

Supplementary Data

Neuropsychiatric Symptoms in Older People with and Without Cognitive Impairment

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Supplementary Table 1
Baseline characteristics included and excluded at follow-up

Baseline variables	Included (<i>n</i> = 630)		Excluded (<i>n</i> = 169)		Statistic		
	Mean	SD	Mean	SD	<i>t</i>	<i>df</i>	<i>p</i>
Age (years)	78.18	4.58	80.39	4.83	5.49	797	<0.001
Education (years)	11.71	3.58	11.31	3.26	−1.32	797	0.186
MMSE (score)	28.22	1.38	27.72	1.60	−3.71	239.13	<0.001
	<i>n</i>	%	<i>n</i>	%	χ^2	<i>df</i>	<i>p</i>
Male	284	45.1	64	37.9	2.82	1	0.09
MCI	233	37.0	86	50.9	10.74	1	0.001
NPI ≥ 1	148	23.5	65	38.5	15.27	1	<0.001

Abbreviations: MMSE = Mini Mental State Examination unadjusted score; MCI = Mild Cognitive Impairment; NPI = Neuropsychiatric Inventory.

Supplementary Table 2
Frequency of NPI domain disturbance by 2-year outcome

NPS Measure	W2 Outcome	<i>n</i> (%)	NPI ≥ 1 (<i>n</i> , %)	OR 95% CI*	<i>p</i>
NPI Domain:					
Delusions	NCI	384 (60.9)	0 (0)	NA	
	MCI	232 (36.8)	0 (0)		
	Dementia	14 (2.2)	2 (14.3)		
Hallucinations	NCI	383 (60.9)	1 (0.3)	NA	
	MCI	232 (36.9)	1 (0.4)		
	Dementia	14 (2.2)	0 (0)		
Agitation	NCI	383 (60.9)	6 (1.6)	REF	0.24
	MCI	232 (36.9)	8 (3.4)		
	Dementia	14 (2.2)	1 (7.1)		
Depression	NCI	382 (60.9)	41 (10.7)	REF	0.63
	MCI	231 (36.8)	22 (9.5)		
	Dementia	14 (2.2)	4 (28.6)		
Anxiety	NCI	384 (61.0)	8 (2.1)	REF	0.038
	MCI	231 (36.7)	11 (4.8)		
	Dementia	14 (2.2)	1 (7.1)		
Elation	NCI	384 (60.9)	3 (0.8)	REF	0.89
	MCI	232 (36.8)	2 (0.9)		
	Dementia	14 (2.2)	0 (0)		
Apathy	NCI	384 (60.9)	9 (2.3)	REF	0.91
	MCI	232 (36.8)	5 (2.2)		
	Dementia	14 (2.2)	0 (0)		
Disinhibition	NCI	383 (60.9)	6 (1.6)	REF	0.56
	MCI	232 (36.9)	5 (2.2)		
	Dementia	14 (2.2)	1 (7.1)		
Irritability	NCI	382 (60.8)	22 (5.8)	REF	0.92
	MCI	232 (36.9)	12 (5.2)		
	Dementia	14 (2.2)	0 (0)		
Aberrant motor	NCI	384 (60.9)	1 (0.3)	REF	0.29
	MCI	232 (36.8)	2 (0.9)		
	Dementia	14 (2.2)	0 (0)		
Sleep	NCI	380 (60.9)	32 (8.4)	REF	0.92
	MCI	230 (36.9)	19 (8.3)		
	Dementia	14 (2.2)	1 (7.1)		
Appetite	NCI	381 (60.9)	19 (5.0)	REF	0.29
	MCI	231 (36.9)	8 (3.5)		
	Dementia	14 (2.2)	0 (0)		

Abbreviations: NCI = no cognitive impairment; MCI = mild cognitive impairment; NPI = Neuropsychiatric Inventory. *All models adjusted for age, education, and gender.

