Supplementary File 1

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1 Reparameterization of SITAR's random effect

The SITAR growth curve is a shape-invariant growth that assumes all individuals to have the same underlying shape of the growth curve [1, 2]. The SITAR formula is expressed as:

$$y_{it} = \alpha_i + h\left\{\frac{t-\beta_i}{e^{-\gamma_i}}\right\} + \epsilon_{it}, \tag{1}$$

where y_{it} is the measurement for subject i at age t; α_i, β_i, and γ_i are, respectively, size, tempo, and intensity random effects; $h(\cdot)$ is a cubic regression spline curve; and ϵ_{it} are independent normally distributed errors.

To reparameterize the intensity random parameter γ_i;

Let γ_w be the new intensity parameter. If we multiply both sides of equation 1 by $\frac{e^{\gamma_w}}{e^{\gamma_w}}$, equation 1 becomes:

$$y_{it} = \alpha_i + h'\left\{\frac{t-\beta_i}{e^{-\gamma_i+\gamma_w}}\right\} + \epsilon_{it}, \tag{2}$$

where $h' = \left\{\frac{h}{e^{\gamma_w}}\right\}$.

Equation 2 can thus be generalized to:

$$y_{it} = \alpha_i + h'\left\{\frac{t-\beta_i}{e^{-(\gamma_i-\gamma_w)}}\right\} + \epsilon_{it}, \tag{3}$$

A general form of the new reparametrized intensity parameter based on γ_w for each individual can thus be obtained as $\gamma_i - \gamma_w$

Ohuma EO, *et al. BMJ Global Health* 2021; 6:e004107. doi: 10.1136/bmjgh-2020-004107

References

[1] Tim J Cole, Malcolm D C Donaldson, and Yoav Ben-Shlomo. SITAR - a useful instrument for growth curve analysis. International Journal of Epidemiology, 39(6):1558–1566, 2010.

[2] TJ Cole, D Kuh, W Johnson, KA Ward, LD Howe, JE Adams, R Hardy, and KK Ong. Using Super-Imposition by Translation And Rotation (SITAR) to relate pubertal growth to bone health in later life: the Medical Research Council (MRC) National Survey of Health and Development. International Journal of Epidemiology, 45(4):1125–1134, 2016.