Symptom interconnectivity in multiple sclerosis: A narrative review of potential underlying biological disease processes – *supplementary material*

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Table S1. List of references identified in the literature search

Title	DOI	PMID	CI	Fatigue	Depression	Pain	Neuroanatomy	Inflammation	HPA Axis	Monoamines	Other
Benign multiple sclerosis: a new definition of this entity is needed	10.1177/1352458511419702	21865415	CI	Fatigue	Depression	Pain	Neuroanatomy				
Cortical thickness and surface area relate to specific symptoms in early relapsing-remitting multiple sclerosis	10.1177/1352458514543811	25139946	CI	Fatigue	Depression		Neuroanatomy				
Default mode network changes in multiple sclerosis: a link between depression and cognitive impairment?	10.1111/ene.13112	27633185	CI	Fatigue	Depression		Neuroanatomy				
Structural correlates for fatigue in early relapsing remitting multiple sclerosis	10.1007/s00330-015-3857-2	26026721	CI	Fatigue			Neuroanatomy				
Fatigue and cognition: Pupillary responses to problem-solving in early multiple sclerosis patients	10.1002/brb3.717	28729927	CI	Fatigue			Neuroanatomy				
Functional Magnetic Resonance Imaging Correlations Between Fatigue and Cognitive Performance in Patients With Relapsing Remitting Multiple Sclerosis	10.3389/fpsyt.2019.00754	31749716	CI	Fatigue			Neuroanatomy				
The effect of morphological and microstructural integrity of the corpus callosum on cognition, fatigue and depression in mildly disabled MS patients	10.1016/j.mri.2017.04.010	28438714	CI	Fatigue			Neuroanatomy				
The relationship between total and regional corpus callosum atrophy, cognitive impairment and fatigue in multiple sclerosis patients	10.1177/1352458513496880	23959709	CI	Fatigue			Neuroanatomy				
Quality of life in multiple sclerosis is associated with lesion burden and brain volume measures	10.1212/WNL.0b013e3181a609f8	19451531	CI	Fatigue			Neuroanatomy				
Tract-specific white matter correlates of fatigue and cognitive impairment in benign multiple sclerosis	10.1016/j.jns.2013.04.005	23643443	CI	Fatigue			Neuroanatomy				
Health-related quality of life, neuropsychiatric symptoms and structural brain changes in clinically isolated syndrome	10.1371/journal.pone.0200254	29979757	CI		Depression		Neuroanatomy				
Decreased hippocampal volume, indirectly measured, is associated with depressive symptoms and consolidation deficits in multiple sclerosis	10.1177/1352458511403530	21546523	CI		Depression		Neuroanatomy				
Structural brain correlates of emotional disorder in multiple sclerosis	10.1093/brain/109.4.585	3730806	CI		Depression		Neuroanatomy				
Gray matter trophism, cognitive impairment, and depression in patients with multiple sclerosis	10.1177/1352458517692886	28169581	CI		Depression		Neuroanatomy				
Correlating Brain Atrophy With Cognitive Dysfunction, Mood Disturbances, and Personality Disorder in Multiple Sclerosis	10.1111/j.1552-6569.2004.tb00277.x	15228758	CI		Depression		Neuroanatomy				
Association of cognitive impairment and lesion volumes in multiple sclerosis--a MRI study	10.1016/j.clineuro.2014.09.019	25459243	CI				Neuroanatomy				
Association of MRI metrics and cognitive impairment in radiologically isolated syndromes	10.1212/WNL.0b013e31824528c9	22262744	CI				Neuroanatomy				
Cognitive and brain reserve in multiple sclerosis--A cross-sectional study	10.1016/j.msard.2019.07.027	31374461	CI				Neuroanatomy				
Cognitive Fatigability is Independent of Subjective Cognitive Fatigue and Mood in Multiple Sclerosis	10.1097/WNN.0000000000000228	32496296	CI				Neuroanatomy				
Cognitive processing speed in multiple sclerosis clinical practice: association with patient-reported outcomes, employment and magnetic resonance imaging metrics	10.1111/ene.14239	32222019	CI				Neuroanatomy				
Contribution of cortical and white matter lesions to cognitive impairment in multiple sclerosis	10.1177/1352458513475490	23459568	CI				Neuroanatomy				
Contribution of cortical lesions to cognitive impairment in Japanese patients with multiple sclerosis	10.1038/s41598-020-61012-3	32251297	CI				Neuroanatomy				
Education, and the balance between dynamic and stationary functional connectivity jointly support executive functions in relapsing-remitting multiple sclerosis	10.1002/hbm.24343	30240533	CI				Neuroanatomy				
Event related potential and response time give evidence for a physiological reserve in cognitive functioning in relapsing-remitting multiple sclerosis	10.1016/j.jns.2015.06.025	26117361	CI				Neuroanatomy				
Impaired Self-Other Distinction and Subcortical Gray-Matter Alterations Characterize Socio-Cognitive Disturbances in Multiple Sclerosis	10.3389/fneur.2019.00525	31164860	CI				Neuroanatomy				
Quality and quantity of diffuse and focal white matter disease and cognitive disability of patients with multiple sclerosis	10.1111/j.1552-6569.2010.00488.x	20626570	CI				Neuroanatomy				
Reduced magnetisation transfer ratio in cognitively impaired patients at the very early stage of multiple sclerosis: a prospective, multicenter, cross-sectional study	10.1136/bmjopen-2013-004409	24722197	CI				Neuroanatomy				
