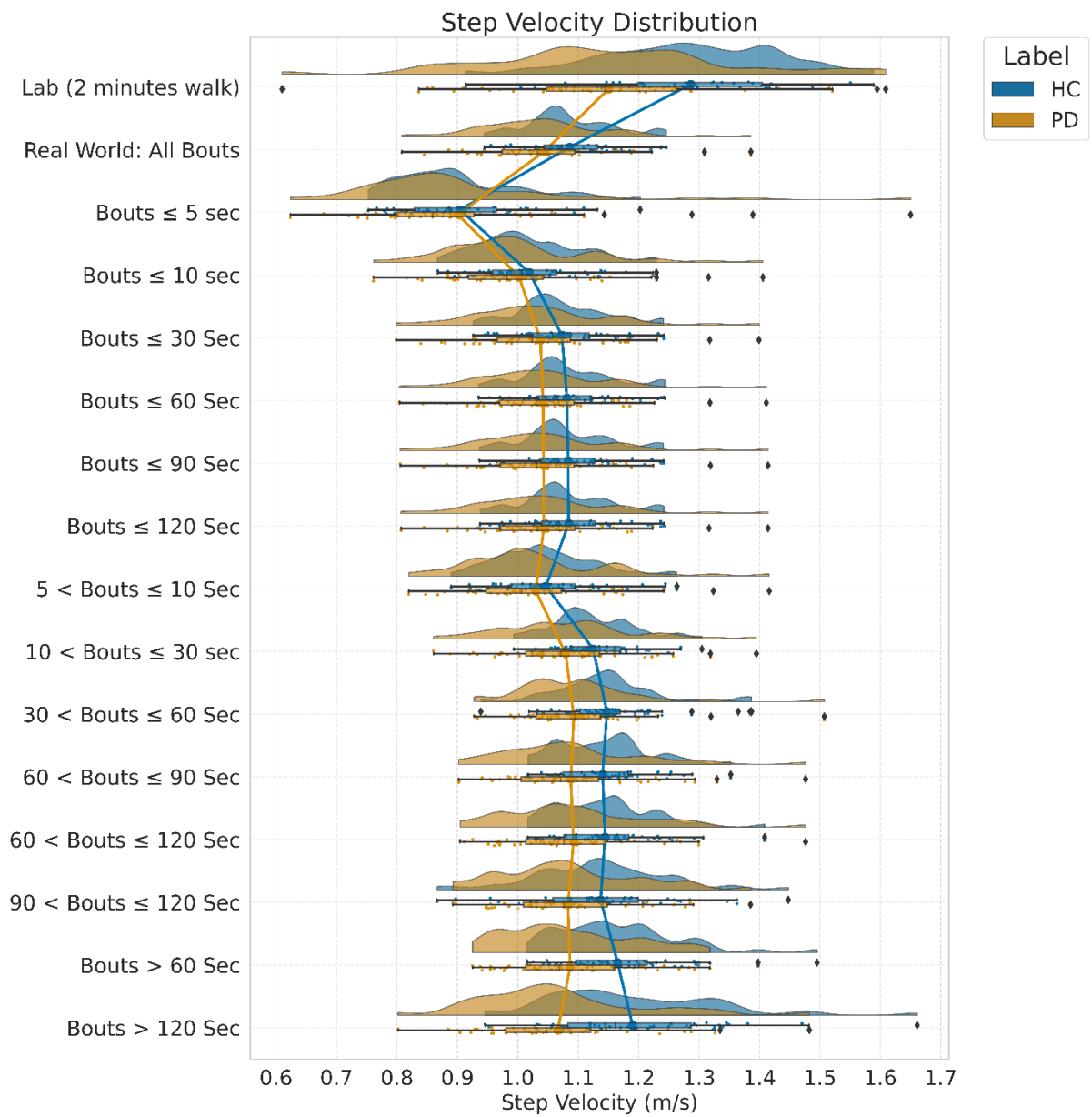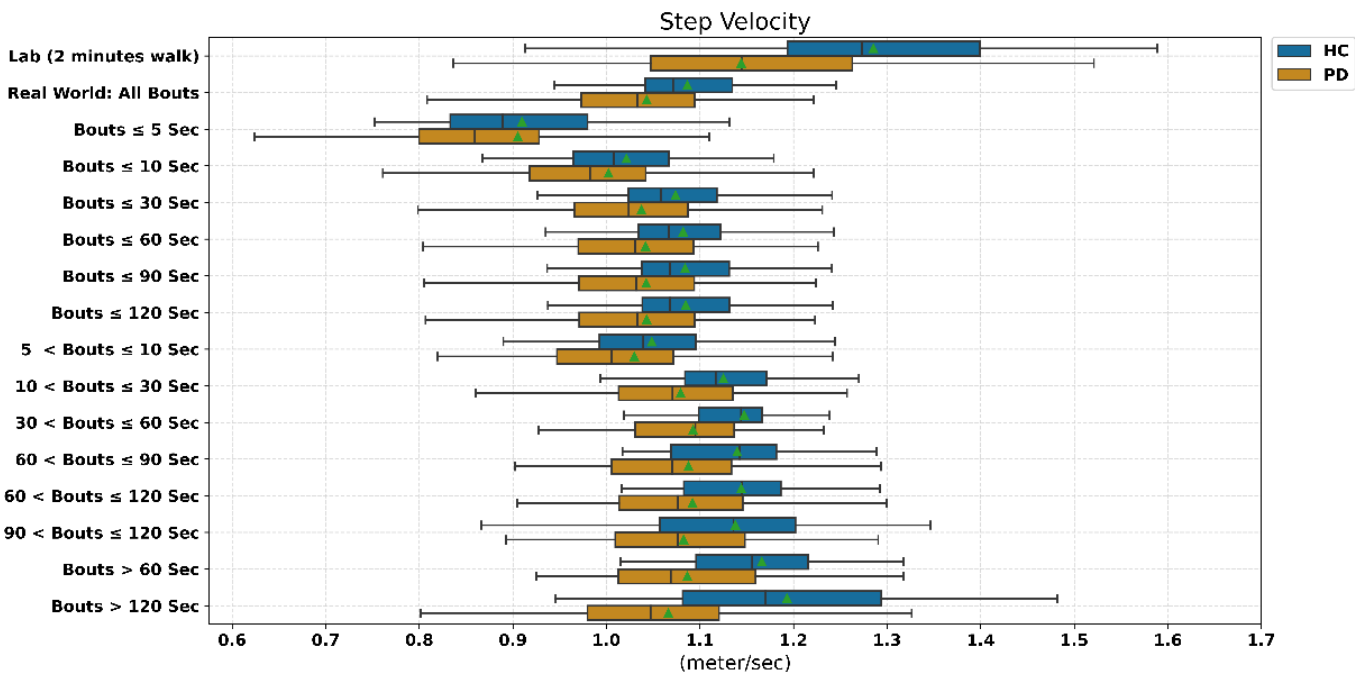# *Supplementary Material*

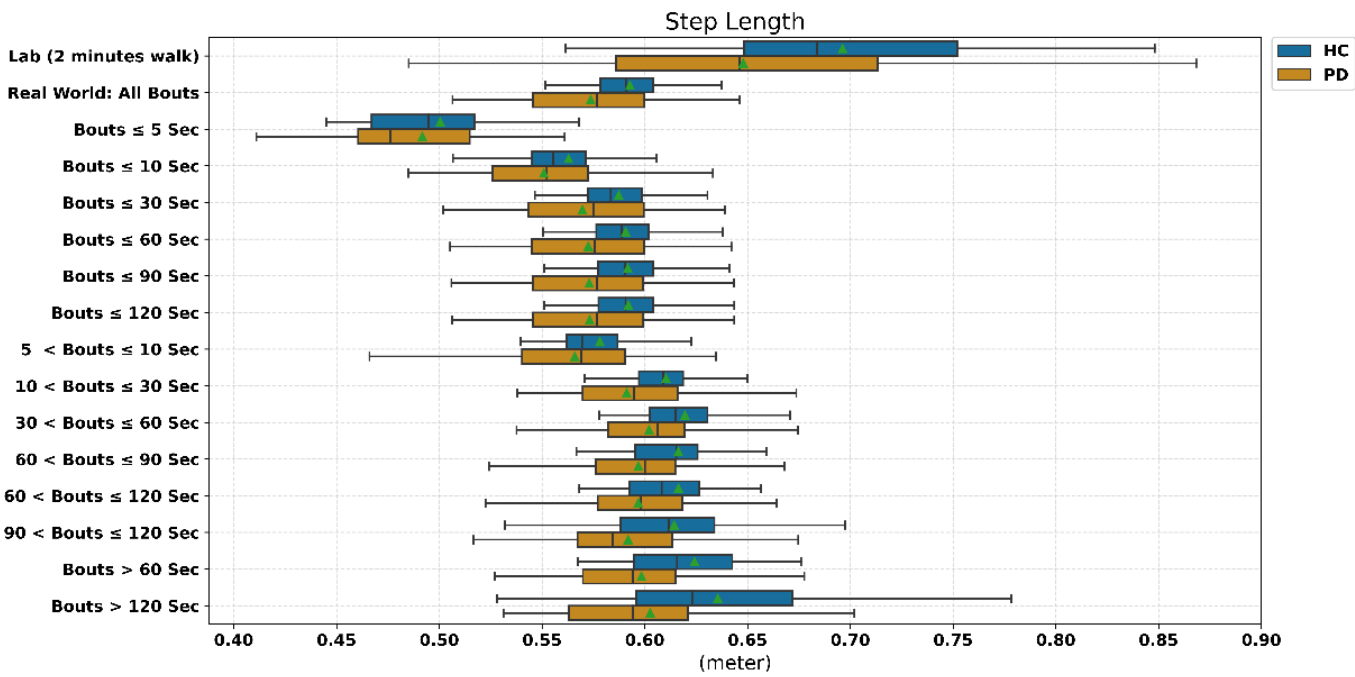**Supplementary Figure 1.** Distribution of step velocity (m/s) into different WB thresholds followed by average of 7 days