Supplementary Table 3
Baseline NPI domains by cognitive impairment

Domain	NPI domain		N (%)	NPI ≥ 1 (n, %)	OR (95% CI)*	p
Executive	Agitation	Normal	652 (83.4)	18 (2.8)	REF	
		Impaired	130 (16.6)	6 (4.6)	1.41 (0.5–3.9)	0.51
	Depression	Normal	651 (83.5)	71 (10.9)	REF	
		Impaired	129 (16.5)	30 (23.3)	2.41 (1.5–3.9)	0.001
	Anxiety	Normal	652 (83.4)	21 (3.2)	REF	
		Impaired	130 (16.6)	7 (5.4)	2.32 (0.9–5.8)	0.07
	Apathy	Normal	653 (83.4)	18 (2.8)	REF	
		Impaired	130 (16.6)	6 (4.6)	1.99 (0.7–5.3)	0.17
	Disinhibition	Normal	652 (83.4)	11 (1.7)	REF	
		Impaired	130 (16.6)	5 (3.8)	2.02 (0.6–6.5)	0.24
	Irritability	Normal	650 (83.3)	36 (5.5)	REF	
		Impaired	130 (16.7)	6 (4.6)	0.72 (0.3–1.8)	0.49
	Sleep	Normal	647 (83.4)	56 (8.7)	REF	
		Impaired	129 (16.6)	13 (10.1)	1.09 (0.6–2.1)	0.79
	Eating	Normal	646 (83.2)	33 (5.1)	REF	
		Impaired	130 (16.8)	11 (8.5)	1.45 (0.7–3.1)	0.33
Attention	Agitation	Normal	674 (85.4)	18 (2.7)	REF	
		Impaired	115 (14.6)	6 (5.2)	1.66 (0.6–4.6)	0.32
	Depression	Normal	672 (85.4)	80 (11.9)	REF	
		Impaired	115 (14.6)	22 (19.1)	1.66 (0.9–2.8)	0.07
	Anxiety	Normal	674 (85.4)	21 (3.1)	REF	
		Impaired	115 (14.6)	7 (6.1)	2.68 (1.1–6.7)	0.035
	Apathy	Normal	675 (85.4)	20 (3.0)	REF	
		Impaired	115 (14.6)	4 (3.5)	1.32 (0.4–4.0)	0.63
	Disinhibition	Normal	674 (85.4)	13 (1.3)	REF	
		Impaired	115 (14.6)	3 (2.6)	1.14 (0.3–4.4)	0.85
	Irritability	Normal	673 (85.5)	33 (4.9)	REF	
		Impaired	114 (14.5)	10 (8.8)	1.81 (0.8–3.9)	0.13
	Sleep	Normal	668 (85.3)	55 (8.2)	REF	
		Impaired	115 (14.7)	14 (12.2)	1.50 (0.8–2.9)	0.22
	Eating	Normal	669 (85.4)	35 (5.2)	REF	
		Impaired	114 (14.6)	9 (7.9)	1.31 (0.6–2.9)	0.50
Memory	Agitation	Normal	647 (81.4)	13 (2.0)	REF	
		Impaired	148 (18.6)	10 (6.8)	3.12 (1.2–7.9)	0.018
	Depression	Normal	645 (81.3)	82 (12.7)	REF	
		Impaired	148 (18.7)	19 (12.8)	0.93 (0.5–1.6)	0.79
	Anxiety	Normal	647 (81.4)	21 (3.2)	REF	
		Impaired	148 (18.6)	8 (5.4)	2.49 (1.0–6.2)	0.047
	Apathy	Normal	648 (81.4)	19 (2.9)	REF	
		Impaired	148 (18.6)	4 (2.7)	0.92 (0.3–2.9)	0.89
	Disinhibition	Normal	648 (81.5)	12 (1.9)	REF	
		Impaired	147 (18.5)	4 (2.7)	0.93 (0.3–3.4)	0.91
	Irritability	Normal	647 (81.6)	36 (5.6)	REF	
		Impaired	146 (18.4)	7 (4.8)	0.61 (0.2–1.5)	0.27
	Sleep	Normal	642 (81.4)	57 (8.9)	REF	
		Impaired	147 (18.6)	12 (8.2)	0.84 (0.4–1.7)	0.63
	Eating	Normal	642 (81.4)	37 (5.8)	REF	
		Impaired	147 (18.6)	7 (4.8)	0.69 (0.3–1.7)	0.41
Language	Agitation	Normal	611 (76.9)	15 (2.5)	REF	
		Impaired	183 (23.0)	9 (4.9)	1.91 (0.8–4.6)	0.16
	Depression	Normal	609 (76.9)	72 (11.8)	REF	
		Impaired	183 (23.1)	29 (15.8)	1.33 (0.8–2.2)	0.25
	Anxiety	Normal	611 (76.9)	21 (3.4)	REF	
		Impaired	183 (23.0)	8 (4.4)	1.52 (0.6–3.6)	0.34
	Apathy	Normal	612 (76.9)	17 (2.8)	REF	
		Impaired	183 (23.0)	7 (3.8)	1.54 (0.6–3.9)	0.35
	Disinhibition	Normal	611 (76.9)	14 (2.3)	REF	
		Impaired	183 (23.0)	2 (1.1)	0.40 (0.1–1.9)	0.25

