SUPPLEMENTAL MATERIALS

Supplemental Table 1. Model parameters

Parameter name	Variable	Value*	Unit	Source
Physical characteristics				
Female reference BMI	BMI_{Fem}^{Ref}	(0.0417,14.2),(0.125,14.9),(0.208,15.5),(0.292,16),(0.375,16.5),(0.458,16.8),(0.542,17.1),(0.625,17.2),(0.708,17.4),(0.792,17.4),(0.875,17.5),(0.958,17.5),(1.04,17.5),(1.13,17.4),(1.21,17.4),(1.29,17.3),(1.38,17.2),(1.46,17.1),(1.54,17),(1.63,16.9),(1.71,16.8),(1.79,16.7),(1.88,16.5),(1.96,16.4),(2,16.4),(2.29,16.2),(2.79,15.8),(3.29,15.6),(3.79,15.4),(4.29,15.2),(4.79,15.2),(5.29,15.2),(5.79,15.2),(6.29,15.3),(6.79,15.4),(7.29,15.5),(7.79,15.7),(8.29,15.9),(8.79,16.2),(9.29,16.4),(9.79,16.7),(10.3,17),(10.8,17.3),(11.3,17.6),(11.8,17.9),(12.3,18.3),(12.8,18.6),(13.3,18.9),(13.8,19.2),(14.3,19.5),(14.8,19.8),(15.3,20.1),(15.8,20.3),(16.3,20.6),(16.8,20.8),(17.3,21),(17.8,21.2),(18.3,21.4),(18.8,21.5), (19.3, 21.6),(19.8,21.7),(20,21.7)	Age in Year, Kg/M² (Age, BMI)	(1)
Male reference BMI	BMI_{Mal}^{Ref}	(0.0417,14.4),(0.125,15.2),(0.208,16),(0.292,16.6),(0.375,17.1),(0.458,17.5),(0.542,17.7),(0.625,17.9),(0.708,18),(0.792,18.1),(0.875,18.1),(0.958,18.1),(1.04,18.1),(1.13,18),(1.21,17.9),(1.29,17.8),(1.38,17.6),(1.46,17.5),(1.54,17.4),(1.63,17.2),(1.71,17.1),(1.79,17),(1.88,16.8),(1.96,16.7),(2,16.6),(2.29,16.4),(2.79,16.1),(3.29,15.9),(3.79,15.7),(4.29,15.6),(4.79,15.5),(5.29,15.4),(5.79,15.4),(6.29,15.4),(6.79,15.5),(7.29,15.6),(7.79,15.7),(8.29,15.9),(8.79,16.1),(9.29,16.3),(9.79,16.5),(10.3,16.8),(10.8,17.1),(11.3,17.3),(11.8,17.7),(12.3,18),(12.8,18.3),(13.3,18.6),(13.8,19),(14.3,19.3),(14.8,19.7),(15.3,20),(15.8,20.4),(16.3,20.7),(16.8,21.1),(17.3,21.4),(17.8,21.7),(18.3,22.1),(18.8,22.4),(19.3,22.6),(19.8,22.9),(20,23)	Age in Year, Kg/M² (Age, BMI)	(1)
Female reference height	H_{Fem}^{Ref}	(0.0417,51.7),(0.125,55.3),(0.208,58.1),(0.292,60.5),(0.375,62.5),(0.458,64.4),(0.542,66.1),(0.625,67.7),(0.708,69.2),(0.792,70.6),(0.875,71.9),(0.958,73.2),(1.04,74.4),(1.13,75.6),(1.21,76.7),(1.29,77.8),(1.38,78.8),(1.46,79.8),(1.54,80.8),(1.63,81.8),(1.71,82.7),(1.79,83.6),(1.88,84.5),(1.96,85.3),(2,85),(2.29,88),(2.79,92.4),(3.29,95.9),(3.79,99.3),(4.29,103),(4.79,106),(5.29,110),(5.79,113),(6.29,117),(6.79,120),(7.29,123),(7.79,126),(8.29,129),(8.79,132),(9.29,134),(9.79,137),(10.3,140),(10.8,143),(11.3,146),(11.8,150),(12.3,153),(12.8,156),(13.3,158),(13.8,160),(14.3,161),(14.8,162),(15.3,162),(15.8,162),(16.3,163),(16.8,163),(17.3,163),(17.8,163),(18.3,163),(18.8,163),(19.3,163),(19.8,163)	Age in Year, cm (Age, height)	(1)
Male reference height	H_{Mal}^{Ref}	(0.0417,52.7),(0.125,56.6),(0.208,59.6),(0.292,62.1),(0.375,64.2),(0.458,66.1),(0.542,67.9),(0.625,69.5),(0.708,70.9),(0.792,72.3),(0.875,73.7),(0.958,74.9),(1.04,76.1),(1.13,77.3),(1.21,78.4),(1.29,79.4),(1.38,80.5),(1.46,81.4),(1.54,82.4),(1.63,83.3),(1.71,84.2),(1.79,85.1),(1.88,86),(1.96,86.8),(2,86.5),(2.29,89.2),(2.79,93.4),(3.29,97.2),(3.79,101),(4.29,104),(4.79,108),(5.29,111),(5.79,114),(6.29,117),(6.79,120),(7.29,124),(7.79,127),(8.29,130),(8.79,132),(9.29,135),(9.79,138),(10.3,140),(10.8,142),(11.3,145),(11.8,148),(12.3,151),(12.8,154),(13.3,158),(13.8,162),(14.3,166),(14.8,169),(15.3,171),(15.8,173),(16.3,174),(16.8,175),(17.3,176),(17.8,176),(18.3,176),(18.8,177),(19.3,177),(19.8,177)	Age in Year, cm (Age, height)	(1)
Female reference fat mass index	FMI_{Fem}^{Ref}	(0,1.92),(0.25,5.16),(0.5,5.52),(0.75,4.9),(1,4.62),(1.5,4.27),(2,3.97),(3,3.66),(4,3.38),(5,3.3),(6,3.54),(7,3.77),(8,4.01),(9,4.24),(10,4.46),(11,4.68),(12,4.9),(13,5.11),(14,5.32),(15,5.51),(16,5.7),(17,5.88),(18,6.05),(19,6.21),(20,6.37),(80,6.55)	Age in Year, Kg/M² (Age, FMI)	(2-4)
Male reference fat mass index	FMI_{Mal}^{Ref}	(0,1.6),(0.25,5.1),(0.5,5.03),(0.75,4.49),(1,4.42),(1.5,4.15),(2,4.04),(3,3.54),(4,3.21),(5,2.84),(6,2.65),(7,2.45),(8,2.54),(9,2.98),(10,3.37),(11,3.52),(12,3.4),(13,3.18),(14,3.02),(15,2.9),(16,2.84),(17,2.9),(18,3.14),(19,3.55),(20,4.01),(80,5.31)	Age in Year, Reference FMI in Kg/M² (Age, FMI)	(2-4)
Female reference fractional cellularity	CL_{Fem}^{Ref}	(0,0.85),(1,0.894),(2,0.928),(3,0.947),(4,0.958),(5,0.966),(6,0.974),(7,0.98),(8,0.988),(9,0.997),(10,1), (20,1), (80,0.895)	Age in Year, Reference Fractional Cellularity	(5)
Male reference fractional cellularity	CL_{Mal}^{Ref}	(0,0.8),(1,0.83),(2,0.871),(3,0.897),(4,0.918),(5,0.934),(6,0.946),(7,0.957),(8,0.968),(9,0.979),(10,0.99),(11,1),(20,1),(80,0.825)	Age in Year, Reference Fractional Cellularity	(5)
Fractional weight of the four active organs	$\sum_{i=1}^{4} \frac{M_i^{Ref}}{BW^{Ref}}$	(0,0.152),(1,0.145),(2,0.132),(3,0.124),(4,0.119),(5,0.106),(6,0.0984),(7,0.0917),(8,0.0833),(9,0.0803),(10,0.077),(11,0.0732),(12,0.0707),(13,0.0663),(14,0.062),(15,0.0592),(16,0.0578),(17,0.0566),(18,0.0573),(20,0.0543)	kg	(6)

