VARIABILITY OF THE CO-REBREATHING METHOD FOR THE ASSESSMENT OF BLOOD VOLUME; EFFECTS OF CO DOSE AND SAMPLE SITE

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Introduction
From the inception of the carbon monoxide (CO) re-breathing technique for assessing blood volume (BV) and hemoglobin (Hb) mass [1], different CO dose (based in body size and fitness), re-breathing time and sampling site (vein, artery or capillary) have been used to improve technique accuracy. The aim of this study was to determine the CO dose and blood sample site which more reliably assess BV and Hb mass using CO re-breathing technique in subjects of different body weights and fitness level.

Methods
Five young healthy subjects (4 men and a woman) volunteered for this study. They had different body weight (from 60 to 88 kg) and aerobic capacity (VO2max from 39 to 72 mL/kg/min). Each subject underwent 6 CO re-breathing assessments in a random order. In 3 of them a bolus of 1 mL CO/kg body weight (LOW) was re-breathed, while in 3 other the bolus was 1.25 mL CO/kg body weight (HIGH). Capillary (fingertip), venous (antecubital vein) and capillary-arterialized (fingertip warmed at 45°C) blood was sampled before and after 10 minutes of CO re-breathing. Blood samples were analyzed for haemoglobin concentration ([Hb]) and increases in carboxyhemoglobin (%COHb) using co-oxymetry (ABL-520, Radiometer, Denmark). Hematocrit was measured in triplicate by microcentrifugation. Hb mass and BV were calculated using Gore et al., equations [2].

Results
Hb mass (687 to 1070 g) and BV (61 to 102 mL/Kg body weight) agreed with previous studies in subjects of similar characteristics. Coefficient of variation (CV) was lower (less variability) using HIGH than LOW. [Hb]: 2.6% vs. 1.5% in capillary and 1.5% vs. 1.1% in venous. Hematocrit: 3.1% vs. 2.8% in capillary and 1.8% vs. 1.8% in venous. Hb mass: 2.8% vs 2.2% in capillary and 3.1% vs. 2.4% in venous. BV: 4.3% vs. 2.3% in capillary and 3.5% vs. 2.0% in venous. Within HIGH, BV variability (calculated from Hb mass, [Hb] and hematocrit) was smaller in venous than capillary or arterialized sample (2.0%, 2.3% and 4.0 respectively).

Conclusions
The choice of an individual dose of 1.25 mL CO/kg of body weight and sampling from venous blood is the most reliable procedure to assess BV and Hb mass using the CO re-breathing technique.

References
2. Gore, C.J., Bourdon, P.C., Woolford, S.M., Ostler, L.M., Eastwood, A. and Scroop, G.C., Time and sample site de-