

Supplementary tables

Table S1. Donor characteristics.

Case number	Clinical diagnosis	Sex	Age at death (years)	Disease duration (years)	PMD (hr:min)	Cause of death	3DT1 scan	DTI scan	IHC	NBV (L)	NGMV (L)	ABC score [5]	Thal phase [6]	Braak NFT stage [1]	Braak LB stage [2]
Controls															
1	Ctrl	M	68	-	8:30	Euthanasia	x		x	1,62	0,86	A1B1C0	2	1	0
2	Ctrl	F	63	-	8:10	Euthanasia	x	x	x	1,53	0,75	A0B0C0	0	0	0
3	Ctrl	M	82	-	10:40	Liver cirrhosis	x	x	x	1,40	0,68	A1B1C0	1	1	0
4	Ctrl	M	85	-	9:22	Euthanasia	x	x	x	1,36	0,68	A1B1C0	1	1	0
5	Ctrl	M	67	-	7:35	Euthanasia	x	x	x	1,51	0,74	A1B1C0	1	2	0
6	Ctrl	F	76	-	7:50	Euthanasia	x	x	x	1,47	0,78	A1B1C0	2	1	0
7	Ctrl	M	67	-	8:10	Liver cirrhosis	x	x	x	1,45	0,74	A1B1C0	1	1	0
8	Ctrl	F	77	-	9:00	Euthanasia	x	x	x	1,41	0,74	A1B1C0	1	2	0
9	Ctrl	F	87	-	8:35	Urinary tract infection	x		x	1,37	0,65	A0B1C0	0	1	0
10	Ctrl	F	72	-	7:20	Heart failure	x		x	1,52	0,80	A0B0C0	0	0	0
11	Ctrl	F	69	-	12:45	Pulmonary embolism	x		x	1,39	0,71	A1B1C0	1	1	1
12	Ctrl	M	59	-	8:00	Euthanasia	x		x	1,49	0,76	A1B1C0	2	1	0
13	Ctrl	M	77	-	11:25	Pneumonia	x	x	x	1,49	0,72	A1B1C0	1	1	0
14	Ctrl	F	78	-	10:00	Unknown	x	x	x	1,51	0,77	A1B1C0	1	1	1
15	Ctrl	F	77	-	4:35	Unknown	x	x	x	1,46	0,76	A1B1C0	2	2	2
16	Ctrl	F	59	-	8:10	Euthanasia	x	x	x	1,46	0,78	A0B0C0	0	0	0
17	Ctrl	F	71	-	6:50	Lung carcinoma	x	x	x	1,47	0,76	A1B1C0	2	1	0
18	Ctrl	M	74	-	10:20	Euthanasia	x	x	x	1,39	0,70	A2B1C0	3	2	0
PD															
1	PD	F	83	22	10:35	Euthanasia	x	x	x	1,42	0,68	A0B1C0	0	1	5

2	PD	F	69	15	07:05	Aspiration pneumonia	x	x	x	1,51	0,73	A1B1C0	2	2	6
3	PD	F	82	17	09:17	Aspiration pneumonia	x	x	x	1,44	0,73	A1B1C0	2	2	6
4	PD	M	78	17	07:15	Euthanasia	x	x	x	1,45	0,76	A1B1C0	1	2	6
5	PD	M	92	16	10:10	Myocardial infarction	x	x	x	1,38	0,70	A2B2C1	3	3	4
6	PD	M	75	20	4:55	End-stage PD	x	x	x	1,41	0,74	A2B1C0	3	2	6
7	PD	M	78	20	3:30	End-stage PD	x	x	x	1,25	0,63	A1B1C0	1	2	6
8	PD	M	70	8	6:55	Euthanasia	x	x	x	1,53	0,78	A1B1C0	1	1	6
9	PD	M	93	23	10:40	Euthanasia	x	x	x	1,50	0,72	A1B2C0	2	4	6
PDD/ DLB															
1	PDD	F	83	16	10:40	End-stage PDD	x	x	x	1,33	0,65	A3B2C2	4	4	6
2	DLB	M	66	4	08:00	Euthanasia	x	x	x	1,49	0,73	A3B2C2	4	4	6
3	PDD	F	94	10	06:50	Femur fracture	x	x	x	1,33	0,68	A3B2C2	4	4	6
4	PDD	F	74	12	08:10	Euthanasia	x	x	x	1,33	0,71	A2B1C0	3	2	6
5	DLB	M	72	5	07:10	Euthanasia	x	x	x	1,42	0,72	A2B1C2	3	2	6
6	DLB	M	77	7	07:15	End-stage DLB	x	x	x	1,45	0,75	A1B2C0	1	3	6
7	PDD	M	79	21	09:25	Subarachnoid bleeding	x	x	x	1,38	0,71	A2B1C1	3	2	6
8	PDD	M	62	18	05:10	End-stage PDD	x		x	1,37	0,71	A1B1C0	1	2	6
9	PDD	M	74	8	8:50	Aspiration pneumonia	x	x	x	1,29	0,62	A1B2C0	2	3	6
10	PDD	F	81	19	5:30	End-stage PDD	x	x	x	1,35	0,66	A2B1C0	3	2	6
11	DLB	M	91	3	4:30	Euthanasia	x	x	x	1,48	0,72	A2B2C2	3	4	6
12	DLB	F	86	6	7:00	Dehydration, cachexia	x	x	x	1,31	0,69	A3B2C2	5	4	6