Supplementary Table 3
(Continued)

	NPI domain		N (%)	NPI ≥ 1 (n, %)	OR (95% CI)*	p
Visuospatial	Irritability	Normal	610 (77.0)	30 (4.9)	REF	
		Impaired	182 (22.9)	12 (6.6)	1.37 (0.7–2.8)	0.39
	Sleep	Normal	608 (77.2)	56 (9.2)	REF	
		Impaired	180 (22.8)	13 (7.2)	0.71 (0.4–1.4)	0.29
	Eating	Normal	607 (77.0)	33 (5.4)	REF	
		Impaired	181 (22.9)	11 (6.1)	0.96 (0.5–1.9)	0.90
	Agitation	Normal	666 (83.7)	16 (2.4)	REF	
		Impaired	130 (16.3)	8 (6.2)	2.58 (1.0–6.5)	0.045
	Depression	Normal	664 (83.6)	81 (12.2)	REF	
		Impaired	130 (16.4)	21 (16.2)	1.29 (0.8–2.2)	0.35
	Anxiety	Normal	665 (83.5)	20 (3.0)	REF	
		Impaired	131 (16.5)	9 (6.9)	2.91 (1.3–6.8)	0.013
	Apathy	Normal	666 (83.6)	17 (2.6)	REF	
		Impaired	131 (16.4)	7 (5.3)	2.56 (1.0–6.5)	0.049
	Disinhibition	Normal	665 (83.5)	11 (1.7)	REF	
		Impaired	131 (16.5)	5 (3.8)	2.64 (0.8–8.2)	0.09
Global cog	Irritability	Normal	663 (83.5)	36 (5.4)	REF	
		Impaired	131 (16.5)	7 (5.3)	1.04 (0.4–2.5)	0.93
	Sleep	Normal	662 (83.8)	56 (8.5)	REF	
		Impaired	128 (16.2)	13 (10.2)	1.16 (0.6–2.2)	0.66
	Eating	Normal	660 (83.5)	34 (5.2)	REF	
		Impaired	130 (16.5)	10 (7.7)	1.3 (.6–2.8)	0.51
	Agitation	Normal	599 (75.5)	12 (2.0)	REF	
		Impaired	194 (24.5)	12 (6.2)	3.46 (1.4–8.7)	0.009
	Depression	Normal	598 (75.5)	67 (11.2)	REF	
		Impaired	194 (24.5)	34 (17.5)	1.6 (0.9–2.6)	0.05
	Anxiety	Normal	599 (75.5)	17 (2.8)	REF	
		Impaired	194 (24.5)	12 (6.2)	3.33 (1.5–7.5)	0.004
	Apathy	Normal	600 (75.6)	14 (2.3)	REF	
		Impaired	194 (24.4)	10 (5.2)	2.94 (1.2–7.1)	0.016
	Disinhibition	Normal	599 (75.5)	11 (1.8)	REF	
		Impaired	194 (24.5)	5 (2.6)	1.19 (0.4–3.9)	0.77
	Irritability	Normal	597 (75.5)	31 (5.2)	REF	
		Impaired	194 (24.5)	12 (6.2)	1.13 (0.5–2.4)	0.74
	Sleep	Normal	597 (75.9)	49 (8.2)	REF	
		Impaired	190 (24.1)	20 (10.5)	1.23 (0.7–2.2)	0.49
	Eating	Normal	594 (75.5)	31 (5.2)	REF	
		Impaired	193 (24.5)	13 (6.7)	1.06 (0.5–2.2)	0.88

