

# Supplementary Material

## Gait Analysis with Wearable Sensors in Isolated REM Sleep Behavior Disorder Associated with Phenoconversion: An Explorative Study

**Supplemental Table 1.** Baseline gait parameters for healthy controls (HCs), patients with idiopathic rapid eye movement sleep behavior disorder (iRBD) who converted to definitive neurodegenerative diseases (converters), and remaining iRBD patients survived to be disease-free (non-converters). Data presented as mean±SD. Repeated measures analysis of covariance was used for statistical comparison.

Variables	HCs (n=33)	non-converters (n=21)	converters (n=10)	iRBD (n=31)	<i>p1</i>	<i>p2</i>
<b>Pace</b>						
Stride length (%stature)						
normal	85.05±3.93	85.16±5.11	82.61±4.12	84.34±4.89		
fast	86.84±4.78	87.44±4.87	83.67±5.19	86.22±5.21		
dual	81.79±6.55	83.74±6.15	81.13±5.00	82.90±5.86		
group					0.283	0.954
condition					<0.001*	<0.001*
condition x group					0.172	0.078
Stride velocity (%stature/s)						
normal	82.42±4.94	79.13±7.16	78.73±7.12	79.00±7.03		
fast	90.47±7.08	87.89±8.19	87.06±7.58	87.62±7.88		
dual	74.09±10.04	75.44±9.27	73.74±9.19	74.48±9.06		
group					0.542	0.294
condition					<0.001*	<0.001*
condition x group					0.122	0.051
Swing variation						
normal	1.88±0.87	2.33±1.23	2.86±2.21	2.50±1.59		
fast	1.75±0.75	2.07±0.93	3.34±3.58	2.48±2.19		
dual	2.85±2.68	2.54±2.19	2.13±0.73	2.41±1.84		
group					0.408	0.343
condition					0.764	0.148
condition x group					0.079	0.087
<b>Rhythm</b>						
Stride time (s)						
normal	1.03±0.05	1.08±0.07	1.06±0.08	1.07±0.08		
fast	0.96±0.06	1.00±0.07	0.97±0.09	0.99±0.08		
dual	1.12±0.11	1.12±0.12	1.11±0.11	1.12±0.12		
group					0.339	0.221
condition					<0.001*	<0.001*

condition x group					0.306	0.129
<b>Swing (%)</b>						
normal	40.36±1.99	40.19±1.68	40.48±1.38	40.29±1.57		
fast	41.40±2.02	41.44±1.64	42.04±1.74	41.63±1.67		
dual	39.35±2.21	39.75±1.79	39.62±1.91	39.71±1.80		
group					0.867	0.698
condition					<0.001*	<0.001*
condition x group					0.319	0.327
<b>Stance (%)</b>						
normal	59.64±1.99	59.81±1.68	59.52±1.38	59.71±1.57		
fast	58.60±2.02	58.56±1.64	57.96±1.74	58.37±1.67		
dual	60.65±2.21	60.25±1.79	60.38±1.91	60.29±1.80		
group					0.867	0.698
condition					<0.001*	<0.001*
condition x group					0.319	0.327
<b>Variability</b>						
<b>Stride length variation</b>						
normal	1.67±0.71	2.09±0.58	3.40±3.04 <sup>ab</sup>	2.51±1.84	0.003*	
fast	2.11±1.10	1.98±0.60	3.83±2.81 <sup>ab</sup>	2.58±1.83	0.002*	
dual	3.17±3.09	2.63±1.77	4.38±2.84	3.20±2.28	0.244	
group					0.006*	0.236
condition					0.016*	0.003*
condition x group					0.567	0.323
<b>Stride time variation</b>						
normal	1.56±0.43	1.88±0.67	3.67±4.77 <sup>a</sup>	2.45±2.80	0.012*	
fast	1.97±0.86	1.99±0.65	5.34±7.57 <sup>ab</sup>	3.07±4.47	0.007*	
dual	4.28±5.23	3.69±3.92	4.62±2.51	3.99±3.51	0.839	
group					0.043*	0.329
condition					0.028*	0.003*
condition x group					0.353	0.331
<b>Stride velocity variation</b>						
normal	2.23±0.93	2.93±1.03	4.80±4.57 <sup>ab</sup>	3.53±2.79	0.003*	
fast	2.83±1.34	2.74±0.69	5.52±5.07 <sup>ab</sup>	3.64±3.12	0.003*	
dual	5.39±5.04	4.29±2.94	6.11±3.81	4.88±3.30	0.49	
group					0.019*	0.329
condition					0.006*	<0.001*
condition x group					0.342	0.164
<b>Asymmetry</b>						
<b>Swing asymmetry (%)</b>						
normal	4.29±2.47	4.66±3.10	4.56±2.23	4.63±2.81		
fast	4.21±2.55	4.87±3.96	4.18±1.92	4.65±3.41		

dual	6.05±3.50	5.12±2.96	4.94±1.85	5.07±2.62		
group					0.757	0.503
condition					0.023*	0.001*
condition x group					0.188	0.063
<b>Stance asymmetry (%)</b>						
normal	2.56±1.43	3.08±1.89	3.07±1.39	3.08±1.72		
fast	2.63±1.64	3.39±2.58	3.04±1.21	3.27±2.22		
dual	3.60±2.32	3.32±1.78	3.24±1.13	3.29±1.58		
group					0.756	0.477
condition					0.111	0.011*
condition x group					0.185	0.058
<b>Postural control</b>						
<b>Stride length asymmetry (%)</b>						
normal	0.89±0.32	0.94±0.25	1.34±0.78	1.07±0.51		
fast	1.05±0.52	1.01±0.27	1.42±0.73	1.14±0.50		
dual	1.48±1.31	1.19±0.52	1.44±0.51	1.27±0.52		
group					0.185	0.86
condition					0.052	0.004*
condition x group					0.362	0.16

iRBD, idiopathic rapid eye movement sleep behavior disorder; converters, iRBD patients who were later diagnosed with degenerative disease; non-converters, iRBD patients who remained free from  $\alpha$ -synucleinopathies; HCs, healthy controls; <sup>a</sup>compared to HCs; <sup>b</sup>compared to non-converters; \* $p < 0.05$ . p1, compare between HCs, converters, and non-converters; p2, compare between HCs and iRBD.