Legend: 3DT1: post-mortem in-situ MRI 3DT1 weighted scan; Ctrl: control; DLB: Dementia with Lewy Bodies; DTI: diffusion tensor imaging; F: female; hr: hour; IHC: immunohistochemistry; L: liter; LB: Lewy Body; M: male; min: minute; NBV: normalized brain volume; NFT: neurofibrillary tangles; NGMV: normalized grey matter volume; PD: Parkinson's disease; PDD: Parkinson's disease dementia; PMD: post-mortem delay.

Table S2. Concatenated labels from Lausanne atlas for the regions of interest of this study.

Region of interest	Labels Lausanne atlas [3, 4]
Superior frontal	Superiorfrontal_4 + Superiorfrontal_5 + Superiorfrontal_6
Anterior cingulate	Caudalanteriorcingulate_2 + Caudalanteriorcingulate_3
Posterior cingulate	Posteriorcingulate_3 + Posteriorcingulate_4
Superior parietal	Superiorparietal_1 + Superiorparietal_2 + Superiorparietal_3
Parahippocampal	Parahippocampal_3
Entorhinal	Entorhinal_1
Fusiform	Fusiform_7
Middle temporal	Middletemporal_5 + Middletemporal_7
Anterior insula	Insula_3 + Insula_4

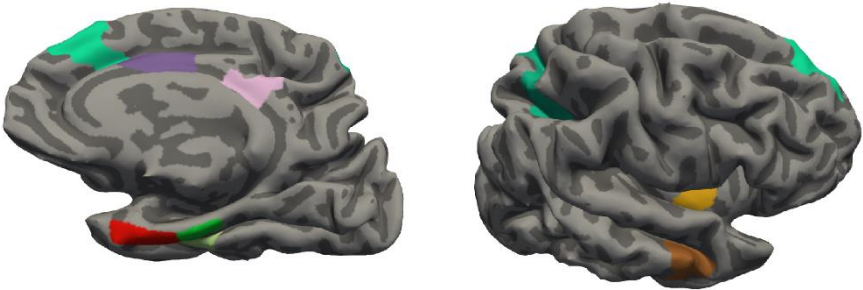
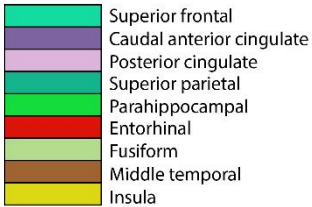


Table S3. Information on primary and secondary antibodies.