Relationship between Social Cognition and traditional cognitive impairment in Progressive Multiple Sclerosis and possible implicated neuroanatomical regions	10.1016/j.msard.2018.01.013	29414284	CI				Neuroanatomy				
Subjective cognitive concern in multiple sclerosis is associated with reduced thalamic and cortical gray matter volumes	10.1177/2055217319827618	30800417	CI				Neuroanatomy				
Thalamic atrophy correlates with dysfunctional impulsivity in multiple sclerosis	10.1016/j.msard.2020.102374	32652509	CI				Neuroanatomy				
The influence of posterior visual pathway damage on visual information processing speed in multiple sclerosis	10.1177/1352458516676642	28273763	CI				Neuroanatomy				
On the relation between self-reported cognitive fatigue and the posterior hypothalamic-brainstem network	10.1111/ene.12815	26278274	CI				Neuroanatomy				
Third ventricular enlargement in early stages of multiple sclerosis is a predictor of motor and neuropsychological deficits: a cross-sectional study	10.1136/bmjopen-2013-003582	24022394	CI				Neuroanatomy				
Translational validity of PASAT and the effect of fatigue and mood in patients with relapsing remitting MS: A functional MRI study	10.1111/jep.12913	29611255	CI				Neuroanatomy				
Frontal cortex atrophy predicts cognitive impairment in multiple sclerosis	10.1176/jnp.14.1.44	11884654	CI				Neuroanatomy				
Regional lobar atrophy predicts memory impairment in multiple sclerosis		16091537	CI				Neuroanatomy				
Evidence for a direct association between cortical atrophy and cognitive impairment in relapsing-remitting MS	10.1016/j.neuroimage.2005.10.032	16360321	CI				Neuroanatomy				
Thalamic atrophy and cognition in multiple sclerosis	10.1212/01.wnl.0000276992.17011.b5	17875909	CI				Neuroanatomy				
Regional hippocampal atrophy in multiple sclerosis	10.1093/brain/awn030	18375977	CI				Neuroanatomy				
Basal ganglia, thalamus and neocortical atrophy predicting slowed cognitive processing in multiple sclerosis	10.1007/s00415-011-6147-1	21720932	CI				Neuroanatomy				
Cortical lesions and atrophy associated with cognitive impairment in relapsing-remitting multiple sclerosis	10.1001/archneurol.2009.174	19752305	CI				Neuroanatomy				
Regional DTI differences in multiple sclerosis patients	10.1016/j.neuroimage.2008.10.026	19027076	CI				Neuroanatomy				
Fornix damage limits verbal memory functional compensation in multiple sclerosis	10.1016/j.neuroimage.2011.09.071	22001266	CI				Neuroanatomy				
Diffusion tensor MRI tractography and cognitive impairment in multiple sclerosis	10.1212/WNL.0b013e31824d5859	22377806	CI				Neuroanatomy				
Increased functional connectivity indicates the severity of cognitive impairment in multiple sclerosis	10.1073/pnas.1110024108	22065778	CI				Neuroanatomy				
Assessing brain connectivity at rest is clinically relevant in early multiple sclerosis	10.1177/1352458511435930	22307385	CI				Neuroanatomy				
Altered inter-subregion connectivity of the default mode network in relapsing remitting multiple sclerosis: a functional and structural connectivity study	10.1371/journal.pone.0101198	24999807	CI				Neuroanatomy				
The link between resting-state functional connectivity and cognition in MS patients	10.1177/1352458513495584	23828871	CI				Neuroanatomy				
Brain networks disconnection in early multiple sclerosis cognitive deficits: an anatomofunctional study	10.1002/hbm.22505	24687771	CI				Neuroanatomy				
T1 cortical hypointensities and their association with cognitive disability in multiple sclerosis	10.1177/1352458510377223	20699284	CI				Neuroanatomy				
Correlation of magnetic resonance imaging with neuropsychological testing in multiple sclerosis	10.1212/wnl.39.2.161	2915783	CI				Neuroanatomy				
Changes in the normal appearing brain tissue and cognitive impairment in multiple sclerosis	10.1136/jnnp.68.2.157	10644780	CI				Neuroanatomy				
Serial neuropsychological assessment and magnetic resonance imaging analysis in multiple sclerosis	10.1001/archneur.1997.00550200074013	9267977	CI				Neuroanatomy				
Prediction of neuropsychological impairment in multiple sclerosis: comparison of conventional magnetic resonance imaging measures of atrophy and lesion burden	10.1001/archneur.61.2.226	14967771	CI				Neuroanatomy				
MRI correlates of cognitive impairment in childhood-onset multiple sclerosis.	10.1037/a0022051	21534686	CI				Neuroanatomy				
White matter integrity and math performance in pediatric multiple sclerosis	10.1097/WNR.0b013e32834dc301	22045260	CI				Neuroanatomy				
Cognitive impairment in relation to MRI metrics in patients with clinically isolated syndrome	10.1177/1352458510384009	20956399	CI				Neuroanatomy				
Frequency of cognitive impairment dramatically increases during the first 5 years of multiple sclerosis	10.1136/jnnp.2010.213744	20971755	CI				Neuroanatomy				
Cognitive impairment at the onset of multiple sclerosis: relationship to lesion location	10.1177/1352458511398265	21372116	CI				Neuroanatomy				
Cognition in multiple sclerosis: relevance of lesions, brain atrophy and proton MR spectroscopy	10.1007/s10072-010-0370-x	20635111	CI				Neuroanatomy				
Early imaging predicts later cognitive impairment in primary progressive multiple sclerosis	10.1212/WNL.0b013e3181cff6a6	20157157	CI				Neuroanatomy				