**Supplementary Table 2.** Baseline arm parameters for healthy controls (HCs), patients with idiopathic rapid eye movement sleep behavior disorder (iRBD) who converted to definitive neurodegenerative diseases (converters), and remaining iRBD patients survived to be disease-free (non-converters). Data presented as mean±SD. Repeated measures analysis of covariance was used for statistical comparison.

Variables	HCs (n=33)	non-converters (n=21)	converters (n=10)	iRBD (n=31)	<i>p</i> 1	<i>p</i> 2
Arm range of motion (degrees)						
normal	26.02±10.29	22.65±11.20	16.94±4.73 <sup>a</sup>	20.81±9.88	0.045*	
fast	32.81±12.68	27.66±11.66	20.52±5.86 <sup>a</sup>	25.36±10.60	0.014*	
dual	26.26±10.67	24.37±11.46	19.05±6.31	22.66±10.29	0.168	
group					0.031*	0.111
condition					<0.001*	0.099
condition x group					0.273	0.085
Peak arm velocity (degrees/s)						
normal	228.98±52.84	179.22±52.83	209.31±94.57	188.93±69.42		
fast	284.49±76.20	255.80±78.26	249.31±85.45	253.71±79.27		
dual	239.94±77.08	208.85±61.60	217.68±66.44	211.70±62.22		
group					0.156	0.06
condition					<0.001*	<0.001*
condition x group					0.583	0.983
Arm range of motion variation						
normal	14.49±6.31	16.28±16.53	16.07±5.63	16.22±13.84		
fast	14.20±7.45	14.10±5.19	22.82±20.70	16.91±12.79		
dual	19.00±14.85	18.94±10.20	20.23±4.60	19.36±8.72		
group					0.345	0.381
condition					0.182	0.067
condition x group					0.506	0.813
Peak arm velocity asymmetry (%)						
normal	18.91±12.34	17.61±7.19	24.44±19.54	19.82±12.63		
fast	19.06±11.69	17.63±7.60	24.64±19.47	19.89±12.78		
dual	23.48±11.87	22.78±9.88	31.29±20.78	25.53±14.52		
group					0.254	0.645
condition					<0.001*	<0.001*
condition x group					0.987	1

iRBD, idiopathic rapid eye movement sleep behavior disorder; converters, iRBD patients who were later diagnosed with degenerative disease; non-converters, iRBD patients who remained free from  $\alpha$ -synucleinopathies; HCs, healthy controls; <sup>a</sup>compared to HCs; \**p*<0.05. *p*1, compare between HCs, converters, and non-converters; *p*2, compare between HCs and iRBD.

**Supplementary Table 3.** Baseline trunk parameters for healthy controls (HCs), patients with idiopathic rapid eye movement sleep behavior disorder (iRBD) who converted to definitive neurodegenerative diseases (converters), and remaining iRBD patients survived to be disease-free (non-converters). Data presented as mean±SD. Repeated measures analysis of covariance was used for statistical comparison.

Variables	HCs (n=33)	non-converters (n=21)	converters (n=10)	iRBD (n=31)	<i>p</i> 1	<i>p</i> 2
Trunk sagittal range of motion (degrees)						
normal	4.19±0.87	3.72±0.71	4.16±0.75	3.86±0.74	0.113	
fast	4.36±0.89	3.81±0.67 <sup>a</sup>	4.41±0.65	4.01±0.71	0.036*	
dual	4.53±1.07	3.96±0.86	4.61±0.66	4.17±0.85	0.078	
group					0.043*	0.087
condition					0.001*	<0.001*
condition x group					0.891	0.955
Peak sagittal trunk velocity (degrees/s)						
normal	24.82±5.28	22.52±4.65	23.67±4.54	22.89±4.57		
fast	29.26±7.59	25.76±5.86	29.42±6.62	26.94±6.25		
dual	24.01±5.43	22.58±6.27	23.99±3.01	23.03±5.42		
group					0.24	0.182
condition					<0.001*	<0.001*
condition x group					0.45	0.481
Trunk horizontal range of motion (degrees)						
normal	7.46±2.00	6.49±1.39	7.45±1.82	6.80±1.58		
fast	7.29±2.01	6.43±1.59	7.32±2.20	6.71±1.82		
dual	8.42±2.57	7.22±1.61	8.47±1.81	7.62±1.75		
group					0.136	0.158
condition					<0.001*	<0.001*
condition x group					0.746	0.632
Peak horizontal trunk velocity (degrees/s)						
normal	24.44±8.20	20.05±3.86	24.48±7.77	21.48±5.70		
fast	26.66±9.31	22.95±4.84	27.65±7.96	24.47±6.30		
dual	25.99±7.58	23.29±5.73	26.32±6.73	24.26±6.13		
group					0.138	0.194
condition					<0.001*	<0.001*
condition x group					0.516	0.41

iRBD, idiopathic rapid eye movement sleep behavior disorder; converters, iRBD patients who were later diagnosed with degenerative disease; non-converters, iRBD patients who remained free from  $\alpha$ -synucleinopathies; HCs, healthy controls; <sup>a</sup>compared to HCs; \**p*<0.05. *p*1, compare between HCs, converters, and non-converters; *p*2, compare between HCs and iRBD.

