

eTable 1. Motor severity of participants and main exclusion criteria of included studies

Study	UPDRS or MDS-UPDRS score	H&Y stage	Main exclusion criteria
Altmann 2016	UPDRS III: Trt1: 23.7±8.7 ^{NS} UPDRS III: Trt2: 17.5±6.4 ^{NS} UPDRS III: Con: 20.6±7.7	Trt1: 2.1±0.5 ^{NR} Trt2: 2.2±0.4 ^{NR} Con: 2.4±0.7	MCI or dementia (MMSE<25) Psychiatric diseases
Avenali 2021	UPDRS III: Trt: 33.7±10.2 ^{NS} UPDRS III: Con: 34.2±4.0	Trt: 2.5±0.3 ^{NS} Con: 2.3±0.6	Cognitive impairment or dementia Psychiatric and neurological diseases
Biddiscombe 2020	NA	NA	Dementia
Cheung 2018	UPDRS III: Trt: 25.6±6.9 ^{NS} UPDRS III: Con: 24.4±7.3	Trt: 2.0±0.8 ^{NS} Con: 2.0±0.8	Cognitive impairment (MoCA<26) Psychiatric and neurological diseases
Gryfe 2022	UPDRS III: Trt: 13.4±10.0 ^{NS} UPDRS III: Con: 16.0±7.6	Trt: 1.8±1.0 ^{NS} Con: 2.2±0.9	MoCA<15 Psychiatric and neurological diseases
Hashimoto 2015	UPDRS total: Trt1: 34.8±15.8 ^{NS} UPDRS total: Trt2: 42.7±13.9 ^{NS} UPDRS total: Con: 33.4±14.2	Trt1: 2.7±0.5 ^{NS} Trt2: 2.7±0.5 ^{NS} Con: 3.0±0.6	NA
Kuhn 2020	UPDRS III: Trt: 23.7±10.0* UPDRS III: Con: 14.2±7.7	NA	NA
Marusiak 2019	UPDRS-BradUE: 2.6±0.5 ^{NS} UPDRS-BradUE: 2.2±0.9	Trt: 2.4±0.6 ^{NS} Con: 2.3±0.5	Neurological diseases
Michels 2018	MDS-UPDRS III: Trt: 27.6±11.6* MDS-UPDRS III: Con: 40.8±8.7	Trt: 2.1±0.3* Con: 2.5±1.0	Cognitive impairment (MoCA<24)
Nocera 2013	UPDRS total: Trt: 34.7±7.4 ^{NS} UPDRS total: Con: 35.4±13.4	Trt: 2–3 ^{NS} Con: 2–3	Dementia (MMSE<26) depression (BDI>17) Neurological diseases
Picelli 2016	UPDRS total: 40.0 (median) ^{NS} UPDRS total: 37.0 (median)	Total: 3 ^{NR}	MMSE<24 Neurological diseases
Rios Romenets 2015	MDS-UPDRS III: Trt: 20.7±10.1 ^{NS} MDS-UPDRS III: Con: 27.5±14.5	Trt: 1.7±0.6 ^{NS} Con: 2.0±0.5	Dementia (MDS dementia criteria)
Sacheli 2019	MDS-UPDRS III: Trt: 23.0±10.4 ^{NS} MDS-UPDRS III: Con: 26.8±13.1	Total: 1–3 ^{NR}	Cognitive impairment (MoCA<24) Depression (BDI>18) Neurological diseases
Shen 2021	UPDRS III: Trt: 26.4±11.2* UPDRS III: Con: 18.1±9.7	Trt: 1.9±0.8 ^{NS} Con: 2.2±0.7	MMSE<24 Deep brain stimulation surgery
Silva-Batista 2016	UPDRS III: Trt1: 43.7±13.4 ^{NS} UPDRS III: Trt2: 45.1±8.2 ^{NS} UPDRS III: Con: 43.4±8.6	Trt1: 2.5±0.5 ^{NS} Trt2: 2.5±0.4 ^{NS} Con: 2.5±0.4	Cognitive impairment (MMSE < 23) Neurological diseases
Silveira 2018	UPDRS III: Trt1: 25.4±8.1 ^{NS} UPDRS III: Trt2: 27.6±9.7 ^{NS} UPDRS III: Con: 21.8±9.2	NA	Neurological diseases
Solla 2019	UPDRS III: Trt: 13.0±7.2 ^{NS} UPDRS III: Con: 14.7±7.0	Trt : 2.1±0.6 ^{NS} Con: 2.3±0.4	MMSE<23 and Dementia (DSM-5 criteria)
Son 2018	NA	Trt: 1–3 ^{NS} Con: 1–3	NA
van der Kolk 2018	UPDRS III: Trt1: 23 (median) ^{NS} UPDRS III: Con: 20 (median)	Total: 1–2 ^{NR}	NA
van der Kolk 2019	MDS-UPDRS III: Trt1: 29.5±15.7 ^{NS} MDS-UPDRS III: Con: 27.2±14.8	Trt: 1.9±0.2 ^{NS} Con: 2.0±0.2	Dementia (MMSE < 24) Psychiatric and neurological diseases Deep brain stimulation surgery
Vergara-Diaz 2018	UPDRS III: Trt: 26.4±9.6 ^{NR} UPDRS III: Con: 20.6±8.7	Trt: 2.2±0.2 ^{NR} Con: 2.1±0.2	Neurological diseases Deep brain stimulation surgery

