

Web Appendix 1

A standard taxonomy of models was used(34), starting from the unconditional means model (Model A), unconditional growth model (Model B), growth model with level-2 controlled effects of demographic factors (Model C), growth model with level-2 controlled effects of demographic factors, adding a squared-age term that would allow the rate of change to vary with time (Model D). In model E, we also added year of birth to allow for secular trends in the intercept and rate of change as well as the curvature by interacting with age-square. In all models, age was centered at 50 years, while education was centered at 16 years. The following equations apply to each of the growth models considered:

-- Web Table 1 about here--

Notations: Y_{ij} is the response variable (BMI or WC) for each individual “i” and age at visit “j”. π_{0i} is the level-1 intercept for individual i; π_{1i} is the level-1 slope for individual i; γ_{00} is the level-2 intercept of the random intercept π_{0i} ; γ_{10} is the level-2 intercept of the slope π_{1i} ; Z_{ik} is a vector of fixed covariates for each individual i that are used to predict level-1 intercepts and slopes; ζ_{0i} and ζ_{1i} are level-2 disturbances; ε_{ij} is the within-person level-1 disturbance.

Model E’s improvement in fit compared to the simpler models was evaluated using Deviance, AIC and BIC statistics as well as pseudo- R^2 . In addition, residuals were plotted against predicted values to assess their normality. Finally, empirical Bayes estimators of BMI and WC at ages 30 through 50, spaced in 5-year periods, were predicted from Model E using the following method, after estimating the random effects ($(\zeta_{0i} + \varepsilon_{ij})$ for the intercept and ζ_{1i} for the slope) for each individual i:

--Web Table 2 about here--

Evaluation of model E in terms of fit to the data indicated that for instance observed BMI at ages ranges between 30 and 40 was highly correlated with predicted values at age 35 ($r=0.95$). The same was observed for all other exposures predicted at each age. In addition, residuals were shown to be random around zero and with comparable accuracy at all values of BMI/WC when plotted against predicted values at each age. Moreover, correlations between empirical bayes estimators of slopes and intercepts were small ($r=0.04$ for WC and 0.31 for BMI) indicating that initial status was not strongly or linearly associated with rate of change over time.

Web Table 1

Model	Level-1 model	Level-2 model	Composite model
A	$Y_{ij} = \pi_{0i} + \varepsilon_{ij}$	$\pi_{0i} = \gamma_{00} + \zeta_{0i}$	$Y_{ij} = \gamma_{00} + (\zeta_{0i} + \varepsilon_{ij})$
B	$Y_{ij} = \pi_{0i} + \pi_{1i}Age_{50} + \varepsilon_{ij}$	$\pi_{0i} = \gamma_{00} + \zeta_{0i}$ $\pi_{1i} = \gamma_{10} + \zeta_{1i}$	$Y_{ij} = \gamma_{00} + \gamma_{10}Age_{50} + (\zeta_{0i} + \zeta_{1i}Age_{50} + \varepsilon_{ij})$
C	$Y_{ij} = \pi_{0i} + \pi_{1i}Age_{50} + \varepsilon_{ij}$	$\pi_{0i} = \gamma_{00} + \sum_{k=1}^7 \gamma_{0k}Z_{ik} + \zeta_{0i}$ $\pi_{1i} = \gamma_{10} + \sum_{k=1}^7 \gamma_{1k}Z_{ik} + \zeta_{1i}$	$Y_{ij} = \gamma_{00} + \sum_{k=1}^7 \gamma_{0k}Z_{ik} + \gamma_{10} + \sum_{k=1}^7 \gamma_{1k}Z_{ik}Age_{50} + (\zeta_{0i} + \zeta_{1i}Age_{50} + \varepsilon_{ij})$
D	$Y_{ij} = \pi_{0i} + \pi_{1i}Age_{50} + \varepsilon_{ij}$	$\pi_{0i} = \gamma_{00} + \sum_{k=1}^7 \gamma_{0k}Z_{ik} + \zeta_{0i}$ $\pi_{1i} = \gamma_{10} + \sum_{k=1}^8 \gamma_{1k}Z_{ik} + \zeta_{1i}$	$Y_{ij} = \gamma_{00} + \sum_{k=1}^7 \gamma_{0k}Z_{ik} + \gamma_{10} + \sum_{k=1}^8 \gamma_{1k}Z_{ik}Age_{50} + (\zeta_{0i} + \zeta_{1i}Age_{50} + \varepsilon_{ij})$
E	$Y_{ij} = \pi_{0i} + \pi_{1i}Age_{50} + \varepsilon_{ij}$	$\pi_{0i} = \gamma_{00} + \sum_{k=1}^8 \gamma_{0k}Z_{ik} + \zeta_{0i}$ $\pi_{1i} = \gamma_{10} + \sum_{k=1}^{10} \gamma_{1k}Z_{ik} + \zeta_{1i}$	$Y_{ij} = \gamma_{00} + \sum_{k=1}^8 \gamma_{0k}Z_{ik} + \gamma_{10} + \sum_{k=1}^{10} \gamma_{1k}Z_{ik}Age_{50} + (\zeta_{0i} + \zeta_{1i}Age_{50} + \varepsilon_{ij})$

