The relationship between depth of breathing and walking speed in individuals post-stroke

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Rationale
- Reduced depth of breathing and walking speed may occur post-stroke secondary to hemiparesis.
- Higher oxygen cost with hemiparetic gait may result in similar ventilatory requirements for people with stroke who walk slower than neurologically intact adults.
- Depth of breathing increases with fast walking in healthy people but it is unknown if this adaptation occurs post-stroke.
- Understanding the relationship between walking speed and tidal volume may provide insight into limitations of exercise capacity and community ambulation in people post-stroke.

Purpose
- To evaluate how increased walking speed impacts the depth of breathing (tidal volume) in healthy and individuals with stroke and the effect of deep breathing on walking speed.

Methods
- 2 groups: People with stroke and age- and gender-matched healthy adults.
- Variables measured: (VC) (2 reps), Quiet Breathing Standing (QST) (60 sec), Deep Breathing Standing (DBS) (60 sec).
- Each walking trial is 2 minutes long with a 5 minute rest in sitting between trials.
- Outcome measures:
  - Gait speed (m/s) (foot markers captured by VICON MX System)
  - Air flow (pneumotachograph) integrated to obtain tidal volume (L)

Off-line data analysis:
- Signals obtained from the pneumotach and VICON Nexus software were processed using a customized script written in C++, to provide gait speed and tidal volume data per breathing and walking cycle. These data were averaged for each individual in each condition.

Statistical analysis:
- Data for the three conditions (QST, DST, DF) were analyzed for each group using an one-way repeated measures ANOVA for tidal volume.
- Data for the four walking conditions (OC, DC, DF, DF) in each group (stroke, control), were analyzed using two-way repeated measures ANOVA for each outcome measure (tidal volume and walking speed). Data was transformed (except tidal volume for post-stroke) to meet normality criteria.
- Rank sum test was used to compare groups (stroke, control).

Results
- Table 1: Demographics and baseline measures of persons with stroke and controls.
- Table 2: Results for tidal volume and walking speed.
- Figure 3: Tidal volume in each condition in people with stroke or the control group.

Conclusions/Implications
- People post-stroke are able to increase depth of breathing in standing similar to the control group, suggesting voluntary control of breathing is intact.
- Attempting to increase walking speed while breathing deeply results in a decrease in tidal volume in persons with stroke, suggesting the respiratory muscles might prioritize postural stability more than depth of breathing while walking fast.
- Walking at a comfortable pace and deep breathing may be beneficial for people post-stroke to optimize tidal volume and walking speed.

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References