**Supplementary Table 4.** Spearman's correlation for the relationships between all gait parameters during normal walking condition and the UPDRSIII score for all iRBD patients.

		UPDRS	Stride length	Stride velocity	Stride time (s)	Swing (%)	Stance (%)	Stride length va.	Stride time va.	Stride velocity va.	Stride length as.(%)	Swing as.(%)	Stance as.(%)	Swing va.	RoM arm (degrees)	Peak arm velocity (degrees/s)	RoM arm va. (degrees)	Peak arm velocity as.(%)	RoM trunk sagit. (degrees)	Peak sagit. trunk velocity (degrees/s)	RoM trunk horiz. (degrees)	Peak horiz. trunk velocity (degrees/s)
UPDRSIII	r	1	-0.116	-0.189	0.147	0.06	-0.06	-0.136	0.089	-0.084	-0.146	0.205	-0.242	-0.265	-0.237	-0.292	0.235	0.258	0.055	0.098	-0.215	-0.138
	p	.	0.533	0.309	0.432	0.749	0.749	0.464	0.633	0.652	0.434	0.269	0.19	0.15	0.2	0.111	0.204	0.162	0.771	0.601	0.245	0.459
Stride length (%stature)	r	-0.116	1	0.509**	0.045	-0.266	0.266	-0.194	-0.374*	-0.257	0.017	-0.208	-0.105	-0.118	0.204	0.247	-0.242	0.045	0.033	0.286	-0.174	-0.143
	p	0.533	.	0.003	0.811	0.148	0.148	0.296	0.038	0.163	0.928	0.262	0.573	0.528	0.272	0.181	0.19	0.809	0.858	0.118	0.349	0.444
Stride velocity (%stature/s)	r	-0.189	0.509**	1	-0.789**	0.361*	-0.361*	-0.349	-0.404*	-0.500**	-0.356*	-0.502**	-0.429*	-0.404*	0.139	0.563**	-0.123	-0.154	-0.153	0.229	-0.064	0.119
	p	0.309	0.003	.	<0.001	0.046	0.046	0.054	0.024	0.004	0.05	0.004	0.016	0.024	0.455	<0.001	0.51	0.407	0.41	0.215	0.732	0.524
Stride time (seconds)	r	0.147	0.045	-0.789**	1	-0.640**	0.640**	0.275	0.201	0.412*	0.452*	0.411*	0.455*	0.409*	-0.05	-0.466**	0.001	0.245	0.113	-0.142	0.034	-0.045
	p	0.432	0.811	<0.001	.	<0.001	<0.001	0.135	0.278	0.021	0.011	0.022	0.01	0.022	0.791	0.008	0.995	0.184	0.545	0.446	0.857	0.811
Swing (%)	r	0.06	-0.266	0.361*	-0.640**	1	-1.000**	-0.376*	-0.111	-0.346	-0.636**	-0.371*	-0.610**	-0.536**	0.116	0.31	0.077	-0.169	-0.271	0.002	0.069	0.045
	p	0.749	0.148	0.046	<0.001	.	.	0.037	0.551	0.057	<0.001	0.04	<0.001	0.002	0.534	0.089	0.682	0.362	0.14	0.991	0.714	0.809
Stance (%)	r	-0.06	0.266	-0.361*	0.640**	-1.000**	1	0.376*	0.111	0.346	0.636**	0.371*	0.610**	0.536**	-0.116	-0.31	-0.077	0.169	0.271	-0.002	-0.069	-0.045
	p	0.749	0.148	0.046	<0.001	.	.	0.037	0.551	0.057	<0.001	0.04	<0.001	0.002	0.534	0.089	0.682	0.362	0.14	0.991	0.714	0.809
Stride length va.	r	-0.136	-0.194	-0.349	0.275	-0.376*	0.376*	1	0.642**	0.811**	0.684**	0.613**	0.620**	0.616**	-0.083	-0.255	0.11	0.385*	0.309	-0.015	0.028	0.127
	p	0.464	0.296	0.054	0.135	0.037	0.037	.	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.658	0.166	0.556	0.033	0.091	0.937	0.88	0.495
Stride time va.	r	0.089	-0.374*	-0.404*	0.201	-0.111	0.111	0.642**	1	0.681**	0.381*	0.292	0.400*	0.435*	-0.115	-0.284	0.023	0.377*	0.414*	0.223	0.189	0.244
	p	0.633	0.038	0.024	0.278	0.551	0.551	<0.001	.	<0.001	0.034	0.111	0.026	0.014	0.537	0.121	0.902	0.036	0.021	0.227	0.308	0.185