(A)

Step Velocity

(B)

Step Length

(C)

Swing Time Variability

(Sec)

(D)

Step Time

(Sec)

(E)

Stance Time

(F)

Swing Time

(G)

Step Time Variability

(H)

Step Length Variability

(I)

Step Velocity Variability

(J)

Stance Time Variability

(K)

Step Time Asymmetry

(L)

Swing Time Asymmetry

(M)

Stance Time Asymmetry

(N)

Step Length Asymmetry
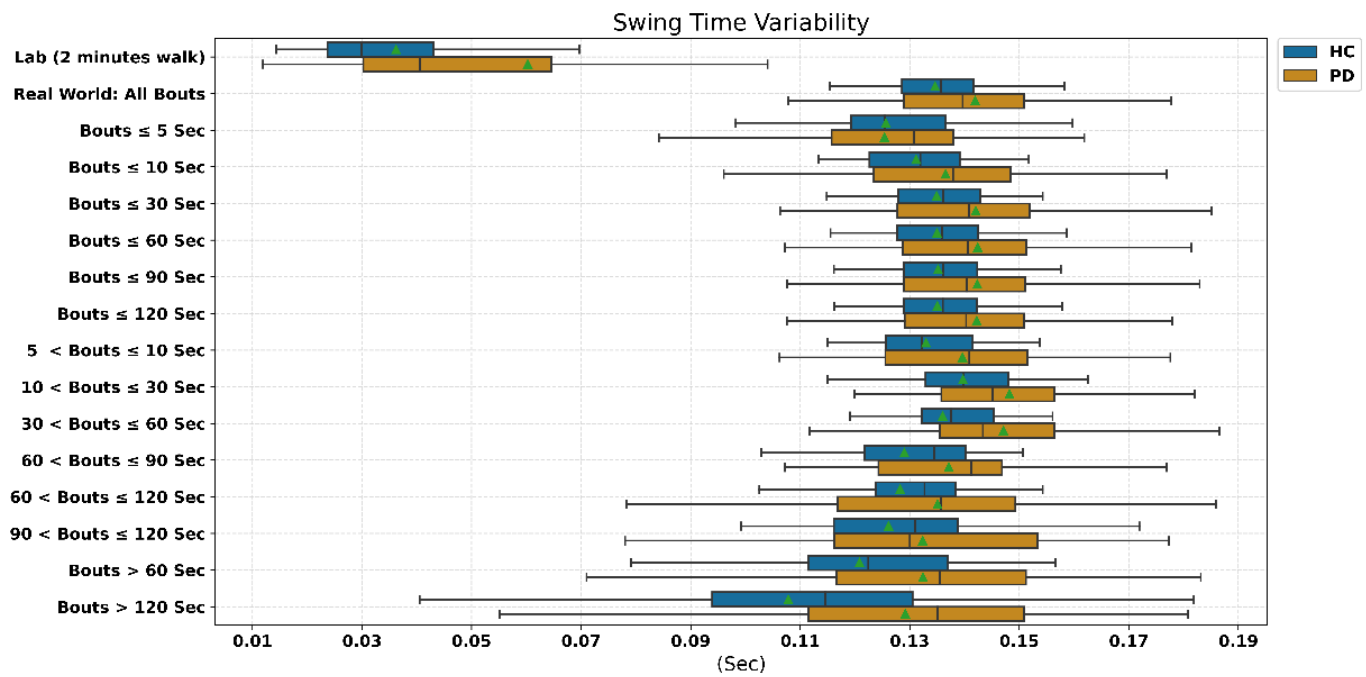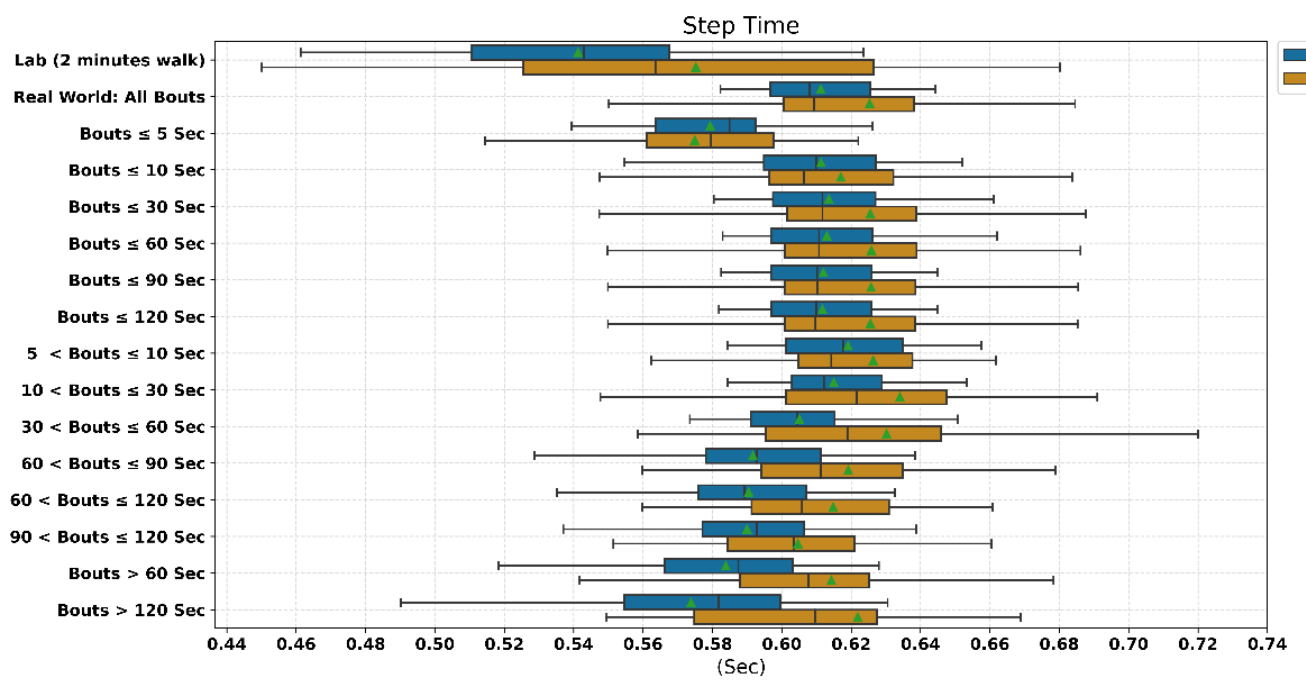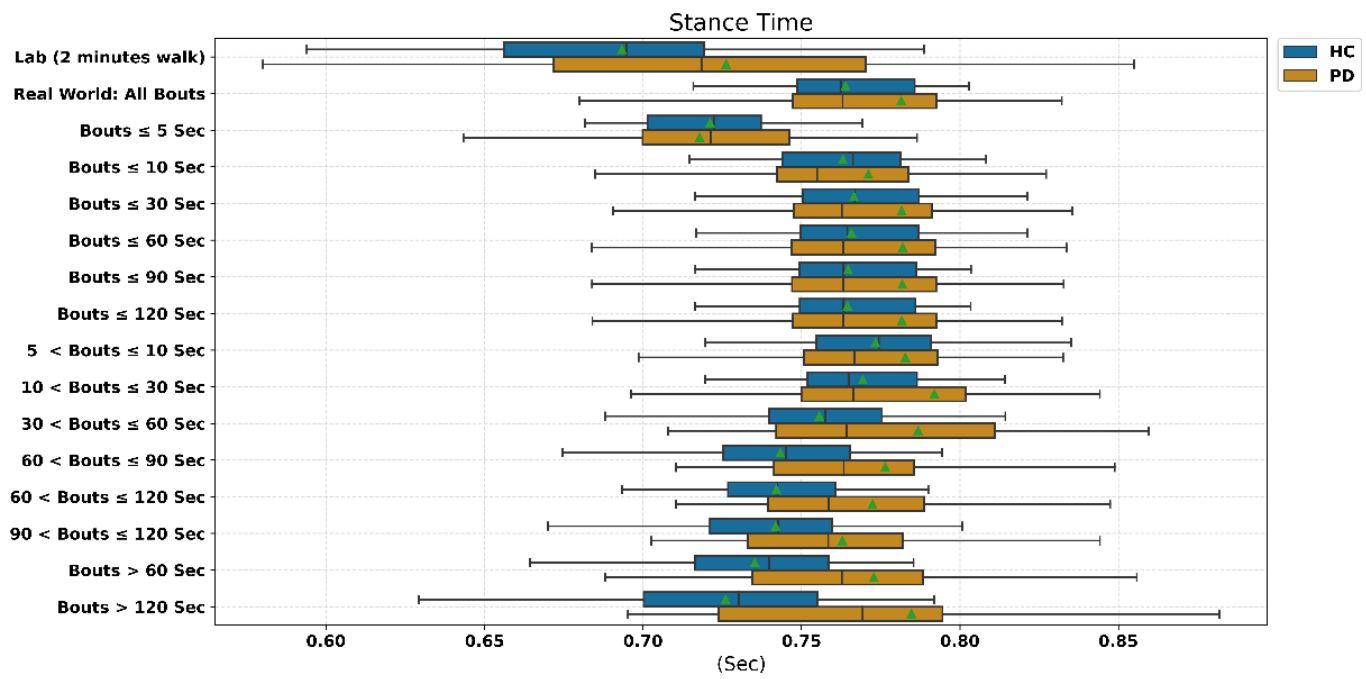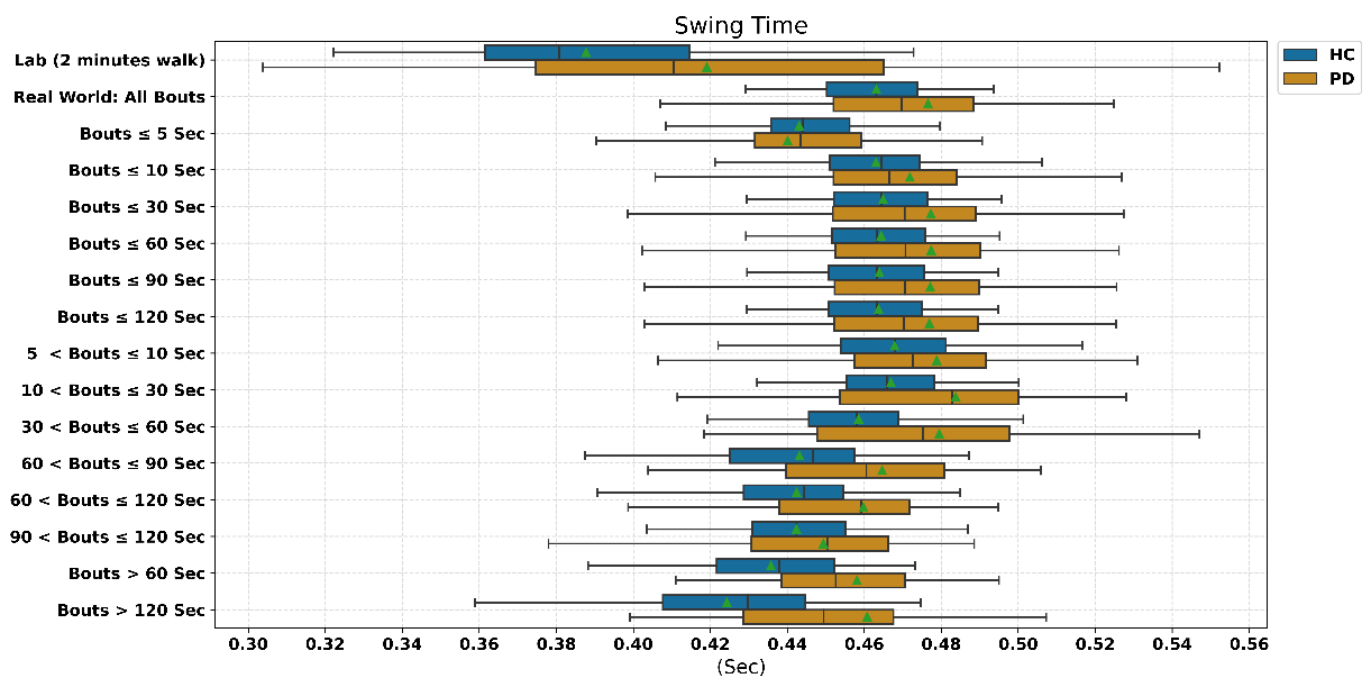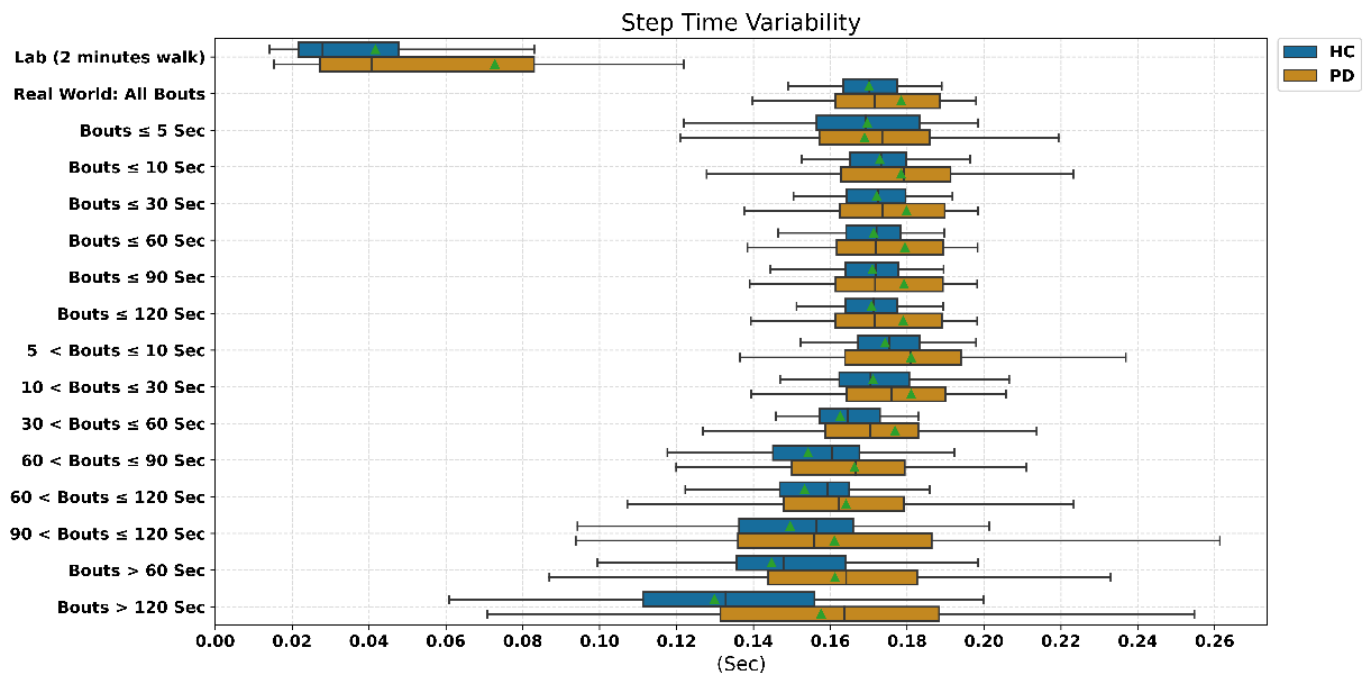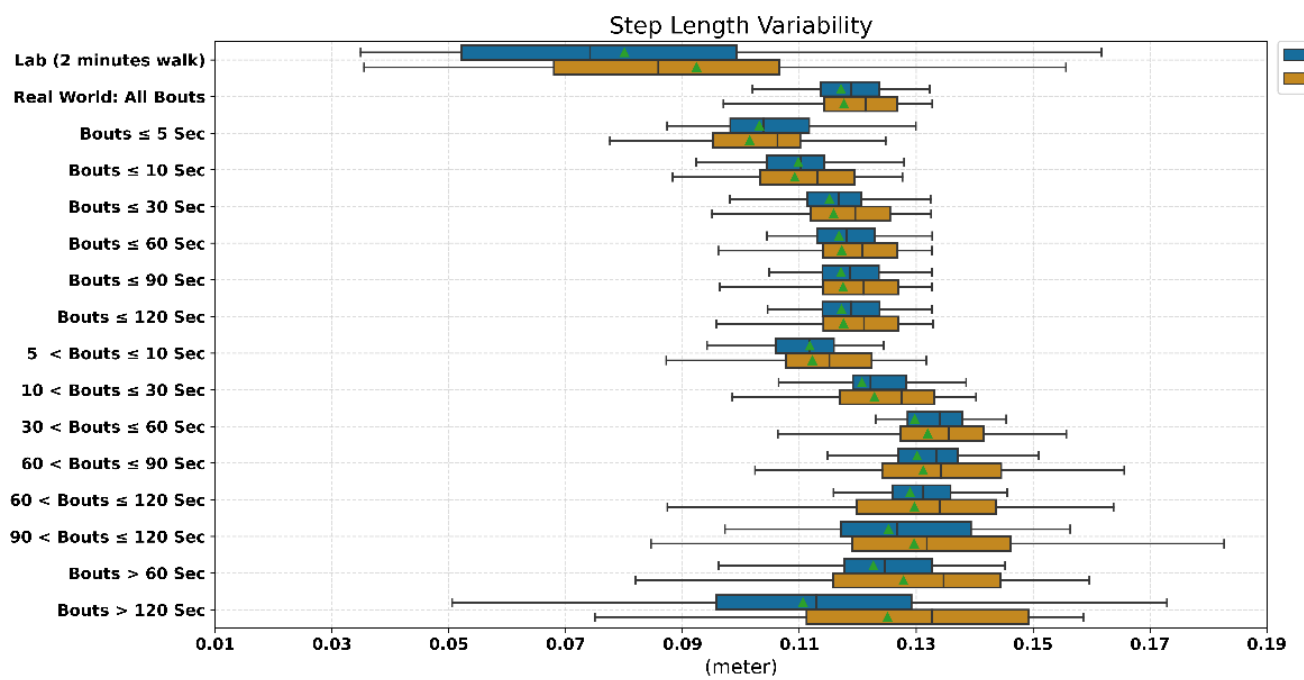