Abbreviations: NPI = Neuropsychiatric Inventory. *All models adjusted for age, education, and gender. †Impairment threshold was set at 1.5SD below mean of baseline NCI. ‡Models were not run due to small frequencies.

Supplementary Table 4
Baseline NPI domains by cognitive decline

Domain	NPI domain		<i>n</i> (%)	NPI ≥ 1 (<i>n</i> , %)	OR (95% CI)*	<i>p</i>
Executive	Agitation	Normal	517 (85.0)	11 (2.1)	REF	
		Decline	91 (14.9)	3 (3.3)	1.39 (0.4–5.2)	0.62
	Depression	Normal	515 (84.9)	54 (10.5)	REF	
		Decline	91 (15.0)	12 (13.2)	1.30 (0.7–2.6)	0.44
	Anxiety	Normal	517 (85.0)	12 (2.3)	REF	
		Decline	91 (14.9)	6 (6.6)	3.54 (1.3–9.9)	0.016
	Apathy	Normal	517 (84.9)	10 (1.9)	REF	
		Decline	92 (15.1)	3 (3.3)	1.84 (0.5–6.9)	0.37
	Disinhibition	Normal	517 (85.0)	10 (1.9)	REF	
		Decline	91 (14.9)	2 (2.2)	0.98 (0.2–4.7)	0.98
	Irritability	Normal	516 (85.0)	30 (5.8)	REF	
		Decline	91 (14.9)	3 (3.3)	0.53 (0.2–1.8)	0.31
	Sleep	Normal	511 (84.7)	42 (8.2)	REF	
		Decline	92 (15.3)	10 (10.9)	1.46 (0.7–3.1)	0.32
	Eating	Normal	513 (84.8)	20 (3.9)	REF	
		Decline	92 (15.2)	5 (5.4)	1.38 (0.5–3.8)	0.54
Attention	Agitation	Normal	525 (85.2)	10 (1.9)	REF	
		Decline	91 (14.8)	4 (4.3)	2.34 (0.7–7.9)	0.17
	Depression	Normal	523 (85.0)	51 (9.8)	REF	
		Decline	92 (14.9)	15 (16.3)	1.89 (1.0–3.6)	0.05
	Anxiety	Normal	525 (85.1)	14 (2.7)	REF	
		Decline	92 (14.9)	4 (4.3)	1.93 (0.6–6.1)	0.26
	Apathy	Normal	526 (85.1)	12 (2.3)	REF	
		Decline	92 (14.9)	1 (1.1)	0.52 (0.1–4.1)	0.54
	Disinhibition	Normal	525 (85.1)	9 (1.7)	REF	
		Decline	92 (14.9)	3 (3.3)	2.08 (0.5–8.2)	0.29
