

Clinical Rheumatology

No evidence of abnormal metabolic or inflammatory activity in the brains of patients with rheumatoid arthritis: examination via whole-brain magnetic resonance spectroscopic imaging (MRSI).

Christina Mueller, M.S., Joanne C. Lin, Ph.D., Halle H. Thannickal, Altamish Daredia, B.S., Thomas S. Denney, Ph.D., Ronald Beyers, Ph.D., Jarred W. Younger, Ph.D.

*Jarred W. Younger (corresponding author)

Department of Psychology, University of Alabama at Birmingham

Campbell Hall suite 233, 1300 University Blvd, Birmingham, AL 35233

e-mail: younger@uab.edu

| ROI | LAC/CR | | | NAA/CR | | | Temperature (°C) | | |
|----------------------|---------|---------------|--------------|---------|---------------|--------------|------------------|---------------|--------------|
| | FSS VAS | DAS28 swollen | DAS28 tender | FSS VAS | DAS28 swollen | DAS28 tender | FSS VAS | DAS28 swollen | DAS28 tender |
| Precentral R | 0.008 | 0.023 | -0.296 | 0.416 | 0.281 | -0.033 | 0.323 | -0.065 | 0.234 |
| Precentral L | 0.028 | 0.043 | -0.195 | 0.098 | 0.385 | 0.081 | -0.337 | 0.136 | 0.064 |
| Frontal Lobe R | 0.152 | -0.113 | -0.385 | 0.287 | 0.238 | -0.139 | -0.438 | -0.156 | -0.128 |
| Frontal Lobe L | 0.048 | -0.094 | -0.209 | 0.250 | 0.456 | -0.020 | -0.275 | -0.054 | -0.006 |
| Rolandic Oper R | -0.208 | 0.238 | -0.131 | -0.093 | 0.130 | -0.153 | 0.157 | -0.371 | 0.064 |
| Rolandic Oper L | -0.096 | 0.187 | 0.092 | 0.483 | 0.150 | -0.028 | 0.166 | 0.283 | 0.287 |
| Supp Motor Area R | 0.128† | -0.018† | -0.363† | 0.292† | 0.174† | -0.113† | 0.217† | 0.054† | 0.109† |
| Supp Motor Area L | 0.065 | 0.051 | -0.248 | 0.214 | 0.442 | 0.092 | -0.128† | -0.109† | 0.116† |
| Insula R | -0.118 | -0.099 | -0.195 | 0.219 | 0.329 | 0.000 | -0.396 | -0.326 | -0.198 |
| Insula L | -0.132 | -0.196 | -0.391 | 0.244 | 0.448 | 0.251 | 0.250 | 0.088 | 0.123 |
| Anterior Cingulum R | 0.142† | -0.454† | -0.589*† | 0.292† | 0.047† | 0.201† | -0.089† | -0.011† | -0.254† |
| Anterior Cingulum L | -0.073 | -0.425 | -0.700** | 0.306 | -0.065 | -0.114 | -0.461 | -0.207 | -0.318 |
| Mid Cingulum R | 0.084 | -0.235 | -0.198 | 0.124 | 0.281 | -0.039 | 0.050† | -0.229† | -0.014† |
| Mid Cingulum L | -0.239 | -0.312 | -0.494 | 0.230 | 0.142 | -0.117 | 0.197 | -0.128 | 0.061 |
| Posterior Cingulum R | -0.101† | -0.118† | -0.203† | 0.356† | 0.050† | 0.118† | 0.029† | 0.186† | 0.285† |
| Posterior Cingulum L | 0.135 | 0.020 | -0.167 | 0.351 | 0.023 | 0.184 | 0.472 | 0.442 | 0.513 |