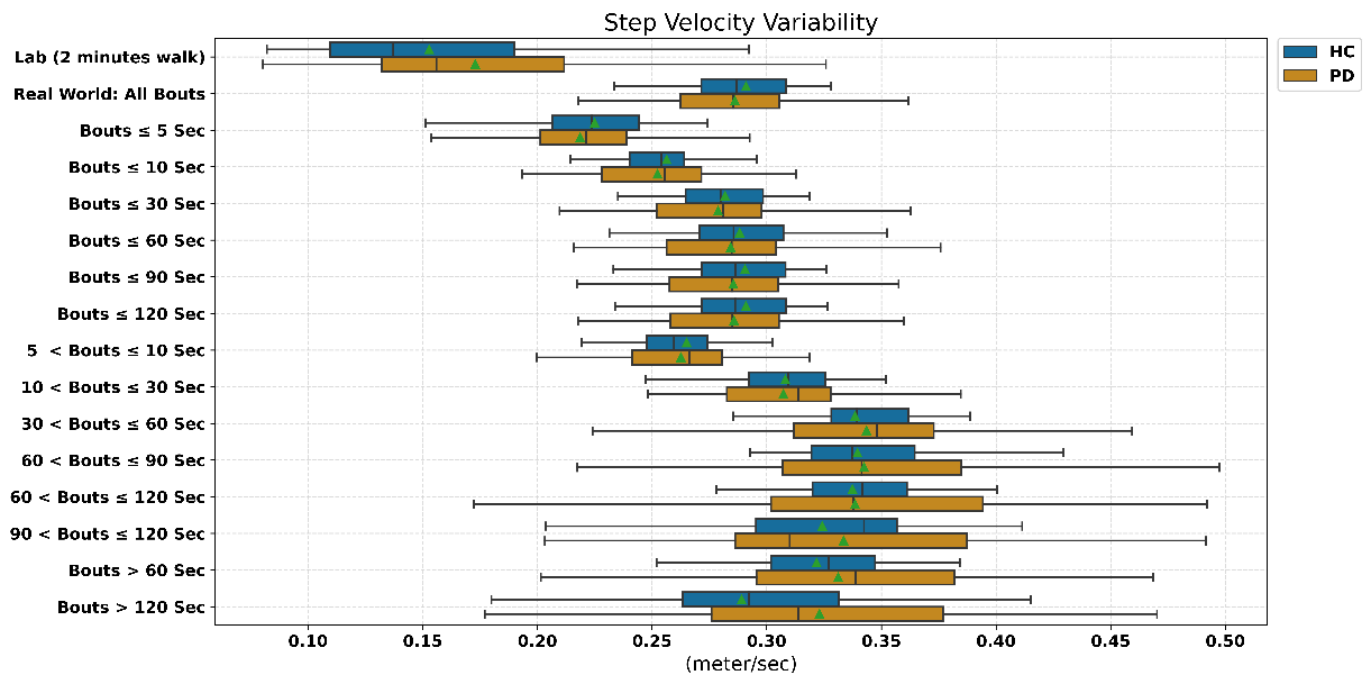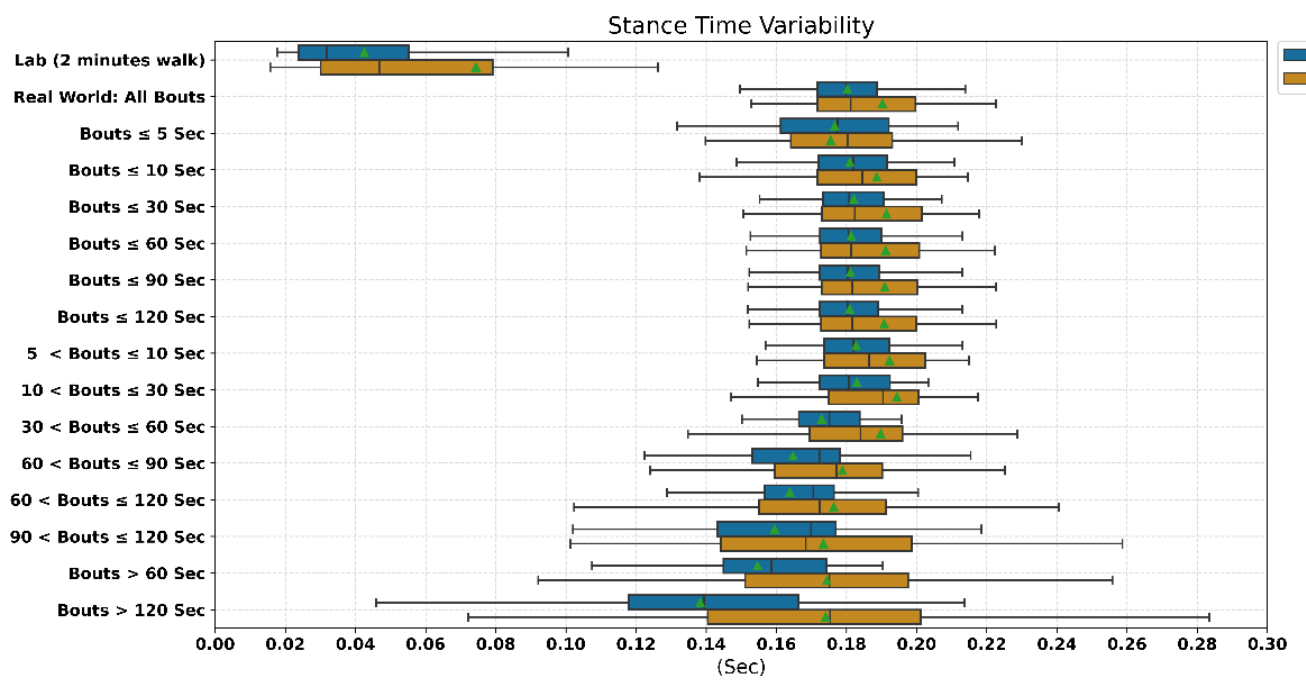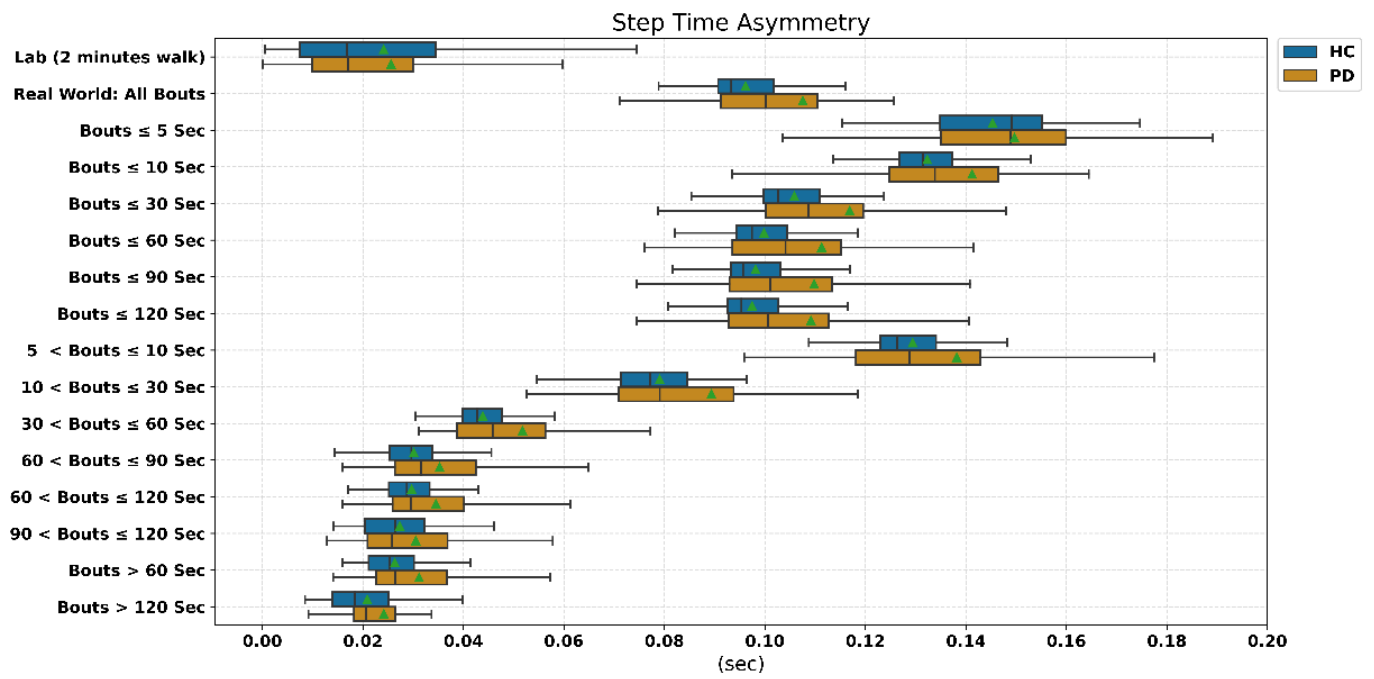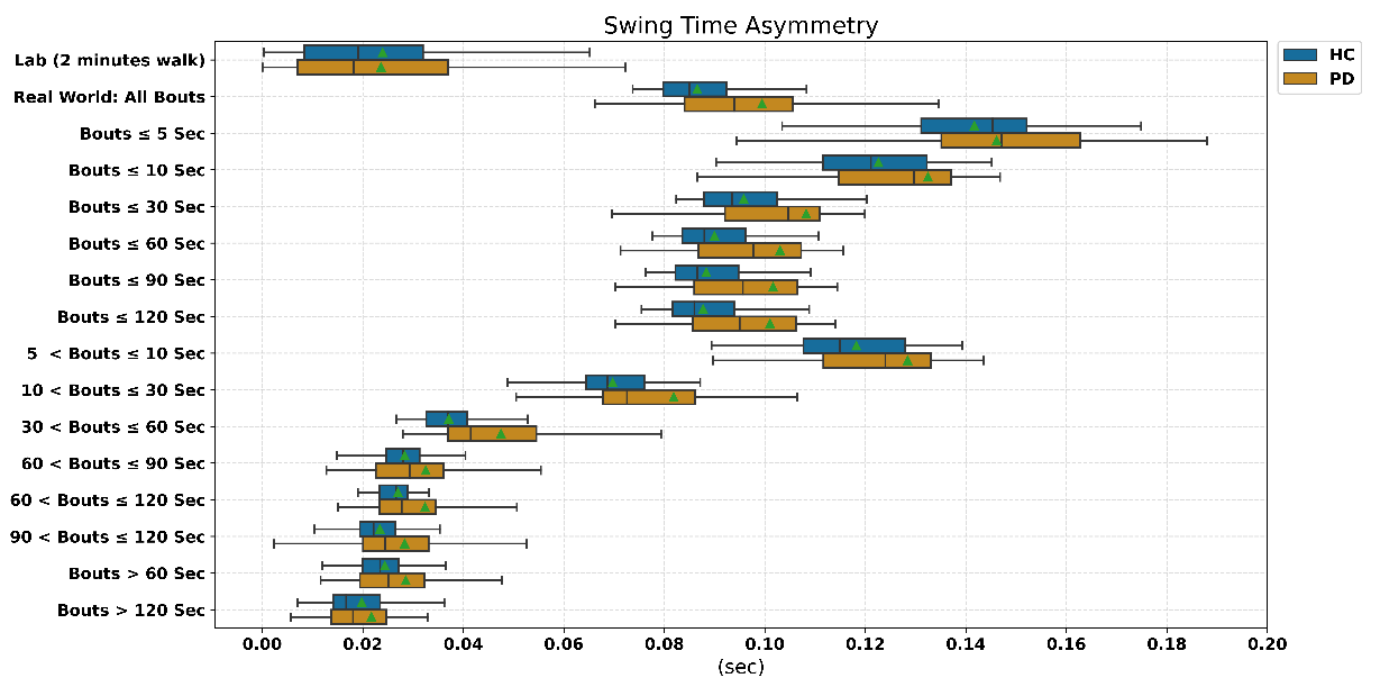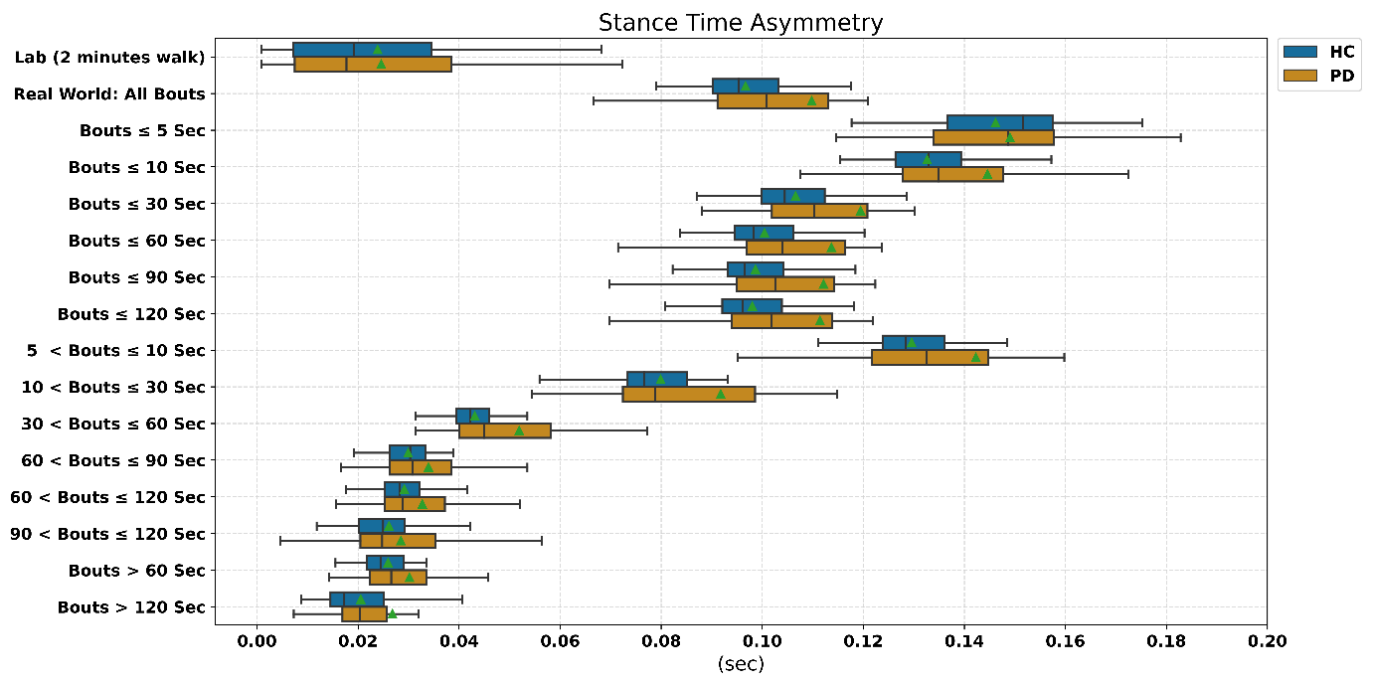
Supplementary Figure 2. Boxplots of 14 gait characteristics (A-N) under different thresholds

