Online Data Supplement - 01

Limiting Factors in Walking Performance of Patients with COPD

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Here, we show in details the materials and methods used in the current study.

Pulmonary Function Test

Spirometry was performed in accordance to international standards using a Jaeger Oxycon (CareFusion Corporation, Heidelberg, Baden-Württemberg, Germany). Results are reported as absolute and percentage of predicted (%p) values.

Cardiopulmonary Exercise Test (CPET)

After 10 minutes familiarization with the treadmill (INBRAMED 10200, Porto Alegre, Rio Grande do Sul, Brazil) acquisition of the relevant parameters (ventilation, $\dot{V}_E$, carbon dioxide production, $\dot{V}CO_2$, oxygen consumption, $\dot{V}O_2$; heart rate, HR; and pulse oxygen saturation, SpO_2) was performed with the subject standing on the treadmill in the orthostatic position. The test started with a warm up at a speed of 1.5 km/h and 1% inclination. Every minute the speed of the treadmill was increased by 0.5-1 km/h, up to 4-6 km/h. Then, only the inclination was increased by 3% each minute. The speed and inclination increments were assigned according to COPD severity. For all healthy subjects, speed increments were of 1 kmh^{-1} up to a final speed of 6 km/h, after that, only inclination increased. The maximal effort was observed according to the following criteria: respiratory exchange ratio $\geq$ 1.1, ventilatory reserve $\leq$ 30%, peak HR $\geq$ 90% of the theoretical peak HR (i.e., 208 − 0.7 × age), and subjective feeling of extreme physical tiredness. In all cases, at least three of the four criteria were met.

Evaluation of Cost of Transport

The participant was asked to walk at a comfortable and usual speed in a 15 m corridor for three times, and the average of the calculated speeds was considered as the ground SSWS. The ground SSWS was used as a reference to determine the SSWS in the treadmill. The speed of the treadmill was set equal to the ground SSWS, and the subject was asked to adjust the speed until the most comfortable pace was reached. In most subjects, the treadmill SSWS was 1 km/h slower than the ground SSWS. This

part of the protocol lasted five to ten minutes and was used as another familiarization with the treadmill.

Along with the SSWS, four other speeds were defined, minus and plus 20% and 40% the SSWS. In addition to these five speeds, subjects walked at a common speed of 3.2 km/h so that all participants could be compared at the same absolute walking speed. (i.e. isovelocity speed).

The participants were requested to walk five minutes at each of the six speeds, in random order. Between the six speeds, the subjects rested until $\dot{V}O_2$, HR, dyspnea sensation and leg fatigue returned to resting values. Ventilatory data were collected continuously with Jaeger Oxycon. Calibration measurements were carried out according to the manufacturer's instructions before each experiment. The values of SpO_2 and HR at the end of each speed were also noted. The dyspnea sensation intensity and leg fatigue were rated using the Borg scale scoring between 0 (no dyspnea or leg fatigue at all) and 10 (most severe sensation of dyspnea or leg fatigue that the patient could imagine).

$\dot{V}O_2$ was measured breath-by-breath and averaged over the last two minutes of walking. The cost of transport (Joules/kg/m) was calculated from $\dot{V}O_2$ as previously described.

For the measurement of the gait variability, a video camera (Casio, Exilim FH25, 120 Hz, Tokyo, Japan) was used to film the subjects left side while walking on the treadmill at each speed. Step phase was defined using the video recording cameras and three reflective markers (on the fifth metatarsal, calcaneus, and lateral malleolus). The stride digitalization was performed with software Dvideow (Laboratory of Biomechanics, FEF Institute of Computing UNICAMP, Campinas, São Paulo, Brazil)[E1]. Gait variability, defined as the stride-to-stride fluctuations, was measured by the coefficient of variation (CoV) of the stride frequency.

References

E1 - Barros RM, Brenzikofer R, Leite N, Figueroa, PJ. Development and evaluation of a system for three-dimensional analysis of human movements. Br J Biomed Eng, 1999;15:79-86.