The following is the abstract of the letter discussed in the following letter:

**Tolfrey, Keith, Alan Barker, Jeanette M. Thom, Christopher L. Morse, Marco V. Narici, and Alan M. Batterham.** Scaling of maximal oxygen uptake by lower leg muscle volume in boys and men. *J Appl Physiol* 100: 1851–1856, 2006. First published February 16, 2006; doi:10.1152/japplphysiol.01213.2005.—The aim of this study was to critically examine the influence of body size on maximal oxygen uptake (VO$_2$ max) in boys and men using body mass (BM), estimated fat-free mass (FFM), and estimated lower leg muscle volume (Vol) as the separate scaling variables. VO$_2$ max and an in vivo measurement of Vol were assessed in 15 boys and 14 men. The FFM was estimated after percentage body fat had been predicted from population-specific skinfold measurements. By using nonlinear allometric modeling, common body size exponents for BM, FFM, and Vol were calculated. The point estimates for the size exponent (95% confidence interval) from the separate allometric models were: BM 0.79 (0.53–1.06), FFM 1.00 (0.78–1.22), and Vol 0.64 (0.40–0.88). For the boys, substantial residual size correlations were observed for VO$_2$ max/BM$^{0.79}$ and VO$_2$ max/FFM$^{1.00}$, indicating that these variables did not correctly partition out the influence of body size. In contrast, scaling by Vol$^{0.64}$ led to no residual size correlation in boys or men. Scaling by BM is confounded by heterogeneity of body composition and potentially substantial differences in the mass exponent between boys and men. The FFM is precluded as an index of involved musculature because Vol did not represent a constant proportion of FFM [Vol$^{0.64}$ (95% confidence interval, 1.13–1.77)] in the boys (unlike the men). We conclude that Vol, as an indicator of the involved muscle mass, is the most valid allometric denominator for the scaling of VO$_2$ max in a sample of boys and men heterogeneous for body size and composition.

**Quantification of active muscle mass during experimental exercise**

*To the Editor:* We read with interest the recent publication in the *Journal of Applied Physiology* by Dr. Tolfrey and colleagues entitled “Scaling of maximal oxygen uptake by lower leg muscle volume in boys and men” (4). We would like to elaborate a little on the paper, in particular the sections that stated, “the question of the influence of body size on energy metabolism has occupied researchers for 100 years” and “further research is required, quantifying a larger proportion of active muscle that is utilized during exercise, to confirm our findings”.

In relation to these comments, we recently examined the influence of the upper body via the handgrip during high-intensity cycle ergometry (1). The with-grip protocol yielded significantly greater ($P < 0.05$) peak mechanical power output than the without-grip protocol, suggesting a significant upper body contribution to the maximum power profile observed for the legs. In addition, as a first step to quantifying the upper body involvement during leg cycle ergometry, surface electromyography of the forearm musculature was measured while the subjects were performing each of the test protocols. During the with-grip ergometer tests, the intensity of the electrical activity recorded for the forearm musculature was greater than the intensity of electrical activity recorded for the forearm musculature during 100% isometric voluntary handgrip dynamometer contractions. This suggests maximum isometric-type forearm muscle contraction during the with-grip leg ergometry tests. There was also a significant reduction in blood lactate concentrations observed in a further study postexercise ($P < 0.01$) when the two protocols were compared (2). These findings indicate that the performance of traditional-style leg cycle ergometry requires a muscular contribution from the whole body. As such, researchers should be mindful of this in relation to the active muscle mass that contributes to the test and in the subsequent analysis of blood-borne metabolites. Isometric contraction has been shown to cause occlusion of the blood passing through and between the activated muscles (3). Blood samples that are removed immediately postexercise from an antecubital vein would likely contain a volume of occluded blood, which may not be representative, in this instance, of leg muscle blood. Equally, the subsequent reperfusion of arm musculature during relaxation would have an unknown effect on the measurement and concentration of blood-borne metabolites. These findings suggest that the accurate quantification of the active muscle tissue that contributes to exercise performance in aerobic and anaerobic conditions is an important consideration in our assessment of the exercising individual. Until it is possible to specifically isolate the mechanical and/or physiological contributions of discrete muscle groups in the performance of coordinated exercise, perhaps the best way forward for practitioners and scientists alike is to acknowledge that coordinated movement likely involves unknown muscular contributions from lean tissue masses throughout the entire body.

**REFERENCES**


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