Supplementary Figure 3. Distribution of the all detected WB in PD and HC group in the real world assessment of 7 days; WB are categorised intro 14 thresholds based on time in seconds followed by their average of 7 days

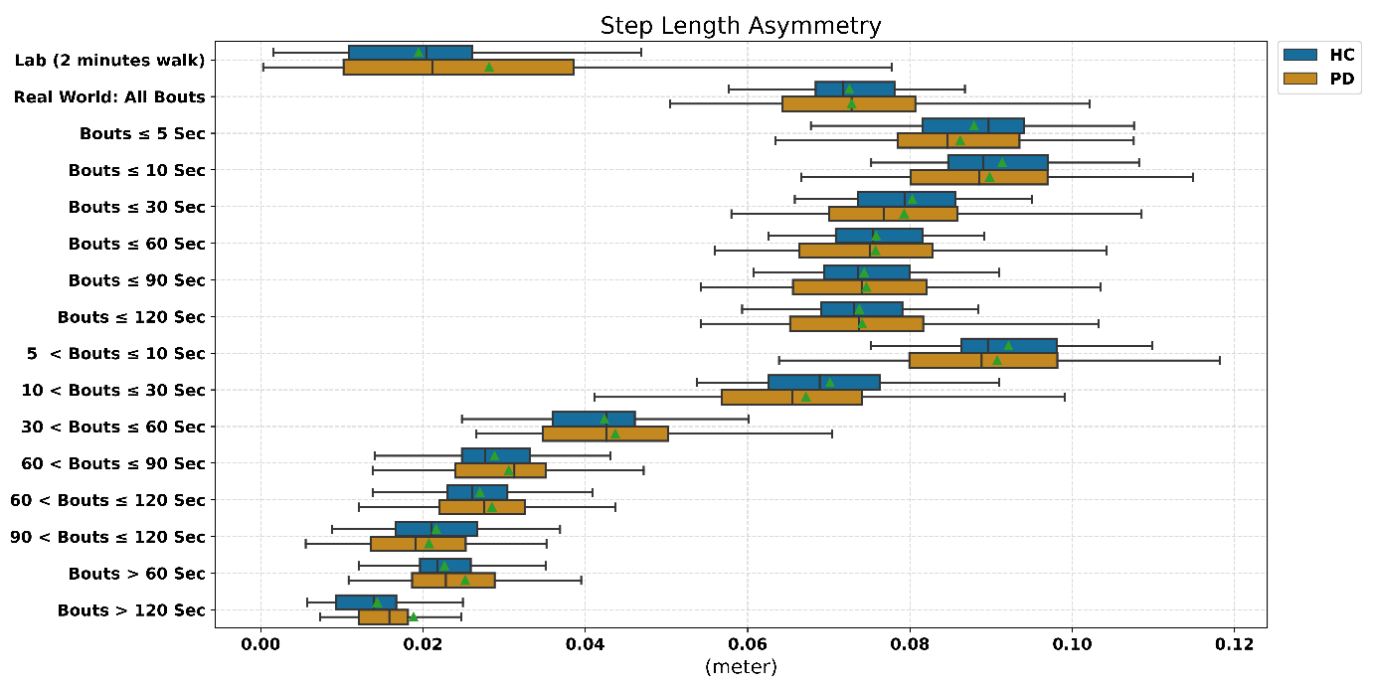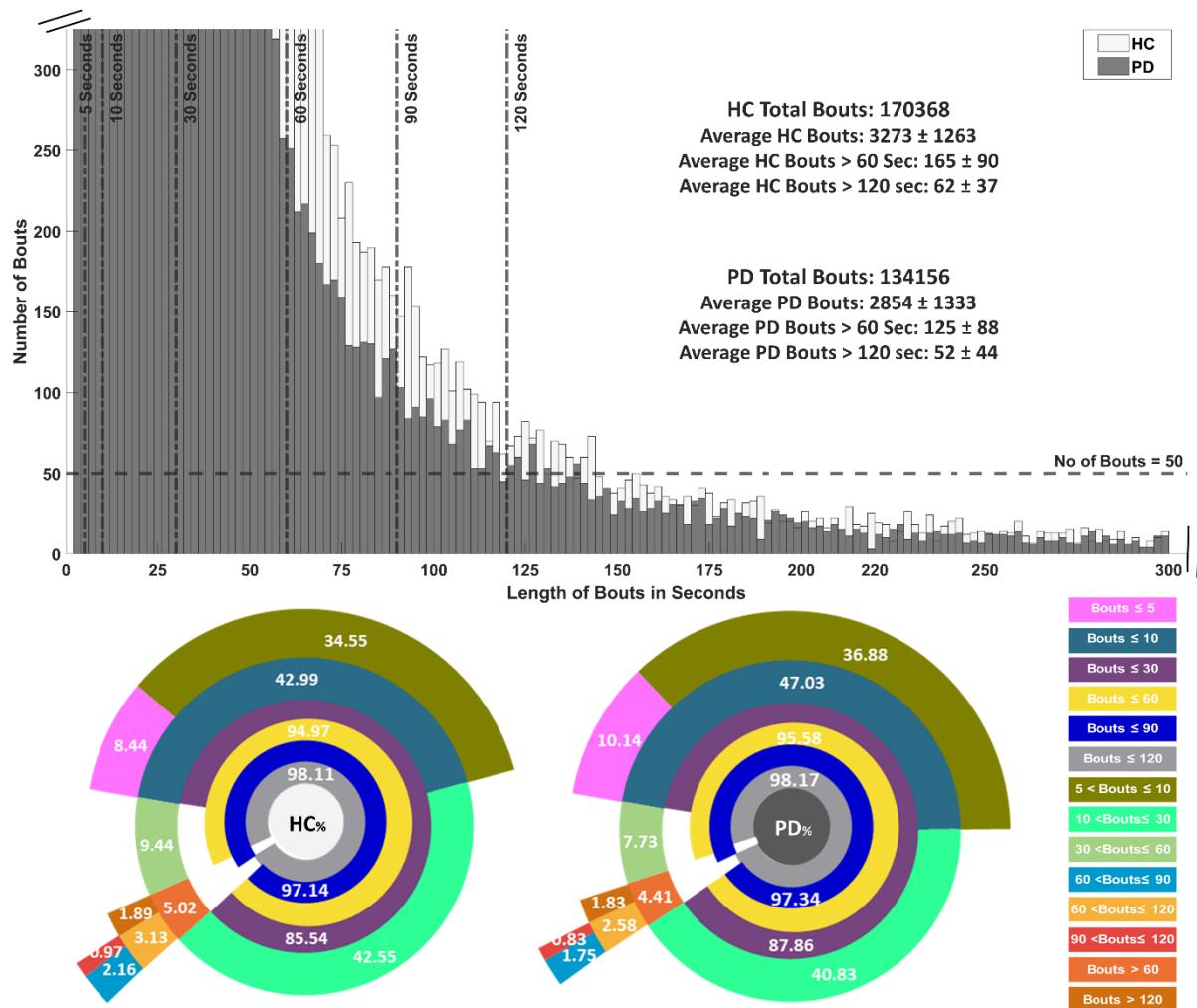|	Step Velocity	Step Length	Swing Time Variability	Step Time	Swing Time	Stance Time	Step Velocity Variability	Step Length Variability	Step Time Variability	Stance Time Variability	Step Time Asymmetry	Swing Time Asymmetry	Stance Time Asymmetry	Step Length Asymmetry
Lab (2 minutes walk)	0.000	0.008	0.018	0.023	0.018	0.066	0.028	0.027	0.024	0.027	0.817	0.985	0.719	0.019
Real World: All Bouts	0.007	0.014	0.033	0.601	0.270	0.743	0.496	0.296	0.510	0.460	0.297	0.006	0.174	0.855
Bouts ≤ 5 Sec	0.280	0.223	0.864	0.566	0.860	0.705	0.358	0.881	0.963	0.917	0.588	0.784	0.284	0.652
Bouts ≤ 10 Sec	0.161	0.242	0.099	0.662	0.615	0.607	0.870	0.344	0.473	0.422	0.702	0.369	0.928	0.581
Bouts ≤ 30 Sec	0.026	0.029	0.033	0.864	0.373	1.000	0.908	0.265	0.582	0.496	0.460	0.014	0.413	0.641
Bouts ≤ 60 Sec	0.014	0.019	0.029	0.764	0.319	0.896	0.584	0.296	0.491	0.443	0.312	0.005	0.224	0.946
Bouts ≤ 90 Sec	0.012	0.016	0.034	0.661	0.299	0.807	0.492	0.316	0.496	0.469	0.260	0.004	0.176	0.901
Bouts ≤ 120 Sec	0.011	0.015	0.034	0.653	0.298	0.797	0.474	0.316	0.496	0.496	0.260	0.004	0.164	0.861
5 < Bouts ≤ 10 sec	0.171	0.239	0.032	0.739	0.437	0.632	0.593	0.163	0.465	0.235	0.542	0.303	0.981	0.638
10 < Bouts ≤ 30 Sec	0.010	0.003	0.011	0.274	0.127	0.468	0.881	0.135	0.180	0.138	0.829	0.049	0.537	0.245
30 < Bouts ≤ 60 Sec	0.000	0.004	0.018	0.035	0.030	0.043	0.848	0.236	0.046	0.040	0.301	0.002	0.092	0.744
60 < Bouts ≤ 90 Sec	0.002	0.015	0.107	0.009	0.015	0.011	0.821	0.309	0.140	0.152	0.753	0.596	0.306	0.394
60 < Bout ≤ 120 Sec	0.004	0.031	0.201	0.019	0.056	0.016	0.919	0.355	0.291	0.308	0.961	0.049	0.388	0.434
90 < Bout ≤ 120 Sec	0.012	0.008	0.245	0.148	0.540	0.065	0.820	0.187	0.424	0.379	0.864	0.295	0.667	0.581
Bouts > 60 Sec	0.000	0.002	0.057	0.001	0.004	0.001	0.436	0.040	0.028	0.034	0.636	0.551	0.261	0.139
Bouts > 120 Sec	0.000	0.002	0.008	0.000	0.000	0.000	0.199	0.007	0.006	0.006	0.323	0.679	0.403	0.096