| | | | | | | | | | |
|----------------------|--------|--------|---------|--------|--------|--------|----------|---------|---------|
| Hippocampus R | -0.126 | -0.298 | -0.449 | 0.346 | 0.247 | 0.262 | -0.135† | -0.033† | 0.233† |
| Hippocampus L | 0.138 | -0.045 | -0.053 | 0.379 | 0.207 | 0.374 | 0.309 | 0.436 | 0.572* |
| Calcarine R | -0.135 | -0.014 | -0.192 | 0.340 | -0.014 | 0.056 | -0.073 | -0.340 | -0.014 |
| Calcarine L | -0.348 | -0.119 | -0.117 | -0.093 | -0.003 | -0.315 | 0.056 | -0.391 | 0.056 |
| Cuneus R | -0.402 | -0.068 | -0.304 | 0.396 | 0.266 | 0.086 | 0.129 | -0.402 | -0.028 |
| Cuneus L | -0.129 | -0.099 | -0.050 | -0.051 | -0.048 | -0.438 | -0.031 | -0.652* | -0.435 |
| Lingual Gyrus R | -0.199 | -0.303 | -0.427 | 0.582* | 0.218 | 0.416 | 0.045 | -0.105 | 0.315 |
| Lingual Gyrus L | -0.391 | -0.383 | -0.505 | 0.081 | 0.122 | -0.095 | 0.037 | -0.278 | 0.084 |
| Occipital Lobe R | -0.126 | -0.176 | -0.145 | 0.028 | 0.320 | 0.067 | 0.253 | 0.048 | 0.008 |
| Occipital Lobe L | -0.084 | 0.136 | -0.268 | -0.087 | 0.062 | -0.352 | -0.138 | -0.612* | -0.379 |
| Fusiform Gyrus R | 0.081 | -0.028 | -0.134 | 0.205 | 0.170 | 0.259 | 0.219 | -0.043 | 0.206 |
| Fusiform Gyrus L | -0.051 | -0.323 | -0.170 | 0.385 | 0.317 | 0.232 | 0.334 | -0.031 | 0.248 |
| Postcentral Gyrus R | 0.056 | 0.125 | -0.075 | 0.104 | 0.241 | -0.259 | -0.233 | -0.096 | -0.128 |
| Postcentral Gyrus L | 0.160 | -0.023 | -0.279 | -0.022 | 0.179 | -0.089 | -0.458 | -0.224 | -0.081 |
| Parietal Lobe R | -0.171 | 0.227 | 0.047 | 0.157 | 0.266 | -0.050 | 0.000 | -0.162 | -0.064 |
| Parietal Lobe L | 0.104 | 0.230 | 0.120 | 0.056 | 0.105 | -0.273 | -0.112 | -0.470 | -0.131 |
| Precuneus R | -0.177 | 0.017 | -0.310 | 0.169 | 0.374 | 0.081 | 0.112 | -0.417 | 0.011 |
| Precuneus L | -0.104 | -0.130 | -0.212 | 0.051 | 0.184 | -0.114 | -0.258 | -0.536 | -0.290 |
| Paracentral Lobule R | 0.064† | 0.084† | -0.261† | 0.470† | 0.436† | 0.113† | -0.037†† | 0.135†† | 0.221†† |

| | | | | | | | | | |
|----------------------|--------|--------|--------|--------|--------|--------|----------|----------|----------|
| Paracentral Lobule L | 0.214 | 0.043 | -0.089 | 0.489 | 0.320 | 0.061 | -0.353†† | -0.308†† | -0.133†† |
| Caudate R | -0.281 | -0.332 | -0.335 | 0.208 | 0.130 | 0.117 | -0.517 | -0.570* | -0.469 |
| Caudate L | -0.326 | 0.037 | -0.237 | -0.037 | 0.337 | -0.109 | -0.084 | 0.244 | 0.234 |
| Putamen R | -0.140 | -0.159 | -0.312 | 0.332 | -0.108 | 0.017 | 0.042 | -0.315 | -0.114 |
| Putamen L | -0.149 | -0.380 | -0.402 | 0.079 | 0.249 | 0.059 | 0.199 | 0.136 | 0.120 |
| Pallidum R | 0.121 | -0.051 | -0.318 | 0.098 | -0.326 | -0.114 | -0.278 | -0.164 | -0.293 |
| Pallidum L | 0.360 | 0.167 | 0.053 | -0.275 | -0.247 | 0.045 | 0.555† | 0.055† | 0.377† |
| Thalamus R | -0.205 | -0.147 | -0.159 | 0.469 | 0.349 | 0.379 | -0.11 | -0.128 | 0.006 |
| Thalamus L | -0.020 | 0.150 | 0.151 | 0.129 | 0.30 | 0.170 | 0.107 | 0.153 | 0.234 |
| Temporal Lobe R | -0.230 | -0.298 | -0.204 | 0.011 | 0.082 | -0.075 | 0.242 | -0.133 | 0.237 |
| Temporal Lobe L | -0.107 | -0.040 | -0.117 | 0.132 | -0.221 | -0.262 | 0.017 | -0.159 | 0.190 |
| Cerebellum | -0.045 | 0.020 | -0.229 | -0.177 | 0.150 | 0.036 | -0.112 | -0.255 | 0.159 |

VAS: visual analog scale

*p<0.05 **p<0.01

n=13 (unless an exception is noted); †: n=12; ††: n=11

Spearman correlations between metabolite ratios and temperature in regions of interest and clinical outcome data in RA patients. None of the results survived corrections for multiple comparisons (equivalent to uncorrected p<0.0023).