confluent	NA	NA	NA	NA
	lPAH_WMHNoc_confluent	2.19	1.00	4.81	0.051

rPAH_WMnoc_confluent	1.81	0.57	5.78	0.316
lPAC_WMnoc_confluent	NA	NA	NA	NA
rPAC_WMnoc_confluent	NA	NA	NA	NA

WMHs: whiter matter hyperintensities;

PV-WMHs: periventricular WMHs; **D-WMHs:** deep matter WMHs; **PDL:** PV-WMHs, D-WMHs and lobe;

AAH: anterior artery hemisphere; **MAH:** middle artery hemisphere; **PAH:** posterior artery hemisphere; **AAC:** anterior artery callosal; **MALL:** middle artery lateral lenticulostriate; **PATMP:** posterior artery thalamic and midbrain perforators; **AML:** anterior artery medial lenticulostriate; **PAC:**posterior artery callosal.

The prefix R or L represent right or left in the above table. The suffix noc represents number of WMHs clusters. The suffix vol_mm3 represents WMHs volume.

Table e-3 Demographic and clinical characteristics in training and testing cohort.

Variable	Training cohort	Testing cohort	P value
Age, y	65.61±12.18	66.36±12.04	0.336
Gender, n (%)			0.686
Male	514(69.2)	216(67.9)	
Female	229(30.8)	102(32.1)	
Circulation territory			0.66
Anterior	491(66.1)	219(68.9)	
Posterior	231(31.1)	90(28.3)	
Both	21(2.8)	9(2.8)	
Stroke subtype (TOAST)			0.68
LAA	368(49.5)	169(53.1)	
CE	61(8.2)	22(6.9)	
SVO	253(34.1)	104(32.7)	
OD	6(0.8)	4(1.3)	
Undetermined	55(7.4)	19(6.0)	
Previous alcohol intake, n(%)	105(14.1)	40(12.6)	0.5
Previous smoking, n(%)	283(38.1)	112(35.2)	0.376
Hypertension, n(%)	498(67.0)	220(69.2)	0.491
Diabetes mellitus, n (%)	253(34.1)	111(34.9)	0.788
Hyperlipidemia, n (%)	209(28.1)	81(25.5)	0.374
Atrial fibrillation, n (%)	79(10.6)	31(9.7)	0.665
Discharge statins	463(62.3)	214(67.3)	0.122
Discharge anticoagulants	36(4.8)	12(3.8)	0.442
Discharge antiplatelets	672(90.4)	290(91.2)	0.7
Admission NIHSS score	3(1,4)	3(1,4)	0.499
mRS at 90days	0(0,1)	1(0,2)	0.602
Fazekas_pv	2(1,2)	2(1,2)	0.345
Fazekas_deep	1(1,2)	1(1,2)	0.77

LAA: large artery atherosclerosis; **CE:** cardioembolism; **SVO:** small vessel occlusion; **OD:** other determined; **NIHSS:** the National Institutes of Health Stroke Scale; **mRS:** modified Rankin Scale; **TOAST:** Trial of Org 10172 in Acute Stroke Treatment stroke; **Fazekas_pv:** periventricular Fazekas scale points; **Fazekas_deep:** deep white matters Fazekas scale points.