**Supplementary Table 1** Statistical model results of longitudinal measures

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Diagnostic group** | **Sex** | **Diagnostic group and sex interaction** | **Time** |
| **15-item Geriatric Depression Scale** | F(2,378)=3.478, *p=0.032*\*, partial η2=0.018-PD-NC vs HC: *p=0.101**-*PD-MCI vs HC: *p=0.050*-PD-MCI vs PD-NC: *p=0.910* | F(1,378)=0.595, *p=0.441*, partial η2=0.002 | F(2,378)=0.270, *p=0.764*, partial η2=0.001 | F(4,1512)=1.129, *p=0.341*, partial η2=0.003 |
| **State and Trait Anxiety Inventory-State** | F(2,378)=19.799, *p<0.001*\*, partial η2=0.095-PD-NC vs HC: *p<0.001\***-*PD-MCI vs HC: *p<0.001\**-PD-MCI vs PD-NC: *p=0.309* | F(1,378)=2.526, *p=0.113*, partial η2=0.007 | F(2,378)=0.984, *p=0.375*, partial η2=0.005 | F(4,1512)=1.430, *p=0.221*, partial η2=0.004 |
| **State and Trait Anxiety Inventory-Trait** | F(2,378)=14.618, *p<0.001*\*, partial η2=0.072-PD-NC vs HC: *p<0.001\***-*PD-MCI vs HC: *p<0.001\**-PD-MCI vs PD-NC: *p=0.460* | F(1,378)=4.236, *p=0.040*\*, partial η2=0.011 | F(2,378)=0.332, *p=0.718*, partial η2=0.002 | F(4,1512)=1.841, *p=0.118*, partial η2=0.005 |
| **Epworth Sleepiness Scale** | F(2,378)=6.792, *p=0.001*\*, partial η2=0.035-PD-NC vs HC: *p=0.001\***-*PD-MCI vs HC: *p=0.041\**-PD-MCI vs PD-NC: *p=0.878* | F(1,378)=4.051, *p=0.045*\*, partial η2=0.011 | F(2,378)=0.487, *p=0.615*, partial η2=0.003 | F(4,1512)=12.948, *p<0.001*\*, partial η2=0.033 |
| **Movement Disorders Society-Unified Parkinson’s Disease Rating Scale- Part III**  | F(1,282)=11.072, *p=0.001*\*, partial η2=0.038 | F(1,282)=1.033, *p=0.310*, partial η2=0.004 | F(2,282)=4.457, *p=0.036\**, partial η2=0.016 | F(4,1128)=0.180, *p=0.949*, partial η2=0.001 |

Statistical significance is marked with \*.

PD-NC: Parkinson’s disease patients with normal cognition, PD-MCI: Parkinson’s disease patients with mild cognitive impairment, HC: healthy controls, n/a: not applicable