Female reference physical activity level	PAL_{Fem}^{Ref}	(0,1.3),(1.5,1.42),(2.5,1.42),(3.5,1.44),(4.5,1.49),(5.5,1.53),(6.5,1.56),(7.5,1.6),(8.5,1.63),(9.5,1.66),(10.5,1.71),(11.5,1.74),(12.5,1.76),(13.5,1.76),(14.5,1.75),(15.5,1.73),(16.5,1.73),(17.5,1.72),(20,1.62),(30,1.48),(40,1.41),(50,1.36),(60,1.32),(70,1.28),(80,1.25)	Age in Year, Reference physical activity level (dimensionless)	(4, 7)
Male reference physical activity level	PAL_{Mal}^{Ref}	(0,1.3),(1.5,1.43),(2.5,1.45),(3.5,1.44),(4.5,1.49),(5.5,1.53),(6.5,1.57),(7.5,1.6),(8.5,1.63),(9.5,1.66),(10.5,1.71),(11.5,1.75),(12.5,1.79),(13.5,1.82),(14.5,1.84),(15.5,1.84),(16.5,1.84),(17.5,1.83),(20,1.75),(30,1.55),(40,1.45),(50,1.38),(60,1.33),(70,1.3),(80,1.27)	Age in Year, Reference physical activity level (dimensionless)	(4, 7)
Energy needs and densities				
BMR contribution of Brain, Kidneys, Liver, Heart based on organ specific weights	$\sum_{i=1}^{4} \gamma_i \frac{M_i^{Ref}}{BW^{Ref}}$	$Max(31.4 + 189.9e^{-0.107.age}, 59.05)$	KJ/Kg/day	(5)
Maximum energy density of lean mass	ρ_L^{Adult}	5000	KJ/Kg	(8)
Minimum energy density of lean mass	ρ_L^{Base}	3514	KJ/Kg	(8)
Slope of lean mass energy density with respect to lean mass	α_ρ	18	KJ/Kg^2	(8)
Energy density of fat mass	ρ_F	39500	KJ/Kg	(9)
Energy need for turnover of lean mass	η_L	960	KJ/Kg	(9)
Energy need for turnover of fat mass	η_F	750	KJ/Kg	(9)
Energy requirements of active organs	$\gamma_{\Delta L}$	92	KJ/Kg/Day	(9)
Energy requirement of structural muscle and other residual lean tissue	γ_5	54	KJ/Kg/Day	(5, 10)
Energy requirements for unit fat mass	γ_F	13	KJ/Kg/Day	(9)
Other Factors				
Growth projection horizon	d	0.02	Year	
Time to consume or adjust body mass reserves	τ	30	Days	
Slope of height growth rate reaction to relative BMI	s_H	8	Dimensionless	
Maximum catch up growth rate relative to normal height growth for age	v_H	4	Dimensionless	(11)
Energy partitioning factor	c	10.4	Kg	Based on Forbes partitioning equation (12)