Independent t-test p values

Supplementary Figure 4. Comparison of effect of environment (lab vs real-world) and bout duration (threshold) on discrimination between PD and HC participants (Dark highlighted colour means lower p values)
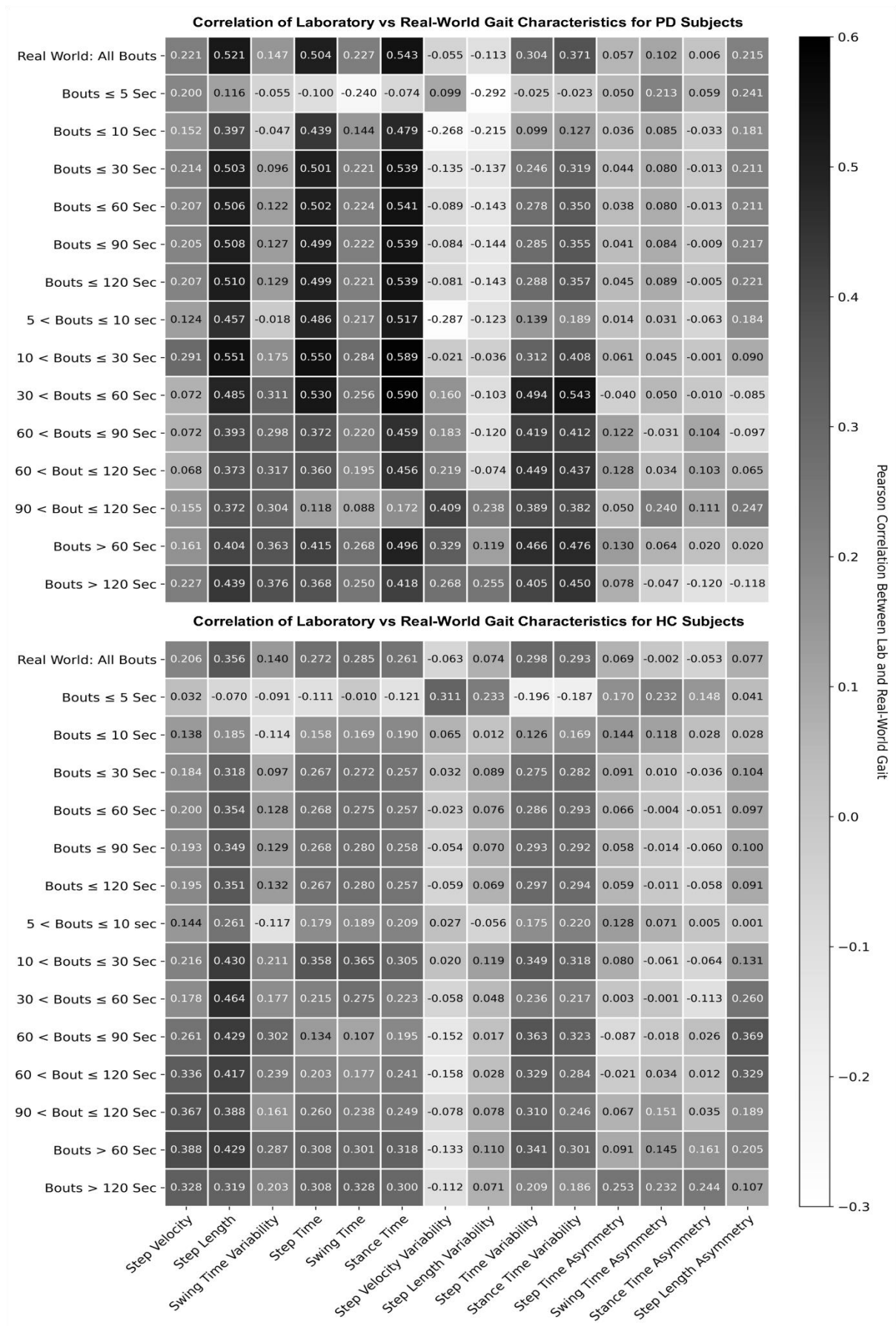
Supplementary Figure 5. Correlation of lab-based gait characteristics with real-world gait

