

Gait variability in patients with COPD during a self-paced 6-minute walk test

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Background & aim

Patients with chronic obstructive pulmonary disease (COPD) have an increased falls risk [1] and demonstrate gait deficits [2,3]. Gait variability has been associated with increased risk for falls in the aging population [4]. However, studies reporting gait variability in COPD are scarce. Gait variability could be assessed during commonly used exercise test in pulmonary rehabilitation, such as the 6-minute walk test (6MWT). Therefore, we aim to assess gait variability in COPD patients during the 6MWT.

Materials and methods

80 COPD patients (48 males; 62±7 yrs.; FEV₁:56±19 %pred.) and 39 healthy subjects (25 males; 62±6 yrs.; FEV₁:119±17 %pred.) performed two self-paced 6MWTs on the Gait Real-time Analysis Interactive Lab, while kinematic parameters were recorded (100Hz, Vicon Nexus). The largest walk distance was used for analysis. The amount (coefficient of variation; CoV) and structure (sample entropy) of variability of stride time, stride length and step width, and local divergence exponent of the centre of mass velocity (COM_v) in mediolateral, anteroposterior and vertical direction were computed from 444 steps. Sub-analysis was performed to account for gait speed influences on gait variability between the groups.

Results

COPD patients achieved 497±79 m and controls 691±64 m. Stride time was higher (MD: 0.13 s, p<0.001) and stride length was smaller (MD:-0.30 s, p<0.001) in COPD. CoV for stride length was increased (MD: 1.8%, p<0.001) and sample entropy of stride length was lower in COPD (MD: 0.21, p<0.001, Fig 1). Local divergence exponent for CoM_v differed in vertical (MD: -0.12, p=0.001) and anteroposterior direction (MD: 0.10, p=0.017).

Differences in CoV for stride length remained higher in COPD (MD: 1.0 %, p=0.003) and sample entropy for stride length remained lower in COPD (MD: -0.12, p=0.011), after a sub-analysis of 14 patients and 14 healthy subjects with comparable walking speeds (MD: -0.02 m/s, p=0.588). Local divergence exponents for CoM_v did not differ between the groups in the sub-analysis.

Conclusion

COPD patients demonstrate alterations in the amount and structure of variability in stride length. These findings indicates alterations in the control of stride length variability pattern and might represent a lack of adaptability during walking as compared to healthy subjects. However, the local stability of the centre of mass was not altered in patients with COPD.

References

- [1] Roig, M. et al. (2011) *Respir Med*
- [2] Yentes, J. et al. (2015) *Respir Res*
- [3] Annegarn, J. et al. (2012) *PLoS One*
- [4] Hausdorff, J. et al. (2001) *Arch Phys Med Rehabil*

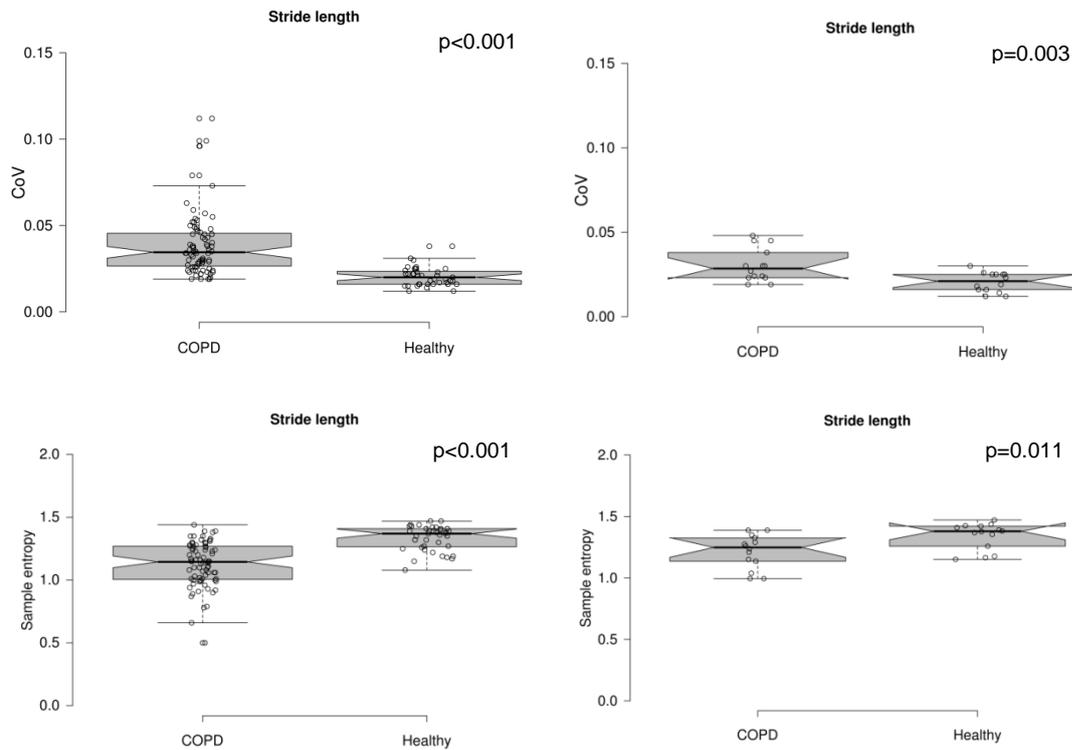


Fig 1. Variability in stride length for patients with COPD and healthy subjects. Upper left: CoV for stride length in total sample. Upper right: CoV for stride length in the subanalysis. Lower left: sample entropy for stride length in total sample. Lower right: sample entropy for stride length in the subanalysis.