Fat mass fraction of active metabolic organs	f_{FM}	0.1	Dimensionless	(5)
Thermic cost of eating	β	0.1	Dimensionless	(9)
Weight of WHO based projection on desired weight	sb	0.5	Dimensionless	
Adaptive thermogenesis effect	β_T	0.14	Dimensionless	(9)

*Simulations use linear interpolation between data-points reported in the table.

References

1. Kuczmarski RJ, Ogden CL, Grummer-Strawn LM, Flegal KM, Guo SS, Wei R, Mei Z, Curtin LR, Roche AF, Johnson CL 2000 CDC growth charts: United States. Adv Data:1-27.
2. Wells JC, Williams JE, Chomtho S, Darch T, Grijalva-Eternod C, Kennedy K, Haroun D, Wilson C, Cole TJ, Fewtrell MS 2012 Body-composition reference data for simple and reference techniques and a 4-component model: a new UK reference child. Am J Clin Nutr 96:1316-1326.
3. Butte NF, Hopkinson JM, Wong WW, Smith EO, Ellis KJ 2000 Body composition during the first 2 years of life: an updated reference. Pediatr Res 47:578-585.
4. CDC 2013 National Health and Nutrition Examination Survey. Centers for Disease Control and Prevention.
5. Wang ZM 2012 High ratio of resting energy expenditure to body mass in childhood and adolescence: A mechanistic model. American Journal of Human Biology 24:460-467.
6. Altman PL, Dittmer DS 1962 Growth including reproduction and morphological development. Federation of American Societies for Experimental Biology, Washington,, pp xii, 608 p.
7. Torun B 2005 Energy requirements of children and adolescents. Public Health Nutrition 8:968-993.
8. Hall KD, Butte NF, Swinburn BA, Chow CC 2013 Quantifying the Dynamics of Childhood Growth and Obesity. Lancet Diabetes and Endocrinology 1:97-105.
9. Hall KD, Sacks G, Chandramohan D, Chow CC, Wang YC, Gortmaker SL, Swinburn BA 2011 Quantification of the effect of energy imbalance on bodyweight. Lancet 378:826-837.

10. Wang Z, Heshka S, Heymsfield SB, Shen W, Gallagher D 2005 A cellular-level approach to predicting resting energy expenditure across the adult years. Am J Clin Nutr 81:799-806.

11. Walker SP, Golden MH 1988 Growth in length of children recovering from severe malnutrition. Eur J Clin Nutr 42:395-404.

12. Hall KD 2007 Body fat and fat-free mass inter-relationships: Forbes's theory revisited. Br J Nutr 97:1059-1063.