

The Perils of Allometric Scaling

Dear Editor,

I read with interest the paper by Chia and Aziz.¹ Using allometric scaling, the authors adjusted peak oxygen uptake (VO_{2max}) for the confounding influence of body mass and found that mass exponents differed markedly for male and female athletes. I believe the mass exponent generated for the female athletes is the suspect.

In the first place, Chia regressed VO_{2max} on body mass (Fig. 1) and concluded that the 2 variables were non-linearly associated with each other. Without an inferential test to formally assess the difference between the linear and non-linear (loess) fits, I am uncomfortable in accepting this assertion.

Yet, it is plausible that *no* association exists between the body mass and VO_{2max} in Chia's female athletes. A visual inspection of the scatterplot in Figure 1 tends to suggest that only a weak – and possibly, statistically insignificant – correlation exists between the 2 variables; hence, I believe the authors are obligated to report the zero-order correlation with the corresponding 95% confidence interval (95% CI). Furthermore, 2 arguments support my contention. First, the *accentuated* association ($r = 0.71$) between the ratio-scaled VO_{2max} values and body mass (Fig. 2 with its correct caption found in Fig. 5) raises the possibility of a statistical artifact – that is, to the extent that little or no correlation exists between 2 variables, relating the part (i.e. body mass) to its whole (body-mass scaled VO_{2max}) can yield a spurious (improved) correlation.² Second and more importantly, the 95% CI of Chia's mass exponent ($b = 0.24$, 95% CI, 0.10 to 0.54) was asymmetrical around the point estimate – and thus, misreported. If the upper bound of the 95 confidence limits reported by Chia were correct, the corresponding lower bound should be -0.10, and not 0.10. Accordingly, to the extent that the 95% CI for the mass exponent contains 0, indicating that body mass should be scaled to the power of 0, no statistical association exists between body mass

and VO_{2max} – and thus, no scaling for body mass is required, at least in Chia's female athletes.

What could have accounted for the seemingly counterintuitive, statistically non-significant associations between body mass and VO_{2max} ? I believe the most parsimonious explanation is the use of a small heterogeneous sample of female athletes with varying training background – and hence, body composition.

In conclusion, it is likely that *no* association exists between body mass and VO_{2max} in Chia's female athletes, rendering any comparisons between allometric and ratio scaling moot. More importantly, the study by Chia and Aziz should be used to call attention to the perils of performing allometric analysis on small heterogeneous samples.

REFERENCES

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2. Pendleton BF, Newman I, Marshall RS. A Monte Carlo approach to correlational spuriousness and ratio variables. *J Stat Comp Sim* 1983; 18:93-124.

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