Grey matter volume in a large cohort of MS patients: relation to MRI parameters and disability	10.1177/1352458511404916	21586487	CI				Neuroanatomy				
Identification and clinical impact of multiple sclerosis cortical lesions as assessed by routine 3T MR imaging	10.3174/ajnr.A2340	21310857	CI				Neuroanatomy				
Intracortical lesions by 3T magnetic resonance imaging and correlation with cognitive impairment in multiple sclerosis	10.1177/1352458511405561	21543552	CI				Neuroanatomy				
Grey matter damage and overall cognitive impairment in primary progressive multiple sclerosis	10.1177/1352458511410341	21803874	CI				Neuroanatomy				
Cognitive impairment in multiple sclerosis is associated to different patterns of gray matter atrophy according to clinical phenotype	10.1002/hbm.21125	20740643	CI				Neuroanatomy				
Cognitive deficits in multiple sclerosis: correlations with T2 changes in normal appearing brain tissue	10.1111/j.1600-0404.2011.01574.x	21793807	CI				Neuroanatomy				
Diffusion tensor imaging and cognitive speed in children with multiple sclerosis	10.1016/j.jns.2011.07.019	21821263	CI				Neuroanatomy				
Functional magnetic resonance imaging correlates of cognitive performance in patients with a clinically isolated syndrome suggestive of multiple sclerosis at presentation: an activa	10.1177/1352458511417744	21828200	CI				Neuroanatomy				
Functional adaptive changes within the hippocampal memory system of patients with multiple sclerosis	10.1002/hbm.21359	21898674	CI				Neuroanatomy				
Cognitive compensation failure in multiple sclerosis	10.1212/WNL.0b013e3181f612e3	20921510	CI				Neuroanatomy				
Thalamic involvement and its impact on clinical disability in patients with multiple sclerosis: a diffusion tensor imaging study at 3T	10.3174/ajnr.A1564	19369608	CI				Neuroanatomy				
Characterization of thalamic lesions and their correlates in multiple sclerosis by ultra-high-field MRI	10.1177/1352458520932804	32584159	CI				Neuroanatomy				
Clinical significance of atrophy and white matter mean diffusivity within the thalamus of multiple sclerosis patients	10.1177/1352458513478675	23459570	CI				Neuroanatomy				
Iron and volume in the deep gray matter: association with cognitive impairment in multiple sclerosis	10.3174/ajnr.A3998	24948507	CI				Neuroanatomy				
Sex-specific extent and severity of white matter damage in multiple sclerosis: implications for cognitive decline	10.1002/hbm.22332	23982918	CI				Neuroanatomy				
Memory in multiple sclerosis is linked to glutamate concentration in grey matter regions	10.1136/jnnp-2013-306662	24431465	CI				Neuroanatomy				
Measures of Thalamic Integrity are Associated with Cognitive Functioning in Fingolimod-treated Multiple Sclerosis Patients	10.1016/j.msard.2020.102635	33260053	CI				Neuroanatomy				
Thalamic white matter in multiple sclerosis: A combined diffusion-tensor imaging and quantitative susceptibility mapping study	10.1002/hbm.24227	29923266	CI				Neuroanatomy				
Yakovlev's Basolateral Limbic Circuit in Multiple Sclerosis Related Cognitive Impairment	10.1111/jon.12531	29893064	CI				Neuroanatomy				
Thalamic Nuclei Volumes and Their Relationships to Neuroperformance in Multiple Sclerosis: A Cross-Sectional Structural MRI Study	10.1002/jmri.27389	33044013	CI				Neuroanatomy				
Localized atrophy of the thalamus and slowed cognitive processing speed in MS patients	10.1177/1352458515616204	26541795	CI				Neuroanatomy				
Regional changes in thalamic shape and volume are related to cognitive performance in multiple sclerosis	10.1177/1352458519892552	31793399	CI				Neuroanatomy				
Structural connectivity-defined thalamic subregions have different functional connectivity abnormalities in multiple sclerosis patients: Implications for clinical correlations	10.1002/hbm.23805	28881433	CI				Neuroanatomy				
Thalamus volume change and cognitive impairment in early relapsing-remitting multiple sclerosis patients	10.1177/1971400918781977	29869576	CI				Neuroanatomy				
Multi-parametric structural magnetic resonance imaging in relation to cognitive dysfunction in long-standing multiple sclerosis	10.1177/1352458515596598	26209593	CI				Neuroanatomy				
FLAIR lesion in multiple sclerosis: relation to processing speed and verbal memory	10.1017/s1355617705050253	15962708	CI				Neuroanatomy				
Statistical mapping analysis of lesion location and neurological disability in multiple sclerosis: application to 452 patient data sets	10.1016/s1053-8119(03)00117-4	12880785	CI				Neuroanatomy				
Intellectual enrichment is linked to cerebral efficiency in multiple sclerosis: functional magnetic resonance imaging evidence for cognitive reserve	10.1093/brain/awp307	20008455	CI				Neuroanatomy				
Disconnection as a mechanism for cognitive dysfunction in multiple sclerosis	10.1093/brain/awn275	18953055	CI				Neuroanatomy				
Default-mode network dysfunction and cognitive impairment in progressive MS	10.1212/WNL.0b013e3181d9ed91	20404306	CI				Neuroanatomy				

Widespread cortical thinning characterizes patients with MS with mild cognitive impairment	10.1212/WNL.0b013e3181cbcd03	20101038	CI				Neuroanatomy					
Memory performance in multiple sclerosis patients correlates with central brain atrophy	10.1191/1352458506ms1286oa	16900756	CI				Neuroanatomy					