|	Step Velocity	Step Length	Swing Time Variability	Step Time	Swing Time	Stance Time	Step Velocity Variability	Step Length Variability	Step Time Variability	Stance Time Variability	Step Time Asymmetry	Swing Time Asymmetry	Stance Time Asymmetry	Step Length Asymmetry
Lab (2 minutes walk)	0.721	0.654	0.661	0.627	0.630	0.604	0.628	0.629	0.633	0.633	0.522	0.502	0.512	0.573
Real World: All Bouts	0.656	0.643	0.597	0.556	0.576	0.527	0.540	0.561	0.558	0.563	0.609	0.683	0.621	0.503
Bouts ≤ 5 Sec	0.563	0.572	0.528	0.517	0.511	0.501	0.554	0.509	0.505	0.507	0.503	0.546	0.520	0.563
Bouts ≤ 10 Sec	0.582	0.569	0.600	0.501	0.543	0.522	0.510	0.556	0.546	0.556	0.532	0.582	0.553	0.564
Bouts ≤ 30 Sec	0.630	0.628	0.599	0.539	0.569	0.508	0.507	0.565	0.550	0.560	0.592	0.668	0.614	0.554
Bouts ≤ 60 Sec	0.642	0.636	0.604	0.552	0.574	0.515	0.532	0.561	0.559	0.565	0.607	0.689	0.630	0.523
Bouts ≤ 90 Sec	0.646	0.641	0.599	0.556	0.577	0.521	0.541	0.559	0.559	0.562	0.613	0.692	0.631	0.513
Bouts ≤ 120 Sec	0.648	0.642	0.597	0.555	0.578	0.523	0.542	0.559	0.559	0.560	0.613	0.693	0.635	0.509
5 < Bouts ≤ 10 sec	0.580	0.569	0.616	0.505	0.563	0.533	0.532	0.582	0.547	0.579	0.519	0.590	0.554	0.560
10 < Bouts ≤ 30 Sec	0.651	0.671	0.619	0.592	0.601	0.557	0.509	0.588	0.596	0.605	0.563	0.641	0.569	0.597
30 < Bouts ≤ 60 Sec	0.714	0.665	0.642	0.631	0.632	0.604	0.511	0.570	0.634	0.637	0.607	0.703	0.619	0.510
60 < Bouts ≤ 90 Sec	0.680	0.641	0.610	0.659	0.653	0.651	0.514	0.560	0.605	0.603	0.570	0.559	0.559	0.539
60 < Bout ≤ 120 Sec	0.667	0.626	0.583	0.650	0.630	0.639	0.506	0.554	0.581	0.579	0.556	0.581	0.561	0.522
90 < Bout ≤ 120 Sec	0.650	0.655	0.538	0.592	0.553	0.615	0.502	0.565	0.552	0.557	0.529	0.586	0.527	0.550
Bouts > 60 Sec	0.709	0.675	0.641	0.678	0.670	0.672	0.546	0.620	0.645	0.641	0.577	0.561	0.583	0.552
Bouts > 120 Sec	0.765	0.675	0.669	0.721	0.712	0.718	0.575	0.658	0.675	0.676	0.586	0.501	0.581	0.612

Area Under the Receiver Operating Characteristics Curve (AUC)

Supplementary Figure 6. Discrimination of PD from HC based on each individual gait characteristic with area under the receiver operating characteristics curve (AUC)
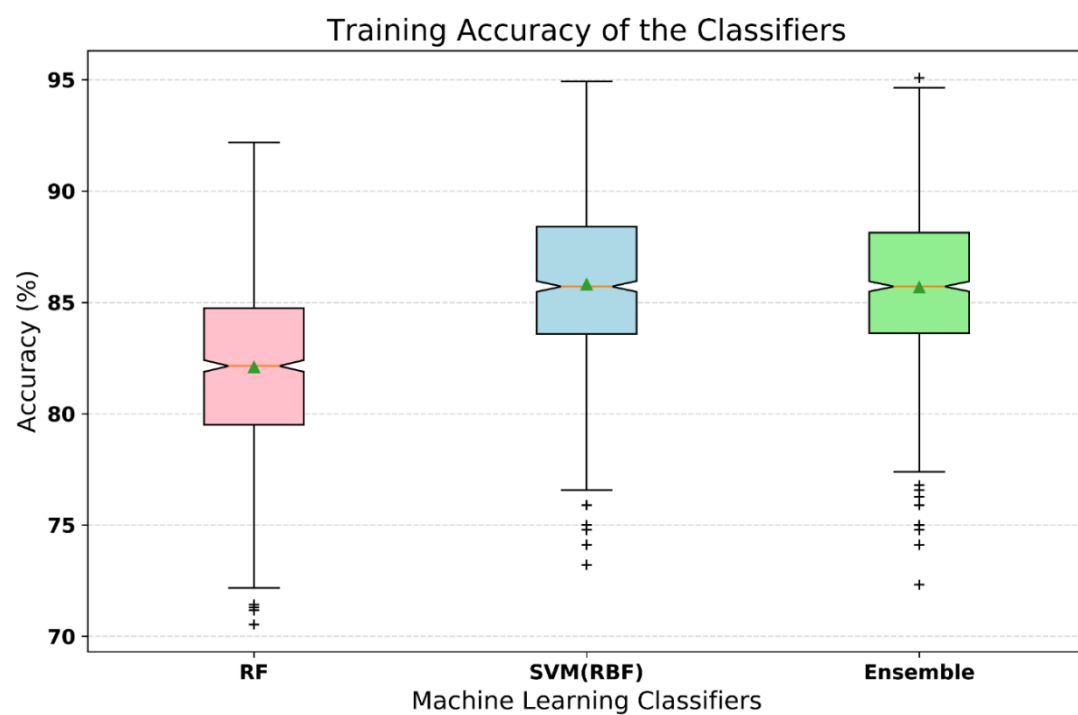
Supplementary Figure 7. Training accuracy of the classifiers based on 10-fold cross-validation by combining the distribution of the overall data
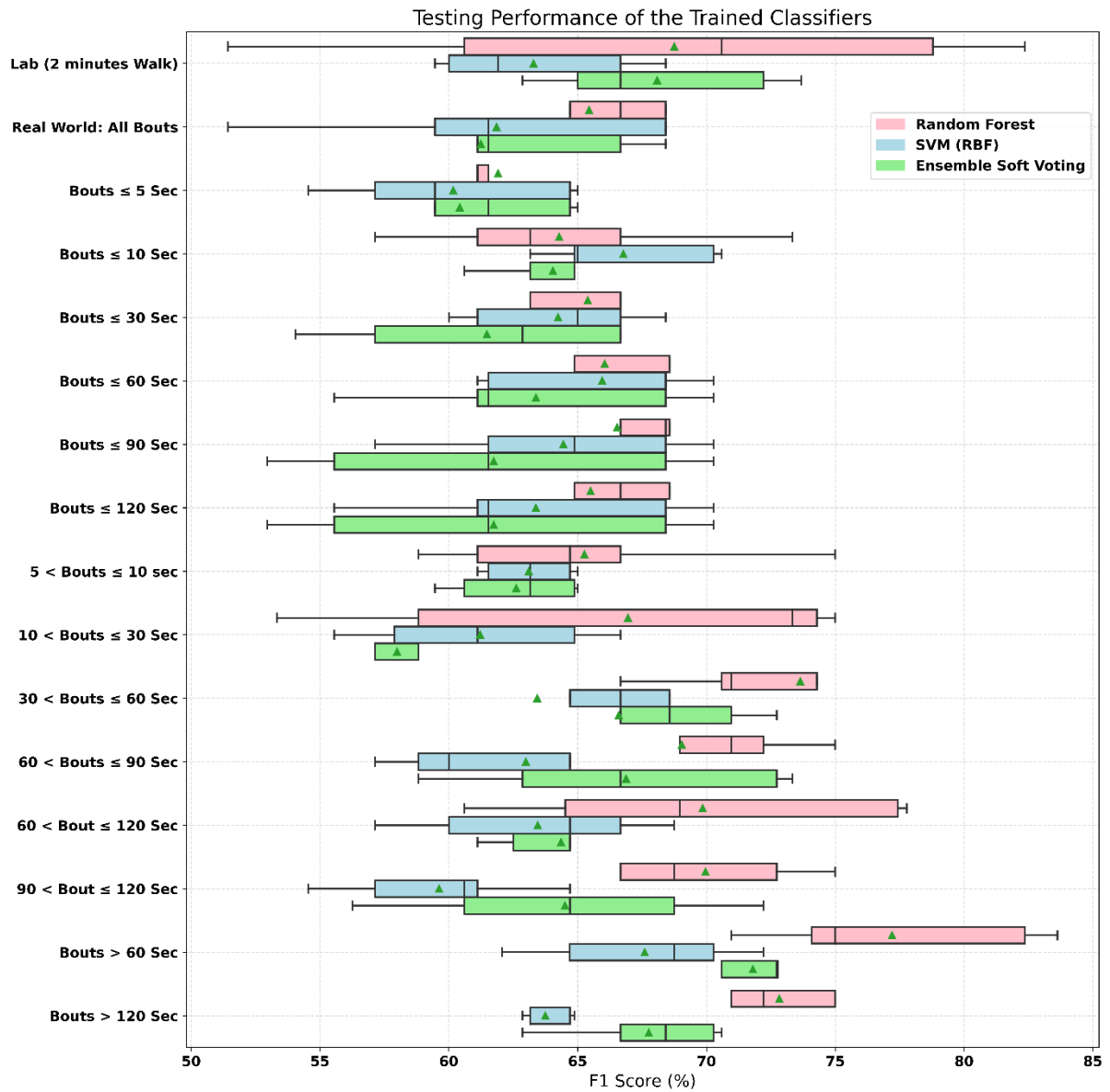
Supplementary Figure 8. Testing accuracy of the trained classifiers based on the lab and real-world assessment of gait under various bout lengths