*Significant differences between treatment and control groups.

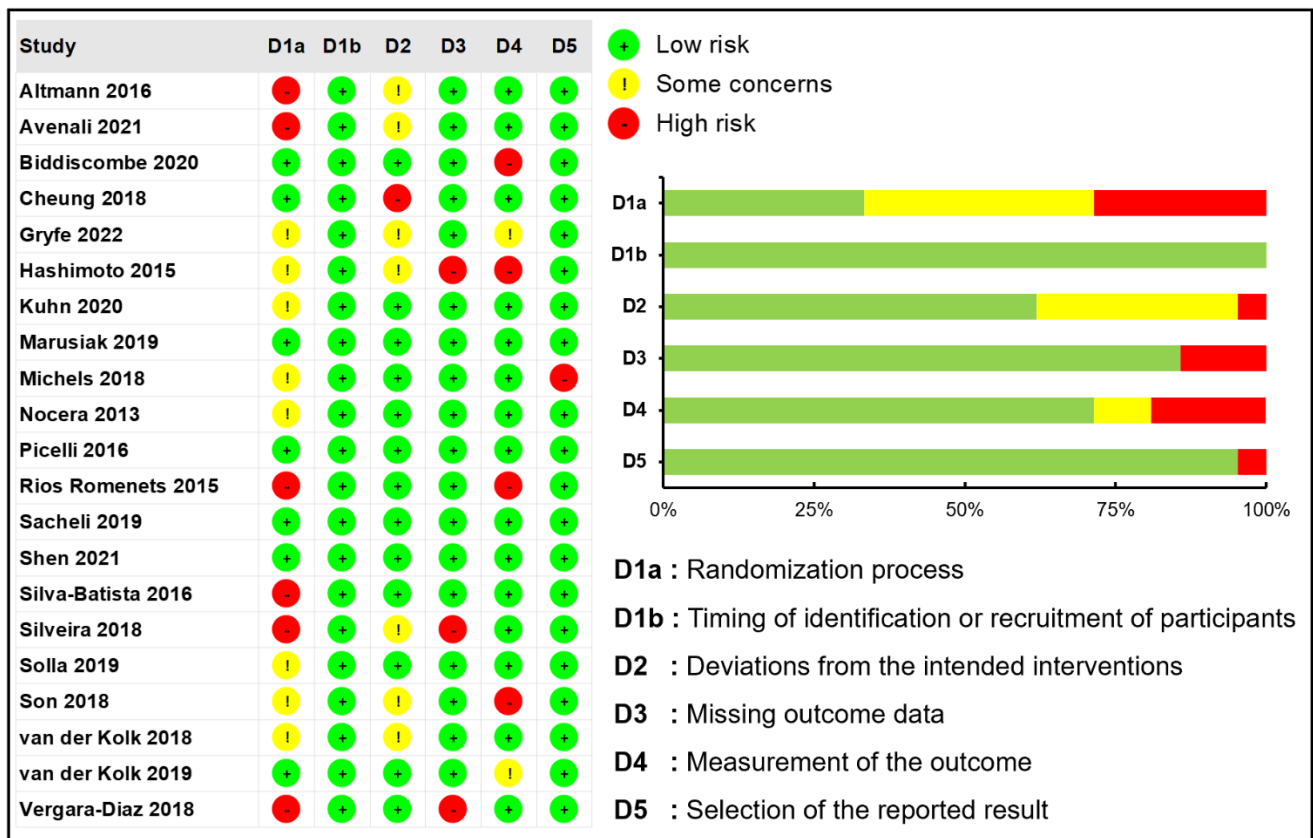
Abbreviations and explanation. BDI=Beck Depression Inventory; BradUE=bradykinesia of the upper extremity; Con=control; DSM-5= diagnostic and statistical manual of mental disorders 5; Trt=treatment; MCI=mild cognitive impairment; MDS=Movement Disorder Society; MMSE=Mini-Mental State Examination; MoCA= Montreal Cognitive Assessment; NA: not available; NS=not significant between groups; NR=not report the significance of group differences; UPDRS=Unified Parkinson's Disease Rating Scale.