Relevance of brain lesion location to cognition in relapsing multiple sclerosis	10.1371/journal.pone.0044826	23144775	CI				Neuroanatomy					
Predictive value of different conventional and non-conventional MRI-parameters for specific domains of cognitive function in multiple sclerosis	10.1016/j.nicl.2015.02.023	25844323	CI				Neuroanatomy					
MRI predictors of cognitive outcome in early multiple sclerosis	10.1212/WNL.0b013e318212a8be	21444901	CI				Neuroanatomy					
Brain pathways of verbal working memory: a lesion-function correlation study	10.1016/j.neuroimage.2009.04.054	19393745	CI				Neuroanatomy					
Cognitive impairment as marker of diffuse brain abnormalities in early relapsing remitting multiple sclerosis	10.1136/jnnp.2004.045872	15774439	CI				Neuroanatomy					
Cortical demyelination in multiple sclerosis: a substrate for cognitive deficits?	10.1016/j.jns.2005.09.021	16650874	CI				Neuroanatomy					
Thalamus structure and function determine severity of cognitive impairment in multiple sclerosis	10.1212/WNL.0000000000001285	25616483	CI				Neuroanatomy					
Gray and white matter brain atrophy and neuropsychological impairment in multiple sclerosis	10.1212/01.wnl.0000201238.93586.d9	16534104	CI				Neuroanatomy					
Executive function in multiple sclerosis. The role of frontal lobe pathology	10.1093/brain/120.1.15	9055794	CI				Neuroanatomy					
Regional magnetic resonance imaging lesion burden and cognitive function in multiple sclerosis: a longitudinal study	10.1001/archneur.58.1.115	11176944	CI				Neuroanatomy					
Cognitive impairment in MS: impact of white matter integrity, gray matter volume, and lesions	10.1212/WNL.0b013e31828726cc	23468546	CI				Neuroanatomy					
Superior temporal gyrus thickness correlates with cognitive performance in multiple sclerosis	10.1007/s00429-012-0440-3	22790785	CI				Neuroanatomy					
Compensatory cortical activation observed by fMRI during a cognitive task at the earliest stage of MS	10.1002/hbm.10128	14505331	CI				Neuroanatomy					
Efficiency of cognitive control recruitment in the very early stage of multiple sclerosis: a one-year fMRI follow-up study	10.1177/1352458508089360	18573836	CI				Neuroanatomy					
Neocortical atrophy, third ventricular width, and cognitive dysfunction in multiple sclerosis	10.1001/archneur.63.9.1301	16966509	CI				Neuroanatomy					
Diffusion-weighted imaging predicts cognitive impairment in multiple sclerosis	10.1177/1352458507075592	17613599	CI				Neuroanatomy					
The correlation between ventricular diameter measured by transcranial sonography and clinical disability and cognitive dysfunction in patients with multiple sclerosis	10.1001/archneur.57.9.1289	10987895	CI				Neuroanatomy					
Bicaudate ratio as a magnetic resonance imaging marker of brain atrophy in multiple sclerosis	10.1001/archneur.59.2.275	11843699	CI				Neuroanatomy					
Structural connectivity influences brain activation during PVSAT in Multiple Sclerosis	10.1016/j.neuroimage.2008.08.015	18790063	CI				Neuroanatomy					
Cognitive impairment is associated with subcortical magnetic resonance imaging grey matter T2 hypointensity in multiple sclerosis	10.1191/135248506ms1301oa	16900757	CI				Neuroanatomy					
Reduced brain functional reserve and altered functional connectivity in patients with multiple sclerosis	10.1093/brain/awh670	16251214	CI				Neuroanatomy					
Cognitive function in primary progressive and transitional progressive multiple sclerosis: a controlled study with MRI correlates	10.1093/brain/122.7.1341	10388799	CI				Neuroanatomy					
Cerebral activation patterns during working memory performance in multiple sclerosis using FMRI	10.1080/13803390513609	15814441	CI				Neuroanatomy					
Brain magnetic resonance imaging correlates of cognitive impairment in multiple sclerosis	10.1016/0022-510X(93)90212-H	8340796	CI				Neuroanatomy					
The unique impact of changes in normal appearing brain tissue on cognitive dysfunction in secondary progressive multiple sclerosis patients	10.1191/1352458504ms1095oa	15584486	CI				Neuroanatomy					
Correlates of executive function in multiple sclerosis: the use of magnetic resonance spectroscopy as an index of focal pathology	10.1176/jnp.11.1.45	9990555	CI				Neuroanatomy					
Correlation of neuropsychological and MRI findings in chronic/progressive multiple sclerosis	10.1212/wnl.38.12.1826	3194059	CI				Neuroanatomy					
Cognitive dysfunction in early multiple sclerosis: altered centrality derived from resting-state functional connectivity using magneto-encephalography	10.1371/journal.pone.0042087	22848712	CI				Neuroanatomy					
Neuropsychological impairment in multiple sclerosis patients: the role of (juxta)cortical lesion on FLAIR	10.1177/135245850000600410	10962549	CI				Neuroanatomy					
fMRI evidence of brain reorganization during attention and memory tasks in multiple sclerosis	10.1016/j.neuroimage.2003.10.004	15006652	CI				Neuroanatomy					
Correlation of global N-acetyl aspartate with cognitive impairment in multiple sclerosis	10.1001/archneur.63.4.533	16606765	CI				Neuroanatomy					
Corpus callosum damage and cognitive dysfunction in benign MS	10.1002/hbm.20692	19067325	CI				Neuroanatomy					