	Irritability	Normal	524 (85.1)	31 (5.9)	REF	
		Decline	92 (14.9)	3 (3.3)	0.57 (0.2–1.9)	0.36
	Sleep	Normal	521 (85.1)	44 (8.4)	REF	
		Decline	91 (14.9)	8 (8.8)	1.16 (0.5–2.6)	0.72
	Eating	Normal	522 (85.0)	23 (4.4)	REF	
		Decline	92 (14.9)	2 (2.2)	0.46 (0.1–2.0)	0.31
Memory	Agitation	Normal	547 (87.7)	11 (2.0)	REF	
		Decline	77 (12.3)	3 (3.9)	1.49 (0.4–5.7)	0.56
	Depression	Normal	547 (87.9)	56 (10.2)	REF	
		Decline	75 (12.1)	9 (12.0)	1.21 (0.6–2.6)	0.63
	Anxiety	Normal	547 (87.7)	16 (2.9)	REF	
		Decline	77 (12.3)	3 (3.9)	1.59 (0.4–5.9)	0.48
	Apathy	Normal	548 (87.7)	11 (2.0)	REF	
		Decline	77 (12.3)	1 (1.3)	0.65 (0.1–5.3)	0.69
	Disinhibition	Normal	547 (87.7)	10 (1.8)	REF	
		Decline	77 (12.3)	2 (2.6)	1.05 (0.2–5.3)	0.95
	Irritability	Normal	546 (87.6)	32 (5.9)	REF	
		Decline	77 (12.4)	2 (2.6)	0.38 (0.1–1.6)	0.19
	Sleep	Normal	542 (87.6)	48 (8.9)	REF	
		Decline	77 (12.4)	4 (5.2)	0.65 (0.2–1.9)	0.42
	Eating	Normal	545 (87.8)	25 (4.6)	REF	
		Decline	76 (12.2)	2 (2.6)	0.52 (0.1–2.3)	0.39
Language	Agitation	Normal	516 (82.3)	9 (1.7)	REF	
		Decline	111 (17.7)	6 (5.4)	3.04 (1.0–8.8)	0.041
	Depression	Normal	514 (82.2)	50 (9.7)	REF	
		Decline	111 (17.8)	17 (15.3)	1.68 (0.9–3.1)	0.09
	Anxiety	Normal	516 (82.3)	15 (2.9)	REF	
		Decline	111 (17.7)	5 (4.5)	1.66 (0.6–4.7)	0.34
	Apathy	Normal	517 (82.3)	13 (2.5)	REF	
		Decline	111 (17.7)	1 (0.9)	0.36 (0.1–2.8)	0.33
	Disinhibition	Normal	516 (82.3)	9 (1.7)	REF	
		Decline	111 (17.7)	3 (2.7)	1.49 (0.4–5.8)	0.56
	Irritability	Normal	515 (82.3)	27 (5.2)	REF	