<i>Antibody</i>	<i>Antigen</i>	<i>Species</i>	<i>Origin details</i>	<i>Dilution</i>	<i>Incubation time</i>	<i>Antigen retrieval</i>	<i>Detection method</i>
Primary antibodies							
<i>pSer129 aSyn, clone EP1536Y</i>	Alpha synuclein phosphorylated at Ser129	Rabbit igG	Abcam, Cambridge, UK	1:8000 for BF 1:4000 for FL	4°C o.n.	Tris EDTA buffer (pH 9.0) in steam cooker	EnVision (HRP)
<i>Aβ, clone 4G8</i>	Aβ amino acid sequence 17-24	Mouse igG2b	BioLegend, San Diego, USA	1:8000	4°C o.n.	Citrate buffer (pH 6.0) in steam cooker	EnVision (HRP)
<i>p-tau, clone AT8</i>	Tau phosphorylated at Ser202 and Thr205	Mouse igG1	ThermoFisher, Pittsburgh, USA	1:800 for BF 1:800 for FL	4°C o.n.	Citrate buffer (pH 6.0) in steam cooker	EnVision (HRP)
<i>NfL</i>	Immunogen corresponds to AA 1 to 284 (with AA 200-292 missing)	Rabbit igG	Synaptic systems, Göttingen, Germany	1:600 for BF 1:200 for FL	4°C o.n.	Tris EDTA buffer (pH 9.0) in steam cooker	EnVision (HRP)
<i>SMI312</i>	Mixture of monoclonal antibodies directed against phosphorylated NfM and NfH.	Mouse igG1	BioLegend, San Diego, USA	1:500 for BF 1:500 for FL	4°C o.n.	Tris EDTA buffer (pH 9.0) in steam cooker	EnVision (HRP)
Secondary antibodies							
	Host species	Target species	Origin details	Dilution	Incubation time	Antigen retrieval	Detection method
<i>DoAM Alexa 488</i>	Donkey IgG	Mouse	ThermoFisher, Pittsburgh, USA	1:200	2 hrs at RT	/	fluorochrome
<i>DoAR Alexa 594</i>	Donkey IgG	Rabbit	ThermoFisher, Pittsburgh, USA	1:200	2 hrs at RT	/	fluorochrome

Legend: BF: bright-field; FL: fluorescence; hrs: hours; o.n.: overnight; RT: room temperature.

Table S4. Correlations between pathological hallmarks.

	Controls	PD + PDD/DLB	PD	PDD/DLB
<i>LB count (LB/mm²)</i>				
<i>p-αSyn load (%)</i>	-	p<0.001, r = 0.89	p<0.001, r = 0.84	p<0.001, r = 0.88
<i>p-tau load (%)</i>	-	p<0.001, r = 0.63	p=0.611, r = 0.06	p<0.001, r = 0.68
<i>Aβ load (%)</i>		p=0.909, r = -0.01	p=0.282, r = -0.13	p=0.999, r = 0.00
<i>pSer129-αSyn load (%)</i>				
<i>p-tau load (%)</i>	-	p<0.001, r = 0.57	p=0.607, r = 0.07	p<0.001, r = 0.60
<i>Aβ load (%)</i>	-	p=0.365, r = -0.05	p=0.670, r = -0.05	p=0.369, r = -0.06
<i>p-tau load (%)</i>				
<i>Aβ load (%)</i>	p=0.280, r = -0.01	p=0.687, r = 0.02	p=0.623, r = 0.05	p=0.906, r = 0.01

For each correlation, p-value and correlation coefficients are shown. When the correlation is significant it is highlighted in bold. **Legend:** *Aβ*: amyloid beta; *DLB*: Dementia with Lewy Bodies; *LB*: Lewy Body; *PD*: Parkinson's disease; *PDD*: Parkinson's disease dementia; *pSer129-αSyn*: phosphorylated Ser129 alpha synuclein; *p-tau*: phosphorylated tau.

Table S5. Correlations of p-NfM/H immunoreactivity with pathology load in superficial (layer I-III) and deep cortical layers (layer IV-VI).