Genotype-Phenotype correlations in multiple sclerosis: HLA genes influence disease severity inferred by 1HMR spectroscopy and MRI measures	10.1093/brain/awn301	19022862	CI				Neuroanatomy					
Cognitive Dysfunction Lateralizes With NAA in Multiple Sclerosis	10.1207/S15324826AN0803_4	11686650	CI				Neuroanatomy					
Potentially adaptive functional changes in cognitive processing for patients with multiple sclerosis and their acute modulation by rivastigmine	10.1093/brain/awg284	12958082	CI				Neuroanatomy					
Analysis of impairment related functional architecture in MS patients during performance of different attention tasks	10.1007/s00415-003-1025-0	12700913	CI				Neuroanatomy					
Longitudinal study of cognitive dysfunction in multiple sclerosis: neuropsychological, neuroradiological, and neurophysiological findings	10.1136/jnnp.74.7.878	12810771	CI				Neuroanatomy					
Differences in cerebral activation patterns in idiopathic inflammatory demyelination using the paced visual serial addition task: an fMRI study	10.1016/j.jns.2005.11.035	16480742	CI				Neuroanatomy					
Structural and functional surrogates of cognitive impairment at the very early stage of multiple sclerosis	10.1016/j.jns.2005.09.019	16631206	CI				Neuroanatomy					
Structural and functional MRI correlates of Stroop control in benign MS	10.1002/hbm.20504	18041737	CI				Neuroanatomy					
Relation between MR abnormalities and patterns of cognitive impairment in multiple sclerosis	10.1212/WNL.50.6.1601	9633700	CI				Neuroanatomy					
Cortical/subcortical disease burden and cognitive impairment in patients with multiple sclerosis		10696031	CI				Neuroanatomy					
Cognitive dysfunction in patients with mildly disabling relapsing–remitting multiple sclerosis: an exploratory study with diffusion tensor MR imaging	10.1016/S0022-510X(01)00690-6	11897239	CI				Neuroanatomy					
Brain atrophy as a marker of cognitive impairment in mildly disabling relapsing-remitting multiple sclerosis	10.1111/j.1468-1331.2008.02259.x	18727673	CI				Neuroanatomy					
Functional imaging during covert auditory attention in multiple sclerosis	10.1016/j.jns.2003.10.019	14759627	CI				Neuroanatomy					
fMRI investigation of disinhibition in cognitively impaired patients with multiple sclerosis	10.1016/j.jns.2009.02.366	19344919	CI				Neuroanatomy					
Cognitive function and fMRI in patients with multiple sclerosis: evidence for compensatory cortical activation during an attention task	10.1093/brain/awf125	12023316	CI				Neuroanatomy					
Magnetic resonance spectroscopy of memory and frontal brain region in early multiple sclerosis	10.1176/jnp.17.3.357	16179658	CI				Neuroanatomy					
Cognitive impairment in relapsing-remitting multiple sclerosis can be predicted by imaging performed several years earlier	10.1177/135245850708235 3	17986503	CI				Neuroanatomy					
Cognitive impairment in multiple sclerosis can be predicted by imaging early in the disease	10.1136/jnnp.2007.138685	18339729	CI				Neuroanatomy					
Functional magnetic resonance imaging of working memory among multiple sclerosis patients	10.1111/j.1552-6569.2004.tb00232.x	15095561	CI				Neuroanatomy					
Functional magnetic resonance imaging response to increased verbal working memory demands among patients with multiple sclerosis	10.1002/hbm.20163	16001441	CI				Neuroanatomy					
Neuropsychological and structural brain lesions in multiple sclerosis: a regional analysis	10.1212/wnl.42.7.1291	1620336	CI				Neuroanatomy					
Cognitive decline in multiple sclerosis: impact of topographic lesion distribution on differential cognitive deficit patterns	10.1177/1352458509106853	19667010	CI				Neuroanatomy					
Occurrence of neuronal dysfunction during the first 5 years of multiple sclerosis is associated with cognitive deterioration	10.1007/s00415-010-5845-4	21132325	CI				Neuroanatomy					
Relationship between frontal lobe lesions and Wisconsin Card Sorting Test performance in patients with multiple sclerosis	10.1212/wnl.44.3_part_1.420	8145908	CI				Neuroanatomy					
An investigation of working memory rehearsal in multiple sclerosis using fMRI	10.1076/jcen.25.7.965.16490	13680443	CI				Neuroanatomy					
fMRI study of episodic memory in relapsing-remitting MS: correlation with T2 lesion volume	10.1212/01.wnl.0000242885.71725.76	17101897	CI				Neuroanatomy					
Magnetic resonance study of the influence of tissue damage and cortical reorganization on PASAT performance at the earliest stage of multiple sclerosis	10.1002/hbm.20083	15543553	CI				Neuroanatomy					
Posterior brain damage and cognitive impairment in pediatric multiple sclerosis	10.1212/WNL.0000000000000309	24647027	CI				Neuroanatomy					
Impaired functional integration in multiple sclerosis: a graph theory study	10.1007/s00429-014-0896-4	25257603	CI				Neuroanatomy					
Subcortical atrophy and cognition: sex effects in multiple sclerosis	10.1212/WNL.0b013e3182703f46	23019265	CI				Neuroanatomy					
Cortical lesion load associates with progression of disability in multiple sclerosis	10.1093/brain/aws246	23065788	CI				Neuroanatomy					
Gray matter damage predicts the accumulation of disability 13 years later in MS	10.1212/01.wnl.0000435551.90824.d0	24122185	CI				Neuroanatomy					