Supplementary Table 4
(Continued)

NPI domain			<i>n</i> (%)	NPI ≥ 1 (<i>n</i> , %)	OR (95% CI)*	<i>p</i>
Visuospatial	Sleep	Decline	111 (17.7)	7 (6.3)	1.24 (0.5–2.9)	0.62
		Normal	511 (82.2)	42 (8.2)	REF	
	Eating	Decline	111 (17.8)	10 (9.0)	1.16 (0.6–2.4)	0.69
		Normal	513 (82.2)	23 (4.5)	REF	
	Agitation	Decline	111 (17.8)	4 (3.6)	0.77 (0.3–2.3)	0.63
		Normal	549 (88.3)	13 (2.4)	REF	
	Depression	Decline	73 (11.7)	2 (2.7)	1.13 (0.2–5.1)	0.87
		Normal	547 (88.2)	55 (10.1)	REF	
	Anxiety	Decline	73 (11.8)	11 (15.1)	1.59 (0.8–3.2)	0.19
		Normal	549 (88.3)	15 (2.7)	REF	
	Apathy	Decline	73 (11.7)	4 (5.5)	2.15 (0.7–6.7)	0.19
		Normal	550 (88.3)	11 (2.0)	REF	
	Disinhibition	Decline	73 (11.7)	2 (2.7)	1.36 (0.3–6.3)	0.69
		Normal	549 (88.3)	11 (2.0)	REF	
	Irritability	Decline	73 (11.7)	1 (1.4)	0.63 (0.1–4.9)	0.66
		Normal	548 (88.2)	32 (5.8)	REF	
Global Cog	Sleep	Decline	73 (11.8)	2 (2.7)	0.43 (0.1–1.9)	0.26
		Normal	544 (88.2)	47 (8.6)	REF	
	Eating	Decline	73 (11.8)	5 (6.8)	0.78 (0.3–2.0)	0.61
		Normal	546 (88.2)	24 (4.4)	REF	
	Agitation	Decline	73 (11.8)	3 (4.1)	0.92 (0.3–3.1)	0.89
		Normal	558 (89.4)	11 (2.0)	REF	
	Depression	Decline	66 (10.6)	4 (6.1)	2.87 (0.9–9.5)	0.08
		Normal	556 (89.4)	57 (10.3)	REF	
	Anxiety	Decline	66 (10.6)	10 (15.2)	1.57 (0.8–3.3)	0.23
		Normal	558 (89.4)	17 (3.0)	REF	
	Apathy	Decline	66 (10.6)	3 (4.5)	1.63 (0.5–5.8)	0.45
		Normal	559 (89.4)	12 (2.1)	REF	
	Disinhibition	Decline	66 (10.6)	1 (1.5)	0.76 (0.1–6.1)	0.79
		Normal	558 (89.4)	10 (1.8)	REF	
	Irritability	Decline	66 (10.6)	2 (3.0)	1.54 (0.3–7.5)	0.59
		Normal	557 (89.4)	32 (5.7)	REF	
	Sleep	Decline	66 (10.6)	2 (3.0)	0.50 (0.1–2.2)	0.36
		Normal	553 (89.3)	48 (8.7)	REF	
	Eating	Decline	66 (10.7)	4 (6.1)	0.74 (0.3–2.1)	0.58
		Normal	555 (89.4)	24 (4.3)	REF	
		Decline	66 (10.6)	3 (4.5)	1.0 (0.3–3.5)	0.99

Abbreviations: NPI = Neuropsychiatric Inventory. *All models adjusted for age, education, and gender. †Impairment threshold was set at 1SD below baseline performance. ‡Models were not run due to small frequencies.

Supplementary Table 5
Baseline and follow-up cognitive outcomes by alternative NPI cut-offs

Cognitive status	NPI cut-off (n, %)	OR (95% CI)*	p
	NPI ≥ 4		
Baseline			
NCI (n = 480)	52 (10.8)	REF	
MCI (n = 319)	44 (13.8)	1.03 (0.9–1.1)	0.07
Follow-up			
NCI (n = 384)	39 (10.2)	REF	
MCI (n = 232)	25 (10.8)	1.06 (0.6–1.8)	0.83
Dementia (n = 14)	3 (21.4)	2.65 (0.7–10.3)	0.16
	NPI ≥ 6		
Baseline			
NCI (n = 480)	25 (5.2)	REF	
MCI (n = 319)	26 (8.2)	1.60 (0.9–2.8)	0.11
Follow-up			
NCI (n = 384)	21 (5.5)	REF	
MCI (n = 232)	13 (5.6)	1.02 (0.5–2.1)	0.96
Dementia (n = 14)	3 (21.4)	6.41 (1.5–26.6)	0.01
	NPI domain ≥ 4		
Baseline			
NCI (n = 480)	34 (7.1)	REF	
MCI (n = 319)	29 (9.1)	1.30 (0.8–2.2)	0.32
Follow-up			
NCI (n = 384)	27 (7.0)	REF	
MCI (n = 232)	16 (6.9)	0.98 (0.5–1.9)	0.95
Dementia (n = 14)	2 (14.3)	2.47 (0.5–12.1)	0.27

Abbreviations: NCI = no cognitive impairment; MCI = mild cognitive impairment; NPI = Neuropsychiatric Inventory. *All models adjusted for age, education, and gender.