eTable 2. Cognitive function assessments

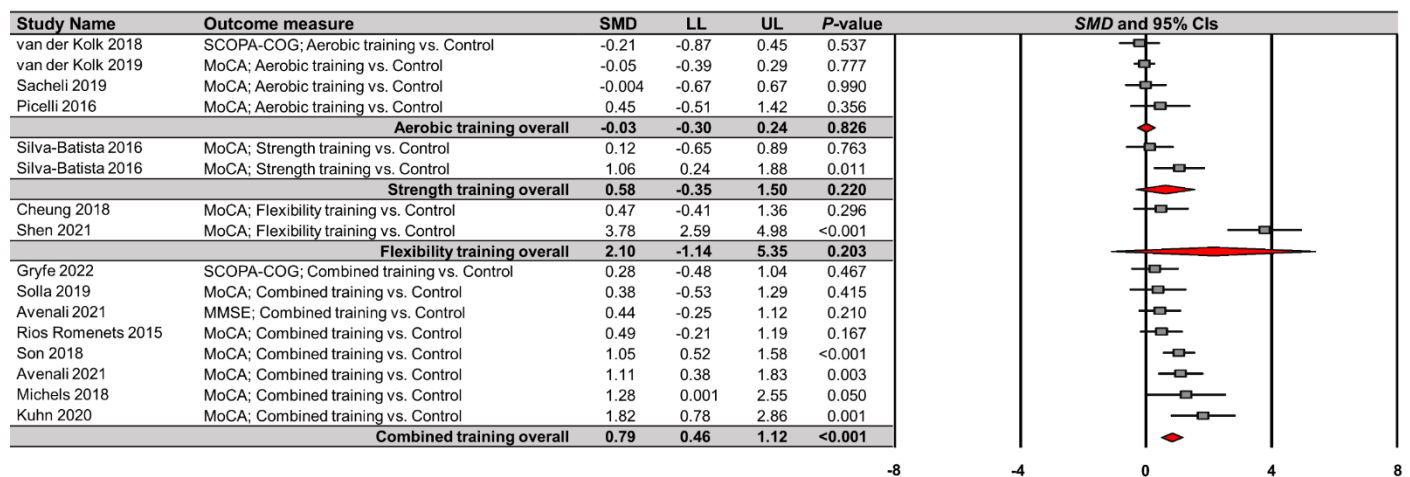
Study	Task	Outcome	Cognitive Domain
Altmann 2016	Simple attention task	Reaction time	Attention and working memory
	Digit symbol substitution task	Reaction time	Attention and working memory
	0-back task	Reaction time	Attention and working memory
	Stroop task	Reaction time	Attention and working memory
	1 & 2 back task	Accuracy	Attention and working memory
	Digit span backward & forward task	Accuracy	Attention and working memory
	Operation span task	Accuracy	Attention and working memory
	Stroop interference task	Reaction time	Attention and working memory
	Language production task	Score	Language
Avenali 2021	Visual memory updating task	Accuracy	Attention and working memory
	MMSE	Score	Global cognitive score
	MoCA	Score	Global cognitive score
	Attentive matrices	Score	Attention and working memory
	Corsi's block-tapping task	Score	Attention and working memory
	Trail making task	Score	Attention and working memory
	Frontal assessment battery task	Score	Executive function
	Raven's matrices	Score	Executive function
Biddiscombe 2020	Phonological fluency task	Score	Language
	Cogstate detection task	Reaction time	Attention and working memory
	Cogstate one back task	Reaction time	Attention and working memory
	Tower of London task	Score	Executive function
Cheung 2018	Wisconsin card sorting task	Score	Executive function
	MoCA	Score	Global cognitive score
Gryfe 2022	SCOPA-COG	Score	Global cognitive score
Hashimoto 2015	Frontal assessment battery task	Score	Executive function
	Mental rotation task	Reaction time & accuracy	Visuospatial
Kuhn 2020	MoCA	Score	Global cognitive score
Marusiak 2019	Trail making task	Reaction time	Attention and working memory
	Stroop task	Reaction time	Attention and working memory
Michels 2018	MoCA	Score	Global cognitive score
Nocera 2013	Trail making task	Reaction time	Attention and working memory
	Stroop task	Reaction time	Attention and working memory
	Digit span backward task	Score	Attention and working memory
	Category verbal fluency task	Score	Language
	Letter verbal fluency task	Score	Language
Picelli 2016	MoCA	Score	Global cognitive score
	Trail making task	Reaction time	Attention and working memory
	Memory with interference task	Score	Attention and working memory
Rios Romenets 2015	MoCA	Score	Global cognitive score
Sacheli 2019	MoCA	Score	Global cognitive score
	Trail making task	Reaction time	Attention and working memory
Shen 2021	MoCA	Score	Global cognitive score
	Stroop task	Reaction time	Attention and working memory
	Frontal assessment battery task	Score	Executive function
Silva-Batista 2016	MoCA	Score	Global cognitive score
Silveira 2018	Corsi's block tapping task	Level	Attention and working memory
	Digit span task	Score	Attention and working memory
	Stroop task	Score	Attention and working memory
	Trail making task	Reaction time	Attention and working memory
	Boston Naming task	Score	Language
	Verbal fluency task	Score	Language
	CVLT recall	Score	Memory
	Rey-Osterrieth complex figure	Score	Memory
	Benton line orientation	Score	Visuospatial
	Pentagons	Score	Visuospatial
Solla 2019	MoCA	Score	Global cognitive score
Son 2018	K-MoCA	Score	Global cognitive score
van der Kolk 2018	SCOPA-COG	Score	Global cognitive score
	Trail making task	Reaction time	Attention and working memory
van der Kolk 2019	MoCA	Score	Global cognitive score
	Trail making task	Reaction time	Attention and working memory
	Test of attentional performance task	Performance index	Attention and working memory
Vergara-Diaz 2018	Trail making task	Reaction time	Attention and working memory