Modulation of effective connectivity inside the working memory network in patients at the earliest stage of multiple sclerosis	10.1016/j.neuroimage.2004.08.038	15627595	CI				Neuroanatomy					
Trigeminal neuralgia due to multiple sclerosis: ultrastructural findings in trigeminal rhizotomy specimens	10.1046/j.0305-1846.2001.00318.x	11489143				Pain	Neuroanatomy	Inflammation				
Hypothalamic damage in multiple sclerosis correlates with disease activity, disability, depression, and fatigue	10.1080/01616412.2016.1275460	28191860		Fatigue	Depression		Neuroanatomy					
Smaller cornu ammonis 2-3/dentate gyrus volumes and elevated cortisol in multiple sclerosis patients with depressive symptoms	10.1016/j.biopsych.2010.04.025	20646680			Depression		Neuroanatomy		HPA axis			
Mood disorders and dysfunction of the hypothalamic-pituitary-adrenal axis in multiple sclerosis: association with cerebral inflammation	10.1001/archneur.55.1.66	9443712			Depression		Neuroanatomy	Inflammation	HPA axis			
Widespread pressure pain hypersensitivity in patients with multiple sclerosis with and without pain as sign of central sensitization	10.1097/AJP.0000000000000084	24525905		Fatigue	Depression	Pain	Neuroanatomy					
Fatigue in multiple sclerosis patients with different clinical phenotypes: a clinical and magnetic resonance imaging study	10.1111/ene.14471	32780554		Fatigue	Depression		Neuroanatomy					
Different cortical underpinnings for fatigue and depression in MS?	10.1016/j.msard.2016.02.005	27063629		Fatigue	Depression		Neuroanatomy					
Fluctuations of spontaneous EEG topographies predict disease state in relapsing-remitting multiple sclerosis	10.1016/j.nicl.2016.08.008	27625987		Fatigue	Depression		Neuroanatomy					
Selective Cerebellar Atrophy Associates with Depression and Fatigue in the Early Phases of Relapse-Onset Multiple Sclerosis	10.1007/s12311-019-01096-4	31898280		Fatigue	Depression		Neuroanatomy					
Influence of the topography of brain damage on depression and fatigue in patients with multiple sclerosis	10.1177/1352458513493684	23812284		Fatigue	Depression		Neuroanatomy					
History of fatigue in multiple sclerosis is associated with grey matter atrophy	10.1038/s41598-019-51110-2	31611598		Fatigue	Depression		Neuroanatomy					
Microstructural fronto-striatal and temporo-insular alterations are associated with fatigue in patients with multiple sclerosis independent of white matter lesion load and depression	10.1177/1352458519869185	31418637		Fatigue			Neuroanatomy					
Neurophysiological, radiological and neuropsychological evaluation of fatigue in multiple sclerosis	10.1016/j.msard.2018.12.029	30594815		Fatigue			Neuroanatomy					
On the role of the amygdala for experiencing fatigue in patients with multiple sclerosis	10.1016/j.msard.2017.12.014	29306741		Fatigue			Neuroanatomy					
Resting-state functional connectivity networks associated with fatigue in multiple sclerosis with early age onset	10.1016/j.msard.2019.03.020	30954931		Fatigue			Neuroanatomy					
Structural and cognitive correlates of fatigue in progressive multiple sclerosis	10.1080/01616412.2018.1547813	30513278		Fatigue			Neuroanatomy					
Fatigue in multiple sclerosis is associated with the disruption of frontal and parietal pathways	10.1177/1352458508098373	18987107		Fatigue			Neuroanatomy					
Cerebellar abnormalities contribute to disability including cognitive impairment in multiple sclerosis	10.1371/journal.pone.0086916	24466290		Fatigue			Neuroanatomy					
Correlation between fatigue and brain atrophy and lesion load in multiple sclerosis patients independent of disability	10.1016/j.jns.2007.07.004	17673234		Fatigue			Neuroanatomy					
Association of fatigue and brain atrophy in multiple sclerosis	10.1016/j.jns.2004.11.046	15694198		Fatigue			Neuroanatomy					
Regional brain atrophy in primary fatigued patients with multiple sclerosis	10.1016/j.neuroimage.2009.12.118	20060048		Fatigue			Neuroanatomy					
Fatigue and progression of corpus callosum atrophy in multiple sclerosis.	10.1007/s00415-011-6091-0	21594686		Fatigue			Neuroanatomy					
Regional brain atrophy and functional connectivity changes related to fatigue in multiple sclerosis	10.1371/journal.pone.0077914	24167590		Fatigue			Neuroanatomy					
Fatigue is associated with metabolic and density alterations of cortical and deep gray matter in relapsing-remitting-multiple sclerosis patients at the earlier stage of the disease: A P	10.1016/j.msard.2013.03.005	25877847		Fatigue			Neuroanatomy					
Voxelwise assessment of the regional distribution of damage in the brains of patients with multiple sclerosis and fatigue	10.3174/ajnr.A2412	21393405		Fatigue			Neuroanatomy					
Basal ganglia and frontal/parietal cortical atrophy is associated with fatigue in relapsing-remitting multiple sclerosis	10.1177/1352458510376405	20670981		Fatigue			Neuroanatomy					
Relationship of cortical atrophy to fatigue in patients with multiple sclerosis	10.1001/archneurol.2010.48	20385911		Fatigue			Neuroanatomy					
Neural correlates of cognitive fatigue in multiple sclerosis using functional MRI	10.1016/j.jns.2008.01.018	18336838		Fatigue			Neuroanatomy					
Functional MRI during the execution of a motor task in patients with multiple sclerosis and fatigue	10.1007/s11547-012-0845-3	22729506		Fatigue			Neuroanatomy					