Supplementary Table 1. Evaluation metrics of the trained classifiers on the lab and real-world test data under various bout lengths

Lab/Bout Lengths	Random Forest			Support Vector Machine			Ensemble Classifier		
	Accuracy	Sensitivity	Specificity	Accuracy	Sensitivity	Specificity	Accuracy	Sensitivity	Specificity
Lab (2 minutes)	64.67±15.02	81.62±11.98	50.27±19.03	51.33±5.58	88.87±5.56	18.12±11.65	60.67±5.96	88.79±3.62	35.77±10.71
Real-world All Bouts	60.67±10.65	79.55±15.94	43.89±12.14	52.67±7.23	82.95±17.90	26.71±5.33	53.33±7.07	80.02±18.85	30.72±7.91
Bouts < 5 sec	54.00±3.65	79.31±6.50	31.51±7.87	52.67±4.35	76.96±15.61	31.73±9.57	51.33±6.06	79.82±15.66	26.56±9.46
Bouts < 10 sec	58.67±9.60	78.09±9.99	41.99±17.87	58.67±6.06	87.94±9.20	32.91±11.84	56.00±2.79	83.75±12.04	31.72±7.58
Bouts < 30 sec	59.33±8.94	80.86±10.06	40.39±15.33	54.67±5.58	86.69±11.53	27.19±11.68	52.67±5.96	81.55±17.85	27.86±7.10
Bouts < 60 sec	60.67±10.11	81.07±13.74	42.72±13.40	57.33±5.48	88.12±11.82	30.72±7.91	54.67±6.91	84.20±15.65	29.29±7.41
Bouts < 90 sec	62.00±9.60	80.98±16.15	45.23±11.97	56.00±5.96	85.53±14.75	30.72±7.91	53.33±7.82	81.53±18.78	29.29±7.41
Bouts < 120 sec	60.67±10.90	79.73±16.37	43.89±12.14	54.67±6.91	84.20±15.65	29.29±7.41	53.33±7.82	81.53±18.78	29.29±7.41
5 < Bouts ≤ 10 sec	60.00±8.16	79.63±11.69	42.99±10.98	54.00±3.65	83.72±10.08	28.13±11.17	54.00±2.79	82.41±12.90	29.46±10.32
10 < Bouts ≤ 30 sec	64.67±10.44	76.59±15.01	54.30±10.25	52.67±5.96	79.41±9.52	29.04±6.68	52.00±6.06	71.30±14.78	35.43±1.48
30 < Bouts ≤ 60 sec	**72.67±7.96**	**80.55±11.19**	**65.35±12.46**	56.67±11.30	79.98±15.36	36.23±12.96	62.00±10.95	79.69±11.79	46.37±16.47
60 < Bouts ≤ 90 sec	68.67±8.37	73.21±9.12	64.08±16.53	58.67±7.67	74.89±10.38	44.13±8.45	63.33±8.50	77.88±7.42	50.42±11.52
60 < Bouts ≤ 120 sec	68.00±8.03	78.97±10.76	58.06±8.63	60.00±6.24	73.87±10.63	47.88±8.92	60.67±5.96	75.22±8.75	47.81±9.31
90 < Bouts ≤ 120 sec	68.67±2.98	81.38±9.38	58.80±5.20	54.00±4.35	75.64±9.89	36.88±7.43	60.67±5.96	79.97±12.36	45.27±5.48
Bouts > 60 sec	**76.27±4.68**	**84.06±6.36**	**70.78±10.45**	**64.13±2.56**	**79.85±12.07**	**50.37±9.98**	**68.93±2.09**	**83.51±6.46**	**56.03±6.24**
Bouts > 120 sec	**70.67±2.79**	**83.62±9.25**	**59.90±10.51**	56.00±2.79	82.19±7.92	32.99±8.49	62.00±3.80	84.87±8.15	41.78±8.04
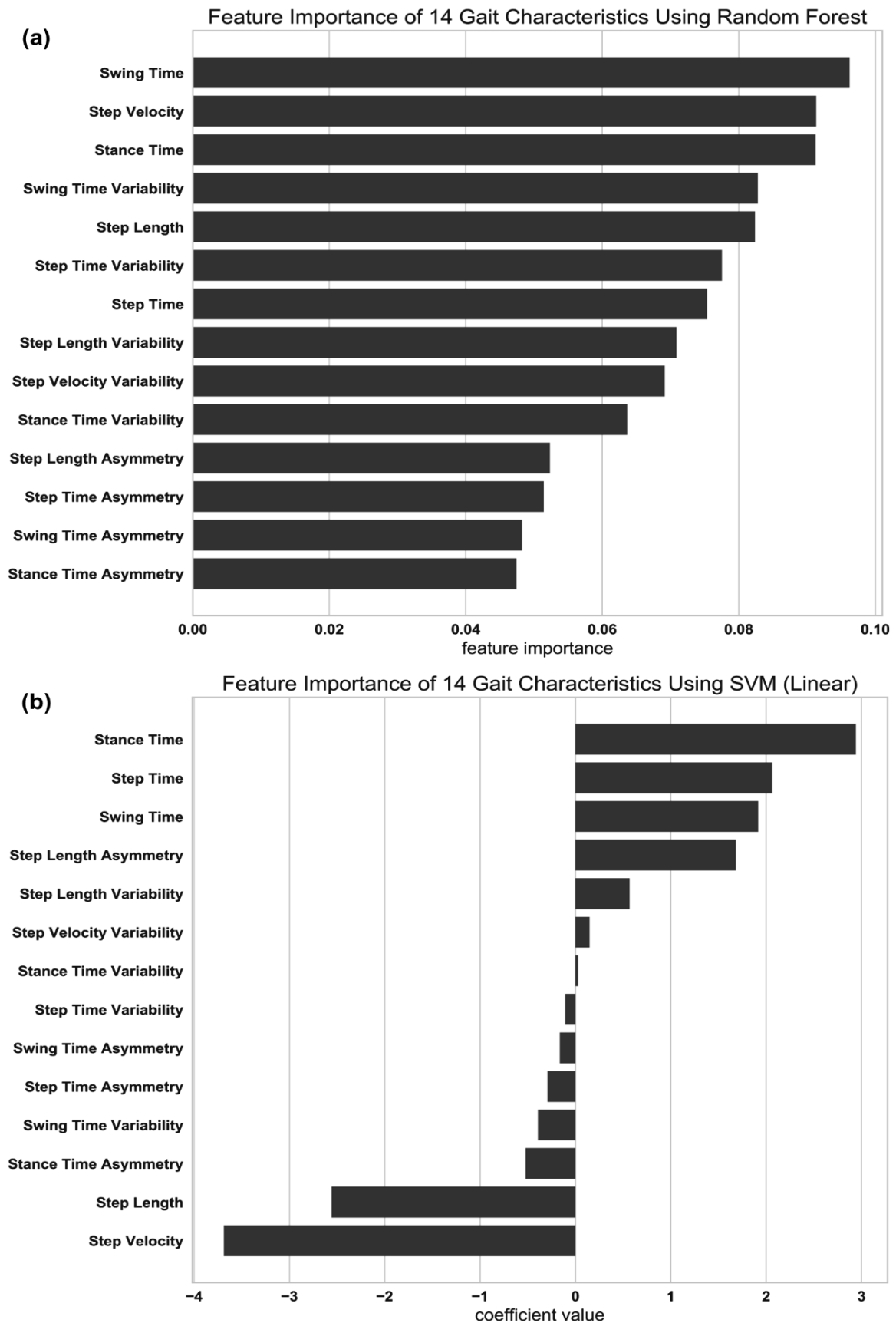
Supplementary Figure 9. Important characteristics identified during the classification of PD with (a) Random Forest Classifier, (b) Support Vector Machine Classifier (longer bar means more influential)