Abbreviations. MMSE=Mini-Mental Statement Examination; MoCA=Montreal Cognitive Assessment; SCOPA-COG=Scales for Outcomes in Parkinson's Disease-Cognition.

eFigure 1. Methodological quality assessment findings.

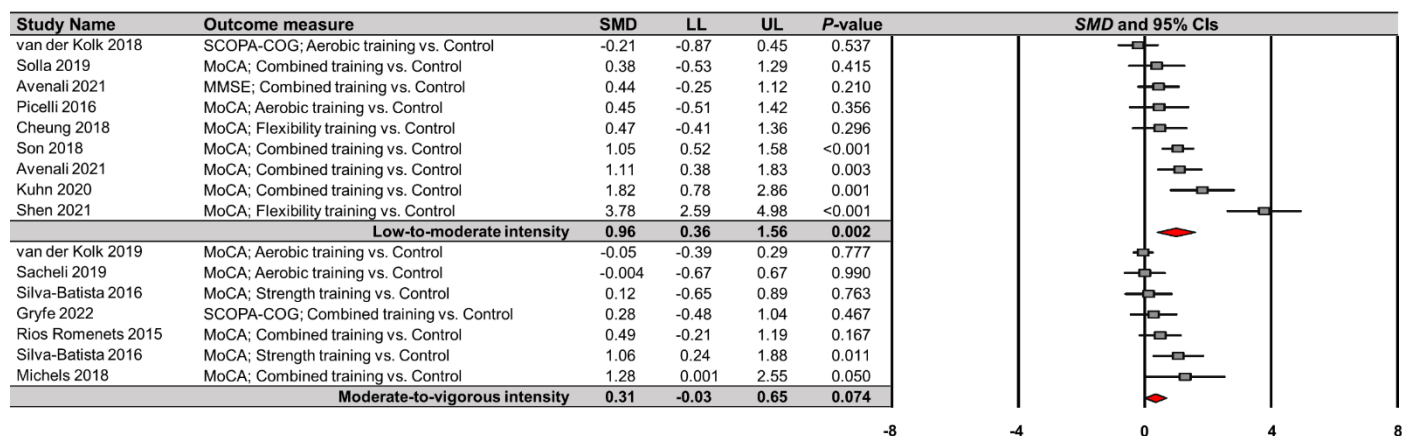


eFigure 2. Moderator variable analysis findings for the effects of exercise type on global cognitive function in patients with Parkinson's disease.



