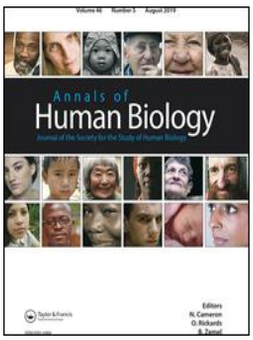

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Estimating peak height velocity in individuals

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The paper by Boeyer et al. (2020) is seriously flawed. It compares three ways to estimate peak height velocity (PHV) and its timing (aPHV) in individuals: my SITAR growth curve model (Cole et al. 2010), a quintic curve and a cubic spline curve.

The abstract compares the population average curve with the curves for individuals, and reports that "In general, mean aPHV was earlier, and PHV was greater for individuals when compared to estimates from population average models". As applied to SITAR this statement is factually incorrect.

There is an important misconception here that relates to the "population average curve". With SITAR, the mean curve based on the population is also an unbiased estimate of the curve for the average individual. Thus aPHV and PHV averaged across individuals are the same *by definition* as aPHV and PHV for the mean curve. This is because SITAR adjusts for aPHV and PHV, as random effects in a mixed effects model, while averaging the individual curves. The paper's Table 1 confirms that the SITAR mean curve is unbiased.

The mean quintic and cubic spline curves do not adjust for individual aPHV or PHV, treating the data as cross-sectional not longitudinal, and Table 1 shows they are biased, as is well known (Merrell 1931, Cole et al. 2008). Yet oddly the authors fail to point out that SITAR performs better, and even more oddly they recommend the use of the quintic curve in paediatric clinical practice.

The authors appear not to properly understand the SITAR model. They say, "The size, tempo, and velocity parameters derived from SITAR describe each individual's deviation from the population average (i.e. fixed effects) but do not provide individual estimates of PHV and aPHV that can be assessed." This is again factually wrong – the random effects (*not* fixed effects) for individual aPHV and PHV are directly obtainable via the `ranef` function, in age units for aPHV and fractional units for PHV.

But setting SITAR aside, the recommendation for use "in paediatric clinical practice" is the bigger problem with the paper. Clinical practice involves comparing a child's growth as seen now with what might be expected given their previous growth pattern. So it is a

process of prediction based on an incomplete growth curve. Yet the analyses by Boeyer et al. involve *complete* growth curves, which include data in the future that are available only in hindsight. As such they cannot be used to predict future growth.

This needs spelling out – complete growth curves in individuals are uninformative, and hence useless, for clinical practice. The converse is also true, that methods like SITAR perform poorly when applied to incomplete pubertal growth curves. Boeyer et al. hint at this in their introduction but take it no further. It is a reasonable research question, how to predict future growth from incomplete growth curves, but importantly it cannot be addressed with complete growth curves.

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