	Controls	PD + PDD/DLB	PD	PDD/DLB
<i>p-NfM/H immunoreactivity (%)</i>				
<i>LB count (LB/mm²) : entire cortex</i>	p=0.187, r = 0.15	p=0.525, r = 0.07	p=0.319, r = 0.15	p=0.920, r = 0.01
superficial	p=0.650, r = 0.04	p=0.416, r = 0.08	p=0.711, r = 0.06	p=0.444, r = 0.11
deep	p=0.214, r = -0.13	p=0.567, r = 0.05	p=0.132, r = 0.19	p=0.907, r = -0.01
<i>pSer129-αSyn load (%) : entire cortex</i>	p=0.760, r = 0.03	p=0.807, r = 0.03	p=0.381, r = 0.13	p=0.825, r = -0.03
superficial	p=0.904, r = 0.01	p=0.834, r = 0.02	p=0.823, r = 0.03	p=0.856, r = -0.02
deep	p=0.370, r = 0.09	p=0.886, r = 0.01	<i>p=0.088, r = 0.22</i>	p=0.728, r = -0.04
<i>p-tau load (%) : entire cortex</i>	p=0.149, r = -0.18	p=0.018, r = 0.26	<i>p=0.066, r = 0.32</i>	p=0.043, r = 0.29
superficial	p=0.707, r = -0.06	p=0.704, r = 0.05	p=0.168, r = 0.34	p=0.608, r = -0.09
deep	p=0.581, r = -0.11	p=0.361, r = -0.13	p=0.758, r = 0.06	p=0.283, r = -0.22
<i>Aβ load (%) : entire cortex</i>	p=0.737, r = -0.03	p=0.441, r = -0.06	p=0.725, r = 0.05	p=0.248, r = -0.12
superficial	p=0.603, r = -0.06	p=0.196, r = -0.10	p=0.776, r = -0.04	p=0.096, r = -0.18
deep	p=0.892, r = 0.02	p=0.784, r = -0.02	p=0.683, r = -0.07	p=0.964, r = 0.01

For each correlation, p-value and correlation coefficients are shown. When the correlation is significant it is highlighted in bold. Correlations coloured in italics are trends. For each marker, the correlations in the entire cortex (layers I-VI), superficial (I-III) and deep (IV-VI) cortical layers are shown. **Legend:** *A β* : amyloid beta; *DLB*: Dementia with Lewy Bodies; *LB*: Lewy Body; *PD*: Parkinson's disease; *PDD*: Parkinson's disease dementia; *pSer129- α Syn*: phosphorylated Ser129 alpha synuclein; *p-NfM/H*: phosphorylated neurofilament medium and heavy chain; *p-tau*: phosphorylated tau.

Table S6. Correlations of NfL immunoreactivity with pathology load in superficial (layer I-III) and deep cortical layers (layer IV-VI).

	Controls	PD + PDD/DLB	PD	PDD/DLB
NfL immunoreactivity (%)				
LB count (LB/mm ²): entire cortex	p=0.658, r = 0.05	p<0.001, r = 0.36	p=0.392, r = 0.10	p=0.002, r = 0.40
superficial	p=0.851, r = 0.02	p<0.001, r = 0.28	p=0.649, r = 0.05	p=0.005, r = 0.33
deep	p=0.144, r = 0.14	p=0.005, r = 0.24	p=0.805, r = 0.02	p=0.025, r = 0.27
pSer129- α Syn load (%): entire cortex	p=0.666, r = -0.04	p<0.001, r = 0.30	p=0.910, r = 0.01	p=0.005, r = 0.36
superficial	p=0.881, r = 0.01	p=0.006, r = 0.22	p=0.997, r = 0.00	p=0.021, r = 0.26
deep	p=0.680, r = -0.04	p=0.046, r = 0.16	p=0.217, r = -0.12	<i>p=0.074, r = 0.21</i>
p-tau load (%): entire cortex	p=0.579, r = -0.06	p<0.001, r = 0.42	p=0.014, r = 0.31	p<0.001, r = 0.42
superficial	p=0.765, r = 0.04	p=0.112, r = 0.18	p=0.872, r = 0.02	p=0.329, r = 0.15
deep	p=0.828, r = 0.03	p=0.436, r = 0.08	p=0.802, r = -0.09	p=0.866, r = 0.03
A β load (%): entire cortex	p=0.831, r = 0.02	p=0.499, r = -0.43	p=0.325, r = -0.09	p=0.652, r = -0.04
superficial	p=0.461, r = -0.07	<i>p=0.051, r = 0.11</i>	p=0.145, r = -0.10	<i>p=0.063, r = 0.15</i>
deep	p=0.034, r = -0.27	p=0.924, r = 0.01	p=0.374, r = 0.11	p=0.819, r = -0.02

For each correlation, p-value and correlation coefficients are shown. When the correlation is significant, it is highlighted in bold, and the strength of the correlation is given by a green shade colour (dark green moderate correlation, light green is a weak correlation). Correlations in italics are trends. For each marker, the correlations in the entire cortex (layers I-VI), superficial (I-III) and deep (IV-VI) cortical layers are shown. **Legend:** A β : amyloid beta; DLB: Dementia with Lewy Bodies; LB: Lewy Body; NfL: neurofilament light chain; PD: Parkinson's disease; PDD: Parkinson's disease dementia; pSer129- α Syn: phosphorylated Ser129 alpha synuclein; p-tau: phosphorylated tau.