Web Table 2

$$2.1 \quad \pi_{0i} = \gamma_{00} + \sum_{k=1}^8 \gamma_{0k} Z_{ik} + (\zeta_{0i} + \varepsilon_{ij})$$

$$2.2 \quad \pi_{1i} = \gamma_{10} + \sum_{k=1}^{10} \gamma_{1k} Z_{ik} + \zeta_{1i}$$

$$2.3 \quad Y_{ij} = \pi_{0i} + \pi_{1i} (Age_{50})_l$$

where $(Age_{50})_l$ is assigned values of -20; -15; -10; -5; and 0.

<u>Rate of Change</u> π_{1i}	Intercept	γ_{10}	—	0.071*** (0.003)	-0.003 (0.011)	0.009 (0.011)	0.047*** (0.010)
	Sex (Female)	γ_{12}	—	—	0.069*** (0.008)	0.066*** (0.007)	0.030*** (0.007)
	Education -16 (years)	γ_{13}	—	—	-0.002~ (0.001)	-0.002~ (0.001)	-0.003* (0.001)
	Former smoker (vs. never smoker)	γ_{14}	—	—	-0.020** (0.007)	-0.009 (0.007)	-0.006 (0.007)
	Current smoker (vs. never smoker)	γ_{15}	—	—	-0.019* (0.008)	-0.014~ (0.008)	-0.009 (0.007)
	NH black vs. NH white	γ_{16}	—	—	0.025~ (0.015)	0.020 (0.014)	-0.019 (0.013)
	other race vs. NH white	γ_{17}	—	—	0.026 (0.031)	0.016 (0.030)	-0.022 (0.028)
	Age-50 (years)	γ_{18}	—	—	—	-0.001*** (0.000)	-0.000 (0.000)
	Year of birth-1920	γ_{19}	—	—	—	—	0.004*** (0.000)
	(Age-50)*(year of birth-1920)	γ_{110}	—	—	—	—	0.000*** (0.000)
	<u>Variance components</u>						
Level 1	Within-person	σ^2_{ϵ}	2.651*** (0.030)	1.189*** (0.015)	1.164*** (0.014)	1.175*** (0.015)	1.160*** (0.014)

Level 2	In initial status	σ^2_0	14.850*** (0.412)	16.054*** (0.493)	14.665*** (0.491)	14.760*** (0.492)	13.818*** (0.459)
	In rate of change	σ^2_1	—	0.020*** (0.001)	0.019*** (0.001)	0.017*** (0.001)	0.014*** (0.001)
	Covariance	σ^2_{01}	—	0.069*** (0.016)	0.101*** (0.015)	0.082*** (0.015)	0.037*** (0.013)
<u>Pseudo R² Statistic and Goodness-of-fit[†]</u>							
	$R^2_{y,y}$		—	—	-0.46	-0.19	0.46
	R^2_ϵ		—	0.55	0.02	0.01	0.02
	R^2_0		—	-0.08	0.09	0.08	0.16
	R^2_1		—	—	0.05	0.15	0.30
	Deviance		80779.260	72005.080	67737.700	67027.380	66455.080
	AIC		80785.250	72017.090	67173.710	67065.370	66899.080
	BIC		80808.760	72064.100	67313.880	67213.330	66670.400