**Supplementary Table 2** Statistical model results of longitudinal cognitive scores

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Diagnostic group** | **Diagnostic group-Pairwise comparisons** | **Sex** | **Diagnostic group and sex interaction** | **Time** | **Diagnostic group and time interaction** | **Sex and time interaction** | **Diagnostic group, sex and time interaction** |
| **PD-NC vs HC** | **PD-MCI vs HC** | **PD-MCI vs PD-NC** |
| **Montreal Cognitive Assessment** | F(2,688)=114.98, *p<0.001\** | t(1,797)=1.13, *p=0.258*, ES=0.226  | t(1,832)=-10.09, *p<0.001*\*, ES=-2.266 | t(1,567)=-14.90, *p<0.001*\*, ES=-2.491 | F(1,562)=4.61, *p=0.032*\*, ES=0.316 | F(2,554)=1.22, *p=0.296* | F(1,456)=2.61, *p=0.107*, ES=-0.046 | F(2,407)=1.28, *p=0.280* | F(1,403)=0.59, *p=0.442* | F(2,397)=1.15, *p=0.318* |
| **Phonemic fluency** | F(2,697)=7.51, *p<0.001*\* | t(1,804)=-1.01, *p=0.312*, ES=-0.447 | t(1,824)=-3.43, *p<0.001*\*, ES=-1.698 | t(1,578)=-3.31, *p=0.001*\*, ES=-1.251 | F(1,574)=2.82, *p=0.094*, ES=0.559 | F(2,563)=0.84, *p=0.432* | F(1,603)=27.86, *p<0.001*\*, ES=0.235 | F(2,518)=3.83, *p=0.022* | F(1,506)=1.40, *p=0.238* | F(2,497)=1.7, *p=0.182* |
| **Hopkins Verbal Learning Test-Revised- Learning** | F(2,677)=75.11, *p<0.001*\* | t(1,772)=-0.72, *p=0.474*, ES=-0.318 | t(1,800)=-9.49, *p<0.001*\*, ES=-4.723 | t(1,564)=-11.55, *p<0.001*\*, ES=-4.405 | F(1,561)=34.29, *p<0.001*\*, ES=1.968 | F(2,553)=0.07, *p=0.929* | F(1,609)=0.37, *p=0.544*, ES=0.029 | F(2,523)=0.10, *p=0.902* | F(1,513)=0.70, *p=0.403* | F(2,500)=0.39, *p=0.679* |
| **Hopkins Verbal Learning Test-Revised- Delayed recall** | F(2,686)=69.51, *p<0.001*\* | t(1,784)=-0.12, *p=0.908*, ES=-0.026 | t(1,810)=-8.74, *p<0.001*\*, ES=-2.233 | t(1,571)=-11.29, *p<0.001*\*, ES=-2.207 | F(1,568)=30.67, *p<0.001*\*, ES=0.954 | F(2,559)=0.29, *p=0.748* | F(1,599)=1.32, *p=0.251*, ES=0.026 | F(2,515)=1.48, *p=0.228* | F(1,504)=0.10, *p=0.751* | F(2,492)=0.79, *p=0.453* |
| **Benton Judgment of Line Orientation 15-item** | F(2,678)=13.54, *p<0.001*\* | t(1,786)=1.46, *p=0.145*, ES=0.585 | t(1,809)=-2.65, *p=0.008*\*, ES=-1.189 | t(1,559)=-5.20, *p<0.001*\*, ES=-1.774 | F(1,554)=64.93, *p<0.001*\*, ES=-2.417 | F(2,543)=0.06, *p=0.939* | F(1,590)=3.74, *p=0.054*, ES=-0.075 | F(2,503)=0.57, *p=0.563* | F(1,493)=1.05, *p=0.305* | F(2,482)=0.54, *p=0.585* |
| **Symbol Digit Modalities Test**  | F(2,632)=3.61, *p=0.028*\* | t(1,674)=-2.59, *p=0.010*\*, ES=-2.827 | t(1,697)=-2.21, *p=0.027*\*, ES=-2.711 | t(1,567)=0.12, *p=0.907*, ES=0.116 | F(1,564)=2.56, *p=0.110*, ES=1.394 | F(2,558)=1.80, *p=0.166* | F(1,523)=16.07, *p<0.001*\*, ES=-0.381 | F(2,451)=0.26, *p=0.773* | F(1,454)=0.38, *p=0.537* | F(2,438)=0.64, *p=0.528* |
| **Wechsler Memory Scale-III Letter Number Sequencing** | F(2,655)=0.56, *p=0.574* | t(1,716)=-0.86, *p=0.393*, ES=-0.235 | t(1,743)=-1.03, *p=0.305*, ES=-0.316 | t(1,570)=-0.33, *p=0.739*, ES=-0.081 | F(1,564)=0.54, *p=0.464*, ES=-0.157 | F(2,556)=0.72, *p=0.488* | F(1,518)=20.35, *p<0.001*\*, ES=-0.114 | F(2,447)=0.44, *p=0.644* | F(1,448)=2.51, *p=0.114* | F(2,434)=0.65, *p=0.521* |
| **Animal naming** | F(2,679)=1.36, *p=0.257* | t(1,768)=0.07, *p=0.941*, ES=0.041 | t(1,785)=-1.17, *p=0.241*, ES=-0.726 | t(1,573)=-1.60, *p=0.110*, ES=-0.767 | F(1,563)=0.21, *p=0.644*, ES=0.194 | F(2,554)=0.27, *p=0.763* | F(1,574)=0.02, *p=0.884*, ES=-0.007 | F(2,491)=0.42, *p=0.658* | F(1,491)=0.05, *p=0.824* | F(2,475)=0.33, *p=0.719* |

Statistical significance is marked with \*.

PD-NC: Parkinson’s disease patients with normal cognition, PD-MCI: Parkinson’s disease patients with mild cognitive impairment, HC: healthy controls, ES: effect size.