Table S7. Correlations of MRI-derived cortical thickness with neurofilaments immunoreactivity and pathology load.

	Controls	PD + PDD/DLB	PD	PDD/DLB
Cortical thickness (Z score)				
<i>p</i> -NfM/H immunoreactivity (%)	p=0.686, r = 0.04	p=0.020, r = -0.23	p=0.047, r = -0.32	p=0.106, r = -0.21
<i>NfL</i> immunoreactivity (%)	p=0.680, r = 0.33	p=0.012, r = -0.22	p=0.025, r = -0.27	p=0.220, r = -0.15
<i>LB</i> count (<i>LB</i> /mm ²)	-	p=0.910, r = -0.01	p=0.506, r = -0.08	p=0.615, r = -0.05
<i>pSer129-αSyn</i> load (%)	-	p=0.784, r = 0.02	p=0.781, r = -0.04	p=0.405, r = 0.09
<i>p</i> -tau load (%)	p=0.400, r = 0.06	p=0.106, r = -0.13	<i>p=0.091, r = -0.20</i>	p=0.440, r = -0.08
<i>Aβ</i> load (%)	p=0.488, r = 0.68	p=0.876, r = -0.01	p=0.632, r = -0.06	p=0.367, r = 0.12

For each correlation, p-value and correlation coefficients are shown. When the correlation is significant it is highlighted in bold, and the strength of the correlation is given by a green shade colour (dark green moderate correlation, light green is a weak correlation). Correlations in italics are trends. **Legend:** *Aβ*: amyloid beta; *DLB*: Dementia with Lewy Bodies; *LB*: Lewy Body; *PD*: Parkinson's disease; *PDD*: Parkinson's disease dementia; *pSer129-αSyn*: phosphorylated Ser129 alpha synuclein; *p*-NfM/H: phosphorylated neurofilament medium and heavy chain; *p*-tau: phosphorylated tau.

Table S8. Correlations of DTI-derived cortical MD with neurofilaments immunoreactivity and pathology load.

	Controls	PD + PDD/DLB	PD	PDD/DLB
FWC-MD ($10^{-3} \text{ mm}^2/\text{s}$)				
<i>p</i> -NfM/H immunoreactivity (%)	p=0.430, r = -0.08	p=0.182, r = 0.14	p=0.586, r = 0.10	p=0.003, r = 0.28
NfL immunoreactivity (%)	p=0.738, r = 0.03	p=0.024, r = 0.21	p=0.184, r = -0.19	p=0.003, r = 0.41
LB count (LB/mm ²)	-	p=0.002, r = 0.23	p=0.533, r = -0.07	p=0.002, r = 0.32
<i>p</i> Ser129- α Syn load (%)	-	p=0.003, r = 0.23	p=0.874, r = 0.02	p=0.002, r = 0.32
<i>p</i> -tau load (%)	p=0.003, r = 0.23	p<0.001, r = 0.28	p=0.393, r = 0.10	p<0.001, r = 0.36
<i>A</i> β load (%)	p=0.779, r = -0.01	p=0.850, r = 0.02	p=0.366, r = -0.11	p=0.339, r = 0.00

For each correlation, p-value and correlation coefficients are shown. When the correlation is significant it is highlighted in bold, and the strength of the correlation is given by a green shade colour (dark green moderate correlation, light green is a weak correlation). **Legend:** *A* β : amyloid beta; DLB: Dementia with Lewy Bodies; DTI: diffusion tensor imaging; FWC-MD: free-water mean diffusivity; LB: Lewy Body; PD: Parkinson's disease; PDD: Parkinson's disease dementia; *p*Ser129- α Syn: phosphorylated Ser129 alpha synuclein; *p*-NfM/H: phosphorylated neurofilament medium and heavy chain; *p*-tau: phosphorylated tau.

References supplementary tables

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