

Online Data Supplement

Patients with COPD Walk with Altered Step Time and Step Width Variability as Compared to Healthy Controls

Jennifer M Yentes, PhD, Stephen I Rennard, MD, Kendra K Schmid, PhD, Daniel Blanke, PhD, Nicholas Stergiou, PhD

Mean, standard deviation, coefficient of variation, and SampEn from the step length, step time, and step width time series for both the healthy controls and patients with COPD were calculated (Tables 1-4). A linear mixed model was used to assess differences in mean length, time, and width between groups (COPD vs. controls) and over the three speed conditions (-20%, self-selected, and +20%). This modeling approach allows us to determine differences within and between groups, while accounting for correlation due to repeated measurements and adjusting for potentially confounding variables. Generalized linear mixed models were used for variables that did not meet the normality assumption. All interactions between speed and group were also investigated. Adjustments for multiple comparisons were made using the simulation technique.

A main effect is a statistical term used to indicate significance from the linear model. If a main effect is found, post hoc analysis is completed. The group, speed, and interaction terms refer to the main comparisons from the linear models used in the statistics. The main effect of group determines if there is a significant difference in groups across all conditions. The main effect of speed determines if there is a significant difference in speed across both groups. A significant interaction would indicate that the difference in groups is dependent on speed, and vice versa. The F value is the value that is calculated in the linear model that is used to determine the p value. The larger the F value, the smaller the p value.

All statistics were performed using SAS (SAS Institute, Inc., Cary, NC). The significance level was set at $p < 0.05$.

Table 1. Comparison of mean values between healthy controls and patients with COPD.

Dependent Variable	Group	-20%	Self-selected	+20%	Group	Speed	Interaction
		Mean (SD) N=20	Mean (SD) N=20	Mean (SD) N=20	F, p	F, p	F, p
Step Length (m)	Control	0.484 (0.08)	0.511 (0.10) [^]	0.577 (0.10) ^{^†}	0.99, 0.33	80.0, <0.001*	0.03, 0.97
	COPD	0.449 (0.11)	0.479 (0.13) [^]	0.543 (0.13) ^{^†}			
Step Time (sec)	Control	0.715 (0.19)	0.587 (0.06) [^]	0.557 (0.05) [^]	5.6, 0.02*	44.5, <0.001*	0.09, 0.92
	COPD	0.790 (0.16)	0.670 (0.12) [^]	0.646 (0.12) [^]			
Step Width (m)	Control	0.103 (0.04)	0.102 (0.03)	0.098 (0.03)	0.28, 0.60	1.7, 0.18	3.4, 0.04*
	COPD	0.094 (0.04)	0.097 (0.04)	0.096 (0.04)			

Note: * indicates a significant ($p < 0.05$) main effect; ^ indicates pace condition was significant ($p < 0.05$) different from -20% pace; † indicates pace condition was significant ($p < 0.05$) different from self-selected pace

Table 2. Comparison of standard deviation between healthy controls and patients with COPD.

Dependent Variable	Group	-20%	Self-selected	+20%	Group	Speed	Interaction
		Mean (SD) N=20	Mean (SD) N=20	Mean (SD) N=20	F, p	F, p	F, p
Step Length (m)	Control	0.025 (0.009)	0.022 (0.006)	0.018 (0.006) ^{^†}	2.2, 0.14	8.5, 0.0005*	1.9, 0.16
	COPD	0.029 (0.014)	0.026 (0.012)	0.026 (0.015) ^{^†}			
Step Time (sec)	Control	0.034 (0.030)	0.019 (0.007) [^]	0.014 (0.005) ^{^†}	5.2, 0.03*	80.1, <0.001*	2.2, 0.12
	COPD	0.040 (0.022)	0.026 (0.014) [^]	0.023 (0.013) ^{^†}			
Step Width (m)	Control	0.018 (0.005)	0.019 (0.005)	0.019 (0.007)	8.1, 0.007*	0.98, 0.38	0.45, 0.64
	COPD	0.014 (0.004)	0.014 (0.004)	0.015 (0.005)			

Note: * indicates a significant ($p < 0.05$) main effect; ^ indicates pace condition was significant ($p < 0.05$) different from -20% pace; † indicates pace condition was significant ($p < 0.05$) different from self-selected pace

Table 3. Comparison of coefficient of variation between healthy controls and patients with COPD.

Dependent Variable	Group	-20%	Self-selected	+20%	Group	Speed	Interaction
		Mean (SD)	Mean (SD)	Mean (SD)	F, p	F, p	F, p
		N=20	N=20	N=20			
Step Length	Control	0.053 (0.022)	0.047 (0.021) [^]	0.034 (0.019) ^{^†}	2.4, 0.13	29.7, <0.001*	1.5, 0.23
	COPD	0.074 (0.055)	0.064 (0.044) [^]	0.054 (0.041) ^{^†}			
Step Time	Control	0.044 (0.022)	0.032 (0.011) [^]	0.026 (0.008) ^{^†}	2.5, 0.12	38.5, <0.001*	1.8, 0.18
	COPD	0.049 (0.019)	0.037 (0.016) [^]	0.035 (0.014) ^{^†}			
Step Width	Control	0.208 (0.159)	0.198 (0.085)	0.211 (0.100)	0.5, 0.47	0.8, 0.45	1.6, 0.22
	COPD	0.256 (0.396)	0.191 (0.188)	0.246 (0.400)			

Note: * indicates a significant ($p < 0.05$) main effect; ^ indicates pace condition was significant ($p < 0.05$) different from -20% pace; † indicates pace condition was significant ($p < 0.05$) different from self-selected pace

Table 4. Comparison of sample entropy between healthy controls and patients with COPD.

Dependent Variable	Group	-20%	Self-selected	+20%	Group	Speed	Interaction
		Mean (SD)	Mean (SD)	Mean (SD)	F, p	F, p	F, p
		N=17 (COPD)	N=20	N=20			
Step Length (bits)	Control	1.87 (0.35)	1.85 (0.30)	1.93 (0.22)	0.12, 0.73	0.48, 0.62	0.38, 0.68
	COPD	1.83 (0.34)	1.86 (0.34)	1.86 (0.49)			
Step Time (bits)	Control	1.78 (0.43)	1.60 (0.41) [^]	1.35 (0.42) ^{^†}	0.41, 0.53	16.8, <0.001*	1.1, 0.35
	COPD	1.71 (0.57)	1.43 (0.53) [^]	1.37 (0.55) ^{^†}			
Step Width (bits)	Control	2.02 (0.17)	1.98 (0.24)	2.03 (0.14)	0.33, 0.57	1.4, 0.25	0.15, 0.86
	COPD	1.97 (0.19)	1.96 (0.17)	2.02 (0.16)			

Note: * indicates a significant ($p < 0.05$) main effect; ^ indicates pace condition was significant ($p < 0.05$) different from -20% pace; † indicates pace condition was significant ($p < 0.05$) different from self-selected pace