Stride velocity	r	-0.084	-0.257	-0.500**	0.412*	-0.346	0.346	0.811**	0.681**	1	0.510**	0.382*	0.487**	0.489**	-0.015	-0.244	0.068	0.336	0.429*	0.063	0.148	0.065
	va.	p	0.652	0.163	0.004	0.021	0.057	0.057	<0.001	<0.001	.	0.003	0.034	0.005	0.005	0.938	0.185	0.716	0.064	0.016	0.738	0.427
Swing va.	r	-0.146	0.017	-0.356*	0.452*	-0.636**	0.636**	0.684**	0.381*	0.510**	1	0.539**	0.869**	0.844**	0.083	-0.204	-0.16	-0.001	0.189	-0.189	0.146	0.19
	p	0.434	0.928	0.05	0.011	<0.001	<0.001	<0.001	0.034	0.003	.	0.002	<0.001	<0.001	0.655	0.271	0.388	0.995	0.308	0.308	0.433	0.306
Stride length as. (%)	r	0.205	-0.208	-0.502**	0.411*	-0.371*	0.371*	0.613**	0.292	0.382*	0.539**	1	0.464**	0.432*	-0.225	-0.322	0.167	0.382*	0.089	-0.159	0.025	0.143
	p	0.269	0.262	0.004	0.022	0.04	0.04	<0.001	0.111	0.034	0.002	.	0.009	0.015	0.223	0.077	0.369	0.034	0.636	0.394	0.892	0.444
Swing as. (%)	r	-0.242	-0.105	-0.429*	0.455*	-0.610**	0.610**	0.620**	0.400*	0.487**	0.869**	0.464**	1	0.989**	0.044	-0.22	-0.202	-0.105	0.21	-0.183	0.167	0.135
	p	0.19	0.573	0.016	0.01	<0.001	<0.001	<0.001	0.026	0.005	<0.001	0.009	.	<0.001	0.814	0.234	0.277	0.575	0.257	0.323	0.37	0.47
Stance as. (%)	r	-0.265	-0.118	-0.404*	0.409*	-0.536**	0.536**	0.616**	0.435*	0.489**	0.844**	0.432*	0.989**	1	0.054	-0.194	-0.206	-0.117	0.161	-0.202	0.233	0.169
	p	0.15	0.528	0.024	0.022	0.002	0.002	<0.001	0.014	0.005	<0.001	0.015	<0.001	.	0.773	0.296	0.266	0.532	0.387	0.276	0.207	0.362
RoM Arm (degrees)	r	-0.237	0.204	0.139	-0.05	0.116	-0.116	-0.083	-0.115	-0.015	0.083	-0.225	0.044	0.054	1	0.497**	-0.392*	-0.307	-0.097	-0.048	0.103	-0.156
	p	0.2	0.272	0.455	0.791	0.534	0.534	0.658	0.537	0.938	0.655	0.223	0.814	0.773	.	0.004	0.029	0.093	0.603	0.798	0.583	0.402
Peak arm velocity (degrees/s)	r	-0.292	0.247	0.563**	-0.466**	0.31	-0.31	-0.255	-0.284	-0.244	-0.204	-0.322	-0.22	-0.194	0.497**	1	-0.002	-0.21	0.006	0.211	0.255	0.23
	p	0.111	0.181	<0.001	0.008	0.089	0.089	0.166	0.121	0.185	0.271	0.077	0.234	0.296	0.004	.	0.99	0.257	0.975	0.254	0.165	0.213
RoM Arm va. (degrees)	r	0.235	-0.242	-0.123	0.001	0.077	-0.077	0.11	0.023	0.068	-0.16	0.167	-0.202	-0.206	-0.392*	-0.002	1	0.104	-0.059	0.012	-0.201	-0.035
	p	0.204	0.19	0.51	0.995	0.682	0.682	0.556	0.902	0.716	0.388	0.369	0.277	0.266	0.029	0.99	.	0.579	0.754	0.95	0.279	0.851
Peak arm velocity as. (%)	r	0.258	0.045	-0.154	0.245	-0.169	0.169	0.385*	0.377*	0.336	-0.001	0.382*	-0.105	-0.117	-0.307	-0.21	0.104	1	0.172	0.283	0.045	0.239
	p	0.162	0.809	0.407	0.184	0.362	0.362	0.033	0.036	0.064	0.995	0.034	0.575	0.532	0.093	0.257	0.579	.	0.356	0.122	0.811	0.195
RoM trunk sagit. (degrees)	r	0.055	0.033	-0.153	0.113	-0.271	0.271	0.309	0.414*	0.429*	0.189	0.089	0.21	0.161	-0.097	0.006	-0.059	0.172	1	0.691**	-0.033	-0.072
	p	0.771	0.858	0.41	0.545	0.14	0.14	0.091	0.021	0.016	0.308	0.636	0.257	0.387	0.603	0.975	0.754	0.356	.	<0.001	0.861	0.7

Peak sagit. trunk velocity (degrees/s)	r	0.098	0.286	0.229	-0.142	0.002	-0.002	-0.015	0.223	0.063	-0.189	-0.159	-0.183	-0.202	-0.048	0.211	0.012	0.283	0.691**	1	-0.063	0.05
	p	0.601	0.118	0.215	0.446	0.991	0.991	0.937	0.227	0.738	0.308	0.394	0.323	0.276	0.798	0.254	0.95	0.122	<0.001	.	0.738	0.788
RoM trunk horiz. (degrees)	r	-0.215	-0.174	-0.064	0.034	0.069	-0.069	0.028	0.189	0.148	0.146	0.025	0.167	0.233	0.103	0.255	-0.201	0.045	-0.033	-0.063	1	0.742**
	p	0.245	0.349	0.732	0.857	0.714	0.714	0.88	0.308	0.427	0.433	0.892	0.37	0.207	0.583	0.165	0.279	0.811	0.861	0.738	.	<0.001
Peak horiz. trunk velocity (degrees/s)	r	-0.138	-0.143	0.119	-0.045	0.045	-0.045	0.127	0.244	0.065	0.19	0.143	0.135	0.169	-0.156	0.23	-0.035	0.239	-0.072	0.05	0.742**	1
	p	0.459	0.444	0.524	0.811	0.809	0.809	0.495	0.185	0.727	0.306	0.444	0.47	0.362	0.402	0.213	0.851	0.195	0.7	0.788	<0.001	.

as., asymmetry; va., variation; RoM, range of motion; sagit., sagittal; horiz. horizontal. \*p<0.05, \*\*p<0.01.