			WC				
			Model A	Model B	Model C	Model D	Model E
			(n'=14852)	(n'=14852)	(n'=14063)	(n'=14063)	(n'=14063)
Parameter						add age-square	add year of birth
Fixed Effects							
<u>Initial status</u>	Intercept	γ_{00}	87.714***	85.844***	103.380***	103.508***	106.477***
π_{0i}			(0.217)	(0.235)	(0.768)	(0.777)	(0.747)
	Sex (Female)	γ_{01}	—	—	-13.217***	-13.155***	-15.651***
					(0.467)	(0.472)	(0.467)
	Education -16 (years)	γ_{02}	—	—	-0.088	-0.104	-0.110
					(0.083)	(0.084)	(0.080)
	Former smoker (vs. never smoker)	γ_{04}	—	—	-0.332	-0.535	-0.272
					(0.492)	(0.500)	(0.479)
	Current smoker (vs. never smoker)	γ_{05}	—	—	0.886	0.960~	0.763
					(0.536)	(0.543)	(0.518)
	NH black vs. NH white	γ_{06}	—	—	5.479***	5.440***	2.204***
					(0.753)	(0.760)	(0.730)
	other race vs. NH white	γ_{07}	—	—	0.701	0.956	-3.115
					(1.630)	(1.642)	(1.554)
	Year of birth-1920	γ_{08}	—	—	—	—	0.221***
							(0.013)
<u>Rate of Change</u>	Intercept	γ_{10}	—	0.349***	0.167***	0.199***	0.270***

π_{1i}				(0.009)	(0.030)	(0.029)	(0.028)
	Sex (Female)	γ_{12}	—	—	0.156*** (0.020)	0.152*** (0.019)	0.094*** (0.019)
	Education -16 (years)	γ_{13}	—	—	-0.004 (0.003)	-0.004 (0.003)	-0.006* (0.003)
	Former smoker (vs. never smoker)	γ_{14}	—	—	-0.035 (0.022)	-0.007 (0.022)	-0.000 (0.021)
	Current smoker (vs. never smoker)	γ_{15}	—	—	-0.040~ (0.022)	-0.028 (0.022)	-0.004 (0.020)
	NH black vs. NH white	γ_{16}	—	—	0.045 (0.039)	0.035 (0.039)	-0.043 (0.036)
	other race vs. NH white	γ_{17}	—	—	0.040 (0.079)	0.018 (0.078)	-0.047 (0.072)
	Age-50 (years)	γ_{18}	—	—	—	-0.002*** (0.000)	0.000 (0.000)
	Year of birth-1920	γ_{19}	—	—	—	—	0.009*** (0.001)
	(Age-50)*(year of birth-1920)	γ_{110}	—	—	—	—	0.000*** (0.000)
<u>Variance components</u>							
Level 1	Within-person	σ^2_{ϵ}	34.166*** (0.440)	19.033*** (0.269)	18.343*** (0.261)	18.383*** (0.262)	18.163*** (0.257)
Level 2	In initial status	σ^2_0	122.928*** (3.584)	125.661*** (4.101)	89.574*** (3.272)	92.091*** (3.392)	81.268*** (2.946)

In rate of change	σ^2_1	—	0.100*** (0.006)	0.091*** (0.005)	0.081*** (0.005)	0.062*** (0.003)
Covariance	σ^2_{01}	—	0.069*** (0.116)	0.609*** (0.098)	0.391*** (0.101)	0.173*** (0.085)
<u>Pseudo R² Statistic and Goodness-of-fit[†]</u>						
R ² _{y,y}		—	—	-7.83	-4.67	-1.51
R ² _ε		—	0.44	0.04	0.03	0.05
R ² ₀		—	-0.02	0.29	0.27	0.35
R ² ₁		—	—	0.09	0.19	0.38
Deviance		102222.040	97099.280	90200.280	90139.560	89479.06
AIC		102228.000	97111.290	90236.280	90177.570	89523.060
BIC		102250.000	97156.920	90372.210	90321.040	89689.190

~p<0.10; *p<0.05; **p<0.01; ***p<0.001

These models predict BMI for the whole age range in the BLSA data (17-132 years) as a function of AGE-50 (at level-1) and various combinations of fixed and time-dependent variables (sex, education, smoking status and race/ethnicity). All models were fitted using maximum likelihood estimation and unstructured covariance matrix.

[†] For Pseudo-R² statistics: Model B was compared to Model A. Subsequent models were compared to model B.