Brain activation in multiple sclerosis: A bold fmri study of the effects of fatiguing hand exercise	10.1177/1352458508100034	19299441		Fatigue			Neuroanatomy				
Thalamo-striato-cortical determinants to fatigue in multiple sclerosis	10.1002/brb3.181	24363974		Fatigue			Neuroanatomy				
Mental fatigue alters the pattern and increases the volume of cerebral activation required for a motor task in multiple sclerosis patients with fatigue	10.1111/j.1468-1331.2008.02090.x	18353127		Fatigue			Neuroanatomy				
Functional magnetic resonance imaging correlates of fatigue in multiple sclerosis	10.1006/nimg.2001.1011	11848698		Fatigue			Neuroanatomy				
Examination of cognitive fatigue in multiple sclerosis using functional magnetic resonance imaging and diffusion tensor imaging	10.1371/journal.pone.0078811	24223850		Fatigue			Neuroanatomy				
Hypothalamic involvement assessed by T1 relaxation time in patients with relapsing-remitting multiple sclerosis	10.1177/1352458509350306	19995847		Fatigue			Neuroanatomy				
Fatigue in multiple sclerosis: Associations with clinical, MRI and CSF parameters	10.1177/1352458517712078	28539075		Fatigue			Neuroanatomy				
Atrophy of reward-related striatal structures in fatigued MS patients is independent of physical disability	10.1177/1352458515599451	26238465		Fatigue			Neuroanatomy				
Frontal networks play a role in fatigue perception in multiple sclerosis	10.1037/a0019585	20528076		Fatigue			Neuroanatomy				
Reduced glucose metabolism in the frontal cortex and basal ganglia of multiple sclerosis patients with fatigue: a 18F-fluorodeoxyglucose positron emission tomography study	10.1212/wnl.48.6.1566	9191767		Fatigue			Neuroanatomy				
Altered basal ganglia functional connectivity in multiple sclerosis patients with fatigue	10.1177/1352458514555784	25392321		Fatigue			Neuroanatomy				
Multiple sclerosis-related fatigue: Altered resting-state functional connectivity of the ventral striatum and dorsolateral prefrontal cortex	10.1177/1352458518758911	29464981		Fatigue			Neuroanatomy				
Fronto-striatal network activation leads to less fatigue in multiple sclerosis	10.1177/1352458517717087	28627957		Fatigue			Neuroanatomy				
Fatigue in Multiple Sclerosis Is Associated with Abnormal Cortical Activation to Voluntary Movement—EEG Evidence	10.1006/nimg.2001.0759	11352624		Fatigue			Neuroanatomy				
The Relationship Between Diffuse Axonal Damage and Fatigue in Multiple Sclerosis	10.1001/archneur.61.2.201	14967766		Fatigue			Neuroanatomy				
MRI and motor evoked potential findings in nondisabled multiple sclerosis patients with and without symptoms of fatigue	10.1007/s004150070148	10993490		Fatigue			Neuroanatomy				
The basal ganglia: a substrate for fatigue in multiple sclerosis.	10.1007/s00234-007-0304-3	17955232		Fatigue			Neuroanatomy				
Deep gray matter and fatigue in MS: a T1 relaxation time study	10.1007/s00415-006-0128-9	16525881		Fatigue			Neuroanatomy				
Regional but not global brain damage contributes to fatigue in multiple sclerosis	10.1148/radiol.14140417	24927473		Fatigue			Neuroanatomy				
Hyperconnectivity of the dorsolateral prefrontal cortex following mental effort in multiple sclerosis patients with cognitive fatigue	10.1177/1352458515625806	26846988		Fatigue			Neuroanatomy				
Abnormal cervical cord function contributes to fatigue in multiple sclerosis	10.1177/1352458512440516	22389415		Fatigue			Neuroanatomy				
Neural correlates of fatigue in multiple sclerosis: a combined neurophysiological and neuroimaging approach (R1)	10.12871/00039829201735	29220866		Fatigue			Neuroanatomy				
Analysis of the pain in multiple sclerosis patients	10.1016/j.nrl.2010.07.014	21163193				Pain	Neuroanatomy				
Impact of depression, fatigue, and global measure of cortical volume on cognitive impairment in multiple sclerosis	10.1155/2015/519785	25861633			Depression		Neuroanatomy				
The association between olfactory bulb volume, cognitive dysfunction, physical disability and depression in multiple sclerosis	10.1111/ene.12891	26699899			Depression		Neuroanatomy				
Lesions in the left arcuate fasciculus region and depressive symptoms in multiple sclerosis	10.1212/wnl.49.4.1105	9339697			Depression		Neuroanatomy				
Beck Depression Inventory factors related to demyelinating lesions of the left arcuate fasciculus region	10.1016/s0925-4927(00)00061-5	11068196			Depression		Neuroanatomy				
Brain MRI lesions and atrophy are related to depression in multiple sclerosis	10.1097/00001756-200004270-00003	10817583			Depression		Neuroanatomy				
Structural brain abnormalities in multiple sclerosis patients with major depression	10.1212/01.wnl.0000110316.12086.0c	14981175			Depression		Neuroanatomy				
Depressive symptoms and MRI changes in multiple sclerosis	10.1046/j.1468-1331.2002.00442.x	12220380			Depression		Neuroanatomy				
Lesion pattern in patients with multiple sclerosis and depression	10.1177/135245850000600304	10871826			Depression		Neuroanatomy				
Diffusion tensor imaging abnormalities in depressed multiple sclerosis patients	10.1177/1352458509355461	20007425			Depression		Neuroanatomy				
Detection of altered hippocampal morphology in multiple sclerosis-associated depression using automated surface mesh modeling	10.1002/hbm.22154	22847919			Depression		Neuroanatomy				