**Supplementary Table 5.** Spearman's correlation for the relationships between all gait parameters during fast walking condition and the UPDRSIII score for all iRBD patients.

		UPDRSII	Stride length (%stature)	Stride velocity (%stature/s)	Stride time (s)	Swing (%)	Stance (%)	Stride length va.	Stride time va.	Stride velocity va.	Stride length as.(%)	Swing as. (%)	Stance as.(%)	Swing va.	RoM arm (degrees)	Peak arm velocity (degrees/s)	RoM arm va. (degrees)	Peak arm velocity as.(%)	RoM trunk sagit. (degrees)	Peak sagit. trunk velocity (degrees/s)	RoM trunk horiz. (degrees)	Peak horiz. trunk velocity (degrees/s)
UPDRSIII	r	1	-0.175	-0.241	0.118	-0.13	0.13	0.057	0.21	0.055	0.038	0.334	-0.089	-0.144	-0.411*	-0.452*	-0.024	0.183	0.014	0.119	-0.232	-0.132
	p	.	0.345	0.191	0.527	0.487	0.487	0.762	0.256	0.771	0.839	0.067	0.635	0.441	0.022	0.011	0.897	0.324	0.941	0.525	0.21	0.48
Stride length (%stature)	r	-0.175	1	0.400*	0.161	-0.360*	0.360*	-0.469**	-0.152	-0.371*	-0.175	-0.204	-0.098	-0.147	0.443*	0.319	-0.460**	0.055	0.063	0.141	-0.086	-0.154
	p	0.345	.	0.026	0.386	0.047	0.047	0.008	0.413	0.04	0.348	0.272	0.602	0.431	0.013	0.08	0.009	0.768	0.737	0.45	0.644	0.409
Stride velocity (%stature/s)	r	-0.241	0.400*	1	-0.772**	0.418*	-0.418*	-0.564**	0.067	-0.321	-0.385*	-0.299	-0.460**	-0.436*	0.189	0.723**	0.087	0.113	0.03	0.488**	-0.012	0.254
	p	0.191	0.026	.	<0.001	0.019	0.019	<0.001	0.719	0.078	0.032	0.102	0.009	0.014	0.308	<0.001	0.643	0.547	0.872	0.005	0.95	0.168
Stride time (seconds)	r	0.118	0.161	-0.772**	1	-0.746**	0.746**	0.345	-0.108	0.155	0.303	0.194	0.400*	0.355	-0.047	-0.566**	-0.247	0.051	-0.091	-0.548**	0.075	-0.228
	p	0.527	0.386	<0.001	.	<0.001	<0.001	0.057	0.564	0.406	0.098	0.296	0.026	0.05	0.801	<0.001	0.181	0.784	0.627	0.001	0.689	0.218
Swing (%)	r	-0.13	-0.360*	0.418*	-0.746**	1	-1.000**	-0.086	0.112	-0.097	-0.229	-0.052	-0.464**	-0.390*	0.069	0.327	0.231	-0.071	0.007	0.435*	0	0.158
	p	0.487	0.047	0.019	<0.001	.	.	0.646	0.548	0.603	0.216	0.781	0.009	0.03	0.711	0.073	0.21	0.706	0.971	0.014	0.998	0.396
Stance (%)	r	0.13	0.360*	-0.418*	0.746**	-1.000**	1	0.086	-0.112	0.097	0.229	0.052	0.464**	0.390*	-0.069	-0.327	-0.231	0.071	-0.007	-0.435*	0	-0.158
	p	0.487	0.047	0.019	<0.001	.	.	0.646	0.548	0.603	0.216	0.781	0.009	0.03	0.711	0.073	0.21	0.706	0.971	0.014	0.998	0.396
Stride length va.	r	0.057	-0.469**	-0.564**	0.345	-0.086	0.086	1	0.402*	0.623**	0.653**	0.542**	0.401*	0.437*	-0.285	-0.357*	0.199	0.042	0.146	-0.16	-0.039	0.165
	p	0.762	0.008	<0.001	0.057	0.646	0.646	.	0.025	<0.001	<0.001	0.002	0.025	0.014	0.121	0.049	0.283	0.824	0.432	0.391	0.835	0.374
Stride time va.	r	0.21	-0.152	0.067	-0.108	0.112	-0.112	0.402*	1	0.690**	0.364*	0.484**	-0.019	-0.024	-0.25	-0.198	0.343	0.345	0.229	0.239	-0.177	0.32
	p	0.256	0.413	0.719	0.564	0.548	0.548	0.025	.	<0.001	0.044	0.006	0.918	0.899	0.174	0.285	0.059	0.057	0.216	0.196	0.34	0.079
Stride velocity va.	r	0.055	-0.371*	-0.321	0.155	-0.097	0.097	0.623**	0.690**	1	0.407*	0.367*	0.268	0.267	-0.284	-0.295	0.376*	0.152	0.231	-0.033	0.062	0.295
	p	0.771	0.04	0.078	0.406	0.603	0.603	<0.001	<0.001	.	0.023	0.042	0.145	0.147	0.122	0.107	0.037	0.414	0.21	0.858	0.74	0.107