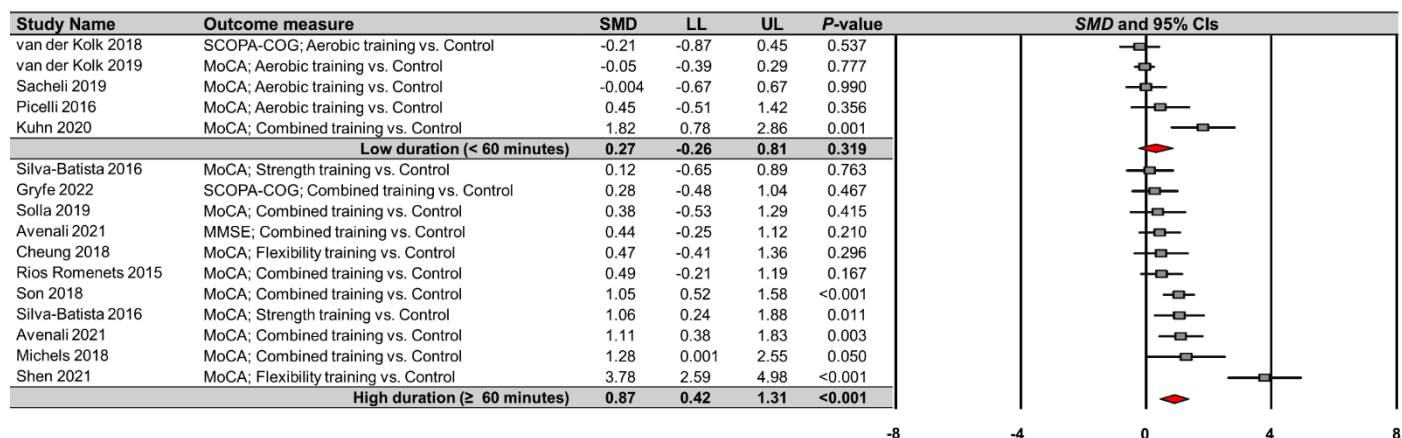
Red diamonds indicate the overall effect size. More positive values indicate a greater reduction in global cognitive function. *Abbreviations:* CI=confidence interval; LL=lower limit; MMSE=Mini-Mental State Examination; MoCA=Montreal Cognitive Assessment; SCOPA-COG=Scales for Outcomes in Parkinson's disease-Cognition; SMD=standardized mean difference; UL=upper limit.

eFigure 3. Moderator variable analysis findings for the effects of exercise intensity on global cognitive function in patients with Parkinson's disease.



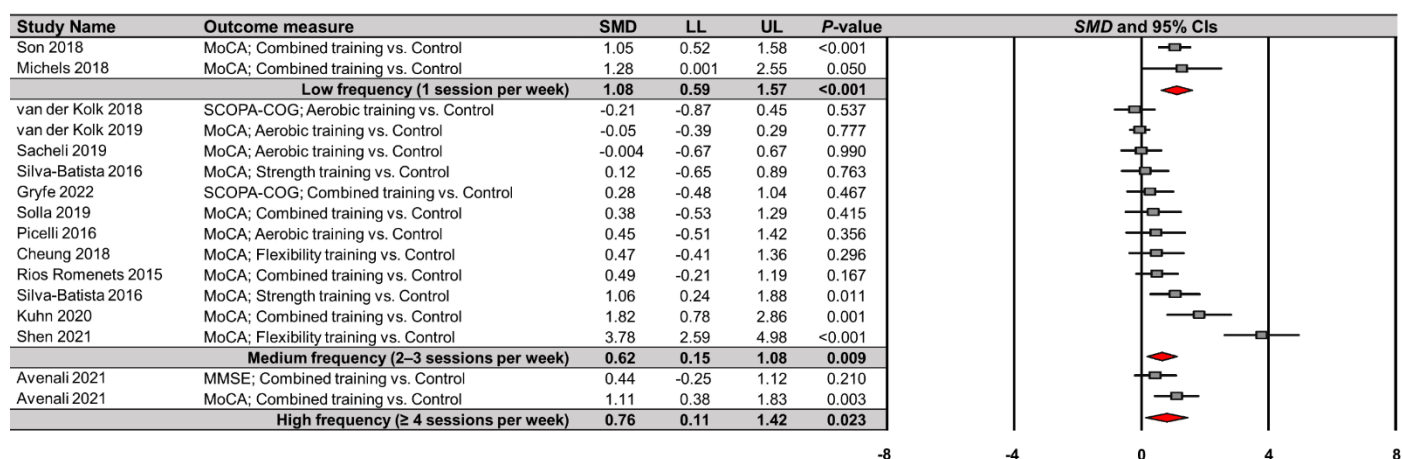
Red diamonds indicate the overall effect size. More positive values indicate a greater reduction in global cognitive function. *Abbreviations:* CI=confidence interval; LL=lower limit; MMSE=Mini-Mental State Examination; MoCA=Montreal Cognitive Assessment; SCOPA-COG=Scales for Outcomes in Parkinson's disease-Cognition; SMD=standardized mean difference; UL=upper limit.