Involvement of the limbic system in multiple sclerosis patients with depressive disorders	10.1016/0006-3223(95)00291-x	9162210			Depression		Neuroanatomy				
Neurobiological mechanisms underlying emotional processing in relapsing-remitting multiple sclerosis	10.1093/brain/awp095	19420090			Depression		Neuroanatomy				
Hippocampal Neuroinflammation, Functional Connectivity, and Depressive Symptoms in Multiple Sclerosis	10.1016/j.biopsych.2015.11.022	26809249			Depression		Neuroanatomy				
Depressive symptoms in multiple sclerosis from an in vivo study with TBSS	10.1155/2014/148465	24877057			Depression		Neuroanatomy				
Structural 'connectomic' alterations in the limbic system of multiple sclerosis patients with major depression	10.1177/1352458514558474	25533294			Depression		Neuroanatomy				
Hippocampal-DMN disconnectivity in MS is related to WM lesions and depression	10.1002/hbm.22992	26366641			Depression		Neuroanatomy				
Individual differences in depression are associated with abnormal function of the limbic system in multiple sclerosis patients	10.1177/1352458515606987	26453680			Depression		Neuroanatomy				
Cross-Sectional and Longitudinal Relationships between Depressive Symptoms and Brain Atrophy in MS Patients	10.3389/fnhum.2016.00622	28018194			Depression		Neuroanatomy				
Sensory Function and Chronic Pain in Multiple Sclerosis	10.1155/2018/1924174	29849839				Pain	Neuroanatomy				
Trigeminal neuralgia and pain related to multiple sclerosis	10.1016/j.pain.2008.12.026	19171430				Pain	Neuroanatomy				
Chronic pain disrupts the reward circuitry in multiple sclerosis	10.1111/ejn.13272	27178661				Pain	Neuroanatomy				
Fatigue in multiple sclerosis: an example of cytokine mediated sickness behaviour?	10.1136/jnnp.2005.065805	16361589	CI	Fatigue				Inflammation	HPA axis		
Altered cytokine responses to cognitive stress in multiple sclerosis patients with fatigue	10.1191/1352458505ms1129oa	15732267	CI	Fatigue				Inflammation			
Correlates of cognitive dysfunction in multiple sclerosis	10.1016/j.bbi.2010.05.006	20621641	CI					Inflammation			
Endocrine and immune substrates of depressive symptoms and fatigue in multiple sclerosis patients with comorbid major depression	10.1136/jnnp.2010.230029	21296901		Fatigue	Depression			Inflammation	HPA axis		
Stimulated peripheral production of interferon-gamma is related to fatigue and depression in multiple sclerosis	10.1016/j.clineuro.2012.02.048	22425464		Fatigue	Depression			Inflammation			
Depression and fatigue in multiple sclerosis: Relation to exposure to violence and cerebrospinal fluid immunomarkers	10.1016/j.psyneuen.2018.01.002	29324301		Fatigue	Depression			Inflammation			
Fatigue in patients with multiple sclerosis: is it related to pro- and anti-inflammatory cytokines?	10.1155/2015/758314	25722532		Fatigue				Inflammation			
Cytokine mRNA expression in patients with multiple sclerosis and fatigue	10.1191/1352458504ms991oa	15124762		Fatigue				Inflammation			
A prospective study of depression and immune dysregulation in multiple sclerosis	10.1001/archneur.1992.00530270052018	1536625			Depression			Inflammation			
Expression of tumor necrosis factor-alpha and interferon-gamma mRNA in blood cells correlates with depression scores during an acute attack in patients with multiple sclerosis	10.1016/s0306-4530(01)00068-3	12084660			Depression			Inflammation			
Nitrosative Stress Biomarkers of Depression Symptoms in Subjects with Multiple Sclerosis: Increased Peripheral Inflammation but Less Acute Neuroinflammation	10.1007/s12035-015-9443-4	26399644			Depression			Inflammation			
Fatigue and regulation of the hypothalamo-pituitary-adrenal axis in multiple sclerosis	10.1001/archneur.62.2.277	15710856		Fatigue					HPA axis		
Fatigue in progressive multiple sclerosis is associated with low levels of dehydroepiandrosterone	10.1191/135248505ms1322oa	16900763		Fatigue					HPA axis		
Circadian cortisol and fatigue severity in relapsing–remitting multiple sclerosis	10.1016/j.psyneuen.2015.03.010	25817406		Fatigue					HPA axis		
Circadian cortisol, depressive symptoms and neurological impairment in early multiple sclerosis	10.1016/j.psyneuen.2011.04.004	21621332			Depression				HPA axis		
Reward responsiveness and fatigue in multiple sclerosis	10.1177/1352458512451509	22723570		Fatigue						Monoamines	
Association of a deficit of arousal with fatigue in multiple sclerosis: effect of modafinil	10.1016/j.neuropharm.2012.06.036	22766394		Fatigue						Monoamines	
Cerebrospinal fluid kynurenines in multiple sclerosis; relation to disease course and neurocognitive symptoms	10.1016/j.bbi.2015.07.016	26189678			Depression					Monoamines	
Factors associated with fatigue in CNS inflammatory diseases with AQP4 and MOG antibodies	10.1002/acn3.51008	32187851		Fatigue	Depression	Pain					Other
Higher levels of reported sun exposure, and not vitamin D status, are associated with less depressive symptoms and fatigue in multiple sclerosis	10.1111/ane.12155	23763464		Fatigue	Depression						Other
Forearm muscle mitochondrial capacity and resting oxygen uptake: Relationship to symptomatic fatigue in persons with multiple sclerosis	10.1177/20552173211028875	34262786		Fatigue							Other