Swing va.	r	0.038	-0.175	-0.385*	0.303	-0.229	0.229	0.653**	0.364*	0.407*	1	0.505**	0.468**	0.475**	-0.01	-0.244	-0.114	-0.169	0.253	-0.011	-0.058	0.04
	p	0.839	0.348	0.032	0.098	0.216	0.216	<0.001	0.044	0.023	.	0.004	0.008	0.007	0.955	0.186	0.542	0.365	0.169	0.952	0.756	0.833
Stride length as. (%)	r	0.334	-0.204	-0.299	0.194	-0.052	0.052	0.542**	0.484**	0.367*	0.505**	1	0.265	0.265	-0.372*	-0.346	0.226	0.161	0.302	0.141	-0.226	0.02
	p	0.067	0.272	0.102	0.296	0.781	0.781	0.002	0.006	0.042	0.004	.	0.149	0.15	0.039	0.057	0.222	0.387	0.099	0.45	0.222	0.916
Swing as. (%)	r	-0.089	-0.098	-0.460**	0.400*	-0.464**	0.464**	0.401*	-0.019	0.268	0.468**	0.265	1	.988**	-0.031	-0.267	-0.116	-0.116	0.19	-0.151	0.129	0.053
	p	0.635	0.602	0.009	0.026	0.009	0.009	0.025	0.918	0.145	0.008	0.149	.	<0.001	0.867	0.147	0.535	0.535	0.307	0.417	0.488	0.778
Stance as. (%)	r	-0.144	-0.147	-0.436*	0.355	-0.390*	0.390*	0.437*	-0.024	0.267	0.475**	0.265	0.988**	1	0.001	-0.222	-0.094	-0.14	0.199	-0.128	0.162	0.083
	p	0.441	0.431	0.014	0.05	0.03	0.03	0.014	0.899	0.147	0.007	0.15	<0.001	.	0.995	0.231	0.615	0.452	0.283	0.492	0.384	0.655
RoM Arm (degrees)	r	-0.411*	0.443*	0.189	-0.047	0.069	-0.069	-0.285	-0.25	-0.284	-0.01	-0.372*	-0.031	0.001	1	0.376*	-0.612**	-0.431*	0.158	0.202	0.202	-0.11
	p	0.022	0.013	0.308	0.801	0.711	0.711	0.121	0.174	0.122	0.955	0.039	0.867	0.995	.	0.037	<0.001	0.015	0.397	0.277	0.275	0.557
Peak arm velocity (degrees/sec)	r	-0.452*	0.319	0.723**	-0.566**	0.327	-0.327	-0.357*	-0.198	-0.295	-0.244	-0.346	-0.267	-0.222	0.376*	1	0.155	-0.077	0.04	0.486**	0.217	0.382*
	p	0.011	0.08	<0.001	<0.001	0.073	0.073	0.049	0.285	0.107	0.186	0.057	0.147	0.231	0.037	.	0.406	0.679	0.831	0.006	0.24	0.034
RoM Arm va. (degrees)	r	-0.024	-0.460**	0.087	-0.247	0.231	-0.231	0.199	0.343	0.376*	-0.114	0.226	-0.116	-0.094	-0.612**	0.155	1	0.438*	-0.098	0.045	-0.019	0.390*
	p	0.897	0.009	0.643	0.181	0.21	0.21	0.283	0.059	0.037	0.542	0.222	0.535	0.615	<0.001	0.406	.	0.014	0.602	0.811	0.921	0.03
Peak arm velocity as. (%)	r	0.183	0.055	0.113	0.051	-0.071	0.071	0.042	0.345	0.152	-0.169	0.161	-0.116	-0.14	-0.431*	-0.077	0.438*	1	-0.055	0.074	0.053	0.223
	p	0.324	0.768	0.547	0.784	0.706	0.706	0.824	0.057	0.414	0.365	0.387	0.535	0.452	0.015	0.679	0.014	.	0.768	0.693	0.776	0.227
RoM trunk sagit. (degrees)	r	0.014	0.063	0.03	-0.091	0.007	-0.007	0.146	0.229	0.231	0.253	0.302	0.19	0.199	0.158	0.04	-0.098	-0.055	1	0.592**	-0.003	0.161
	p	0.941	0.737	0.872	0.627	0.971	0.971	0.432	0.216	0.21	0.169	0.099	0.307	0.283	0.397	0.831	0.602	0.768	.	<0.001	0.988	0.387
Peak sagit. trunk velocity (degrees/sec)	r	0.119	0.141	0.488**	-0.548**	0.435*	-0.435*	-0.16	0.239	-0.033	-0.011	0.141	-0.151	-0.128	0.202	0.486**	0.045	0.074	0.592**	1	0.017	0.29
	p	0.525	0.45	0.005	0.001	0.014	0.014	0.391	0.196	0.858	0.952	0.45	0.417	0.492	0.277	0.006	0.811	0.693	<0.001	.	0.928	0.114
RoM trunk horiz. (degrees)	r	-0.232	-0.086	-0.012	0.075	0	0	-0.039	-0.177	0.062	-0.058	-0.226	0.129	0.162	0.202	0.217	-0.019	0.053	-0.003	0.017	1	0.656**
	p	0.21	0.644	0.95	0.689	0.998	0.998	0.835	0.34	0.74	0.756	0.222	0.488	0.384	0.275	0.24	0.921	0.776	0.988	0.928	.	<0.001

Peak horiz.	r	-0.132	-0.154	0.254	-0.228	0.158	-0.158	0.165	0.32	0.295	0.04	0.02	0.053	0.083	-0.11	0.382*	0.390*	0.223	0.161	0.29	0.656**	1
trunk velocity	p	0.48	0.409	0.168	0.218	0.396	0.396	0.374	0.079	0.107	0.833	0.916	0.778	0.655	0.557	0.034	0.03	0.227	0.387	0.114	<0.001	.

as., asymmetry; va., variation; RoM, range of motion; sagit., sagittal; horiz. horizontal. \*p<0.05, \*\*p<0.01.