eFigure 4. Moderator variable analysis findings for the effects of exercise duration on global cognitive function in patients with Parkinson's disease.



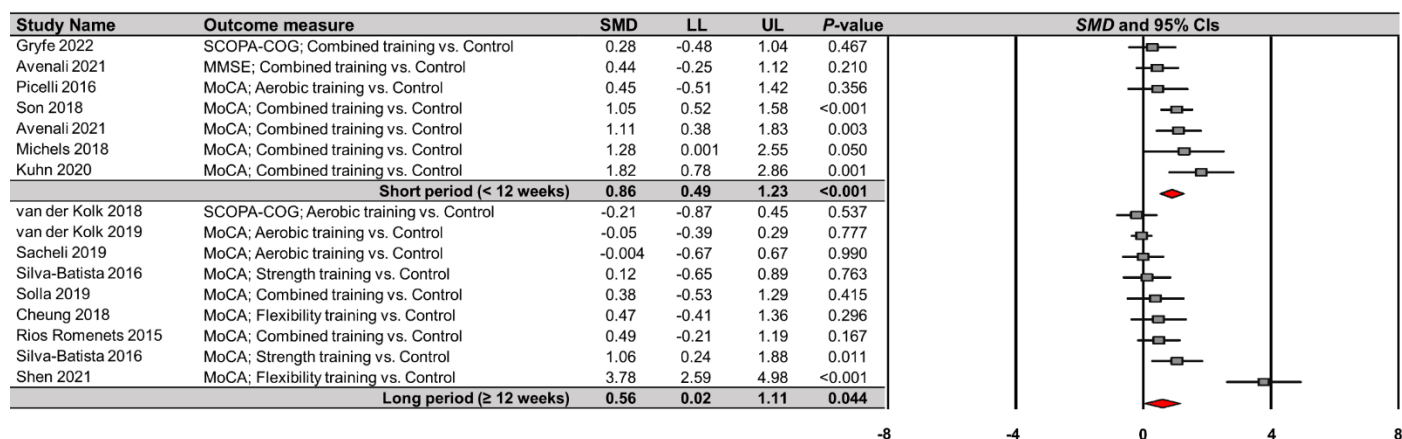
Red diamonds indicate the overall effect size. More positive values indicate a greater reduction in global cognitive function. *Abbreviations:* CI=confidence interval; LL=lower limit; MMSE=Mini-Mental State Examination; MoCA=Montreal Cognitive Assessment; SCOPA-COG=Scales for Outcomes in Parkinson's disease-Cognition; SMD=standardized mean difference; UL=upper limit.

eFigure 5. Moderator variable analysis findings for the effects of exercise frequency on global cognitive function in patients with Parkinson's disease.



Red diamonds indicate the overall effect size. More positive values indicate a greater reduction in global cognitive function. *Abbreviations:* CI=confidence interval; LL=lower limit; MMSE=Mini-Mental State Examination; MoCA=Montreal Cognitive Assessment; SCOPA-COG=Scales for Outcomes in Parkinson's disease-Cognition; SMD=standardized mean difference; UL=upper limit.

eFigure 6. Moderator variable analysis findings for the effects of exercise period on global cognitive function in patients with Parkinson's disease.



Red diamonds indicate the overall effect size. More positive values indicate a greater reduction in global cognitive function. *Abbreviations:* CI=confidence interval; LL=lower limit; MMSE=Mini-Mental State Examination; MoCA=Montreal Cognitive Assessment; SCOPA-COG=Scales for Outcomes in Parkinson's disease-Cognition; SMD=standardized mean difference; UL=upper limit.