**Supplementary Table 3** Covariate effects on longitudinal cognitive measures

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Years of education** | **15-item Geriatric Depression Scale** | **State and Trait Anxiety Inventory-State** | **State and Trait Anxiety Inventory-Trait** | **Epworth Sleepiness Scale** | **Movement Disorders Society-Unified Parkinson’s Disease Rating Scale Part III**  |
|
| **Montreal Cognitive Assessment** | F(1,571)=0.00, *p=0.988*, ES<0.001 | F(1,2432)=0.02, *p=0.890*, ES=-0.004 | F(1,2040)=3.26, *p=0.071*, ES=-0.010 | F(1,2258)=0.71, *p=0.399*, ES=0.006 | F(1,2474)=13.53, *p<0.001*\*, ES=-0.046 | F(1,2632)=12.27, *p<0.001*\*, ES=-0.018 |
| **Phonemic fluency** | F(1,587)=37.23, *p<0.001*\*, ES=0.331 | F(1,2641)=2.45, *p=0.118*, ES=-0.084 | F(1,2061)=0.39, *p=0.531*, ES=0.007 | F(1,2689)=0.41, *p=0.522*, ES=-0.009 | F(1,2741)=0.02, *p=0.889*, ES=-0.003 | F(1,2589)=1.06, *p=0.303*, ES=-0.010 |
| **Hopkins Verbal Learning Test-Revised- Learning** | F(1,571)=9.10, *p=0.003*\*, ES=0.165 | F(1,2455)=0.02, *p=0.892*, ES=-0.007 | F(1,2123)=0.21, *p=0.645*, ES=0.005 | F(1,2588)=0.38, *p=0.537*, ES=-0.009 | F(1,2643)=0.66, *p=0.415*, ES=-0.020 | F(1,2572)=6.67, *p=0.010*\*, ES=-0.025 |
| **Hopkins Verbal Learning Test-Revised- Delayed recall** | F(1,578)=14.28, *p<0.001*\*, ES=0.106 | F(1,2513)=0.46, *p=0.499*, ES=0.019 | F(1,2094)=1.25, *p=0.263*, ES=-0.006 | F(1,2560)=0.79, *p=0.373*, ES=-0.006 | F(1,2633)=0.02, *p=0.902*, ES=0.002 | F(1,2506)=9.29, *p=0.002*\*, ES=-0.015 |
| **Benton Judgment of Line Orientation 15-item** | F(1,566)=21.46, *p<0.001*\*, ES=0.226 | F(1,2451)=2.15, *p=0.143*, ES=-0.073 | F(1,2116)=1.01, *p=0.315*, ES=-0.010 | F(1,2541)=1.13, *p=0.289*, ES=-0.014 | F(1,2425)=3.19, *p=0.074*, ES=-0.040 | F(1,2297)=5.50, *p=0.019*\*, ES=-0.020 |
| **Symbol Digit Modalities Test** | F(1,570)=0.34, *p=0.561*, ES=0.082 | F(1,2037)=4.13, *p=0.042*\*, ES=-0.199 | F(1,1750)=2.05, *p=0.152*, ES=-0.028 | F(1,2326)=0.46, *p=0.498*, ES=-0.018 | F(1,2427)=0.01, *p=0.938*, ES=0.004 | F(1,2327)=0.67, *p=0.414*, ES=-0.015 |
| **Wechsler Memory Scale-III Letter Number Sequencing** | F(1,575)=0.09, *p=0.759*, ES=0.011 | F(1,2197)=0.32, *p=0.573*, ES=-0.016 | F(1,1893)=5.88, *p=0.015*\*, ES=-0.014 | F(1,2426)=0.50, *p=0.481*, ES=0.005 | F(1,2517)=7.64, *p=0.006*\*, ES=-0.037 | F(1,2369)=0.60, *p=0.438*, ES=0.004 |
| **Animal naming** | F(1,581)=5.40, *p=0.021*\*, ES=-0.160 | F(1,2202)=2.47, *p=0.116*, ES=-0.095 | F(1,1821)=5.09, *p=0.024*\*, ES=-0.027 | F(1,2344)=1.01, *p=0.314*, ES=0.015 | F(1,2430)=4.87, *p=0.027*\*, ES=-0.061 | F(1,2240)=3.87, *p=0.049*\*, ES=-0.021 |

Statistical significance is marked with \*.

ES: effect size.