**Supplementary Table 6.** Spearman's correlation for the relationships between all gait parameters during dual-task walking condition and the UPDRSIII score for all iRBD patients.

		UPDRS III	Stride length (%stature)	Stride velocity (%stature/s)	Stride time (s)	Swing (%)	Stance (%)	Stride length va.	Stride time va.	Stride velocity va.	Stride length as.(%)	Swing as.(%)	Stance as.(%)	Swing va.	RoM arm (degrees)	Peak arm velocity (degrees/s)	RoM arm va. (degrees)	Peak arm velocity as.(%)	RoM trunk sagit.(degre es)	Peak sagit. trunk velocity (degrees/s)	RoM trunk horiz. (degrees)	Peak horiz. trunk velocity (degrees/s)
UPDRSIII	r	1	-0.22	-0.343	0.253	-0.126	0.126	.357*	0.333	0.374*	0.132	0.137	0.118	0.058	-0.339	-0.435*	0.11	0.297	0.171	0.097	0.092	-0.063
	p	.	0.234	0.059	0.169	0.499	0.499	0.049	0.067	0.038	0.479	0.463	0.528	0.756	0.062	0.015	0.558	0.105	0.358	0.605	0.622	0.738
Stride length (%stature)	r	-0.22	1	0.451*	0.023	-0.107	0.107	-0.461**	-0.370*	-0.387*	-0.367*	-0.371**	-0.099	-0.14	0.423*	0.254	-0.208	-0.034	0.049	0.256	0.005	0.085
	p	0.234	.	0.011	0.904	0.566	0.566	0.009	0.041	0.031	0.043	0.04	0.595	0.453	0.018	0.167	0.26	0.855	0.793	0.164	0.978	0.648
Stride velocity (%stature/s)	r	-0.343	0.451*	1	-0.838**	0.565**	-0.565**	-0.517**	-0.568**	-0.497**	-0.449*	-0.520**	-0.535**	-0.532**	0.245	0.601**	-0.242	-0.229	-0.082	0.407*	-0.147	0.192
	p	0.059	0.011	.	<0.001	<0.001	<0.001	0.003	<0.001	0.004	0.011	0.003	0.002	0.002	0.184	<0.001	0.191	0.215	0.66	0.023	0.431	0.301
Stride time (s)	r	0.253	0.023	-0.838**	1	-0.786**	0.786**	0.31	.479**	0.377*	0.324	0.456**	0.602**	0.558**	0.021	-0.478**	0.148	0.257	0.22	-0.231	0.223	-0.114
	p	0.169	0.904	<0.001	.	<0.001	<0.001	0.09	0.006	0.037	0.075	0.01	<0.001	0.001	0.909	0.007	0.427	0.163	0.235	0.211	0.228	0.541
Swing (%)	r	-0.126	-0.107	0.565**	-0.786**	1	-1.000**	-0.183	-0.387*	-0.34	-0.301	-0.324	-0.548**	-0.458**	-0.022	0.365*	-0.158	-0.124	-0.246	0.231	-0.044	0.233
	p	0.499	0.566	<0.001	<0.001	.	.	0.323	0.031	0.061	0.1	0.076	0.001	0.01	0.907	0.044	0.397	0.507	0.183	0.21	0.814	0.206
Stance (%)	r	0.126	0.107	-0.565**	0.786**	-1.000**	1	0.183	0.387*	0.34	0.301	0.324	0.548**	0.458**	0.022	-0.365*	0.158	0.124	0.246	-0.231	0.044	-0.233
	p	0.499	0.566	<0.001	<0.001	.	.	0.323	0.031	0.061	0.1	0.076	0.001	0.01	0.907	0.044	0.397	0.507	0.183	0.21	0.814	0.206
Stride length va.	r	0.357*	-0.461**	-0.517**	0.31	-0.183	0.183	1	0.677**	0.885**	0.713**	0.717**	0.515**	0.502**	-0.541**	-0.395*	0.398*	0.498**	0.183	-0.165	0.146	0.11
	p	0.049	0.009	0.003	0.09	0.323	0.323	.	<0.001	<0.001	<0.001	<0.001	0.003	0.004	0.002	0.028	0.027	0.004	0.325	0.374	0.432	0.554
Stride time va.	r	0.333	-0.370*	-0.568**	0.479**	-0.387*	0.387*	0.677**	1	0.827**	0.691**	0.506**	0.594**	0.570**	-0.244	-0.416*	0.434*	0.492**	0.390*	-0.111	0.142	0.024
	p	0.067	0.041	<0.001	0.006	0.031	0.031	<0.001	.	<0.001	<0.001	0.004	<0.001	<0.001	0.186	0.02	0.015	0.005	0.03	0.551	0.448	0.899
Stride velocity va.	r	0.374*	-0.387*	-0.497**	0.377*	-0.34	0.34	0.885**	0.827**	1	0.709**	0.671**	0.579**	0.546**	-0.551**	-0.450*	0.444*	0.493**	0.297	-0.148	0.202	0.12
	p	0.038	0.031	0.004	0.037	0.061	0.061	<0.001	<0.001	.	<0.001	<0.001	<0.001	0.001	0.001	0.011	0.012	0.005	0.105	0.426	0.277	0.521

Swing va.	r	0.132	-0.367*	-0.449*	0.324	-0.301	0.301	0.713**	0.691**	0.709**	1	0.550**	0.650**	0.656**	-0.319	-0.385*	0.458**	0.467**	0.227	-0.144	0.061	0.113
	p	0.479	0.043	0.011	0.075	0.1	0.1	<0.001	<0.001	<0.001	.	0.001	<0.001	<0.001	0.081	0.032	0.01	0.008	0.22	0.438	0.743	0.544
Stride length as. (%)	r	0.137	-0.371*	-0.520**	0.456**	-0.324	0.324	0.717**	0.506**	0.671**	0.550**	1	0.573**	0.564**	-0.430*	-0.212	0.477**	0.440*	0.111	-0.067	0.102	0.092
	p	0.463	0.04	0.003	0.01	0.076	0.076	<0.001	0.004	<0.001	0.001	.	<0.001	<0.001	0.016	0.252	0.007	0.013	0.553	0.721	0.586	0.623
Swing as. (%)	r	0.118	-0.099	-0.535**	0.602**	-0.548**	0.548**	0.515**	0.594**	0.579**	0.650**	0.573**	1	0.986**	0.029	-0.271	0.314	0.33	0.417*	-0.1	0.211	0.158
	p	0.528	0.595	0.002	<0.001	0.001	0.001	0.003	<0.001	<0.001	<0.001	<0.001	.	<0.001	0.877	0.141	0.085	0.07	0.02	0.592	0.255	0.396
Stance as. (%)	r	0.058	-0.14	-0.532**	0.558**	-0.458**	0.458**	0.502**	0.570**	0.546**	0.656**	0.564**	0.986**	1	0.058	-0.258	0.331	0.294	0.386*	-0.113	0.197	0.156
	p	0.756	0.453	0.002	0.001	0.01	0.01	0.004	<0.001	0.001	<0.001	<0.001	<0.001	.	0.755	0.162	0.069	0.109	0.032	0.545	0.288	0.401
RoM Arm (degrees)	r	-0.339	0.423*	0.245	0.021	-0.022	0.022	-0.541**	-0.244	-0.551**	-0.319	-0.430*	0.029	0.058	1	0.435*	-0.348	-0.213	0.17	0.223	-0.012	0.001
	p	0.062	0.018	0.184	0.909	0.907	0.907	0.002	0.186	0.001	0.081	0.016	0.877	0.755	.	0.014	0.055	0.249	0.361	0.228	0.947	0.997
Peak arm velocity (degrees/s)	r	-0.435*	0.254	0.601**	-0.478**	0.365*	-0.365*	-0.395*	-0.416*	-0.450*	-0.385*	-0.212	-0.271	-0.258	0.435*	1	-0.062	-0.131	0.154	0.379*	0.111	0.339
	p	0.015	0.167	<0.001	0.007	0.044	0.044	0.028	0.02	0.011	0.032	0.252	0.141	0.162	0.014	.	0.742	0.484	0.409	0.036	0.553	0.062
RoM Arm va. (degrees)	r	0.11	-0.208	-0.242	0.148	-0.158	0.158	0.398*	0.434*	0.444*	0.458**	0.477**	0.314	0.331	-0.348	-0.062	1	0.239	0.273	0.083	-0.045	0.126
	p	0.558	0.26	0.191	0.427	0.397	0.397	0.027	0.015	0.012	0.01	0.007	0.085	0.069	0.055	0.742	.	0.195	0.138	0.658	0.809	0.5
Peak arm velocity as. (%)	r	0.297	-0.034	-0.229	0.257	-0.124	0.124	0.498**	0.492**	0.493**	0.467**	0.440*	0.33	0.294	-0.213	-0.131	0.239	1	0.231	0.164	0.153	0.146
	p	0.105	0.855	0.215	0.163	0.507	0.507	0.004	0.005	0.005	0.008	0.013	0.07	0.109	0.249	0.484	0.195	.	0.211	0.379	0.412	0.435
RoM trunk sagit. (degrees)	r	0.171	0.049	-0.082	0.22	-0.246	0.246	0.183	0.390*	0.297	0.227	0.111	0.417*	0.386*	0.17	0.154	0.273	0.231	1	0.517**	0.126	0.161
	p	0.358	0.793	0.66	0.235	0.183	0.183	0.325	0.03	0.105	0.22	0.553	0.02	0.032	0.361	0.409	0.138	0.211	.	0.003	0.5	0.386
Peak sagit. trunk velocity (degrees/s)	r	0.097	0.256	0.407*	-0.231	0.231	-0.231	-0.165	-0.111	-0.148	-0.144	-0.067	-0.1	-0.113	0.223	0.379*	0.083	0.164	0.517**	1	-0.017	0.213
	p	0.605	0.164	0.023	0.211	0.21	0.21	0.374	0.551	0.426	0.438	0.721	0.592	0.545	0.228	0.036	0.658	0.379	0.003	.	0.93	0.25

RoM trunk horiz.	r	0.092	0.005	-0.147	0.223	-0.044	0.044	0.146	0.142	0.202	0.061	0.102	0.211	0.197	-0.012	0.111	-0.045	0.153	0.126	-0.017	1	0.722**
(degrees)	p	0.622	0.978	0.431	0.228	0.814	0.814	0.432	0.448	0.277	0.743	0.586	0.255	0.288	0.947	0.553	0.809	0.412	0.5	0.93	.	<0.001
Peak horiz. trunk velocity	r	-0.063	0.085	0.192	-0.114	0.233	-0.233	0.11	0.024	0.12	0.113	0.092	0.158	0.156	0.001	0.339	0.126	0.146	0.161	0.213	0.722**	1
(degrees/s)	p	0.738	0.648	0.301	0.541	0.206	0.206	0.554	0.899	0.521	0.544	0.623	0.396	0.401	0.997	0.062	0.5	0.435	0.386	0.25	<0.001	.

as., asymmetry; va., variation; RoM, range of motion; sagit., sagittal; horiz. horizontal. \*p<0.05, \*\*p<0.01.