Supporting Information

Israel et al. 10.1073/pnas.1409794111

SI Text

Dunedin Study Sample. Participants are members of the Dunedin Multidisciplinary Health and Development Study, a longitudinal investigation of health and behavior in a complete birth cohort. Study members (n = 1,037; 91% of eligible births; 52% male) were all individuals born between April 1972 and March 1973 in Dunedin, New Zealand, who were eligible for the longitudinal study based on residence in the province at age 3 and who participated in the first follow-up assessment at age 3 (1). The cohort represents the full range of socioeconomic status in the general population of New Zealand's South Island and is primarily white. Assessments were carried out at birth and at ages 3, 5, 7, 9, 11, 13, 15, 18, 21, 26, 32, and, most recently, 38 y, when 95% of the 1,007 Study Members still alive took part. At each assessment wave, each study member is brought to the Dunedin research unit for a full day of interviews and examinations. The Otago Ethics Committee approved each phase of the study, and informed consent was obtained from all study members. It was important to the study that our actions not negatively impact the study members, and as such we negotiated "research only" access to the data, which would not affect individual credit scores.

Statistical Analyses. We used two methods to test the relative contribution of our predictor variables to our age 38 outcome measures (credit scores and heart age): (*i*) linear regression and (*ii*) structural equation modeling (SEM).

Linear regression models were used to test the association between predictor variables and each one of our age 38 outcome measures. Standardized β coefficients (denoted as β) are presented to facilitate comparisons across predictor variables. All statistical tests included controls for sex.

SEM models were used to test whether predictor variables accounted for a significant portion of the covariation between our two age 38 outcome measures. SEM models were estimated using STATA 13 (Stata Corp) with direct maximum likelihood. These models are presented in Fig. 3, Figs. S1–S4 (adult models), and Fig. 5 (childhood model). The adult models include paths between age 38 predictor variables to age 38 credit scores and to age 38 Framingham heart age. Predictor variables were allowed to be correlated. Importantly, disturbance terms between credit scores and heart age were also correlated to account for unexplained shared variance. The childhood model (Fig. 5) has the same form as the adult model (Fig. 3) with the exception that adult human capital factors were replaced with their childhood antecedents. For all models, sex was included as an exogenous variable with paths to all observed measures.

SEM significance tests involved comparisons of nested models. Nested model forms were identical to their comparators except that the covariance between credit scores and heart age was constrained to initial levels before the inclusion of predictor variables. Poorer fit of the constrained models would indicate that predictor variables accounted for a significant portion of the covariation between credit scores and heart age. Comparisons of nested models were assessed using χ^2 difference tests, as well as multiple indices of model fit including the comparative fit index (CFI), the Tucker-Lewis index (TLI), and the root mean square error of approximation (RMSEA). The CFI and TLI range from 0 to 1, with 0 indicating the absence of model fit and 1 indicating perfect model fit (2). RMSEA values of less than 0.05 are generally accepted as indicators of good model fit in the social sciences; those between 0.05 and 0.08 are indicative of an adequate model fit (3).

1. Moffitt TE, Caspi A, Rutter M, Silva PA (2001) *Sex Differences in Antisocial Behaviour: Conduct Disorder, Delinquency, and Violence in the Dunedin Longitudinal Study* (Cambridge Univ Press, New York).
2. Hoyle R, Panter A (1995) Writing about structural equation models. *Structural Equation Modeling: Concepts, Issues, and Applications*, ed Hoyle R (Sage, Thousand Oaks, CA), pp 158–176.
3. Browne MW, Cudeck R (1992) Alternative Ways of Assessing Model Fit. *Sociol Methods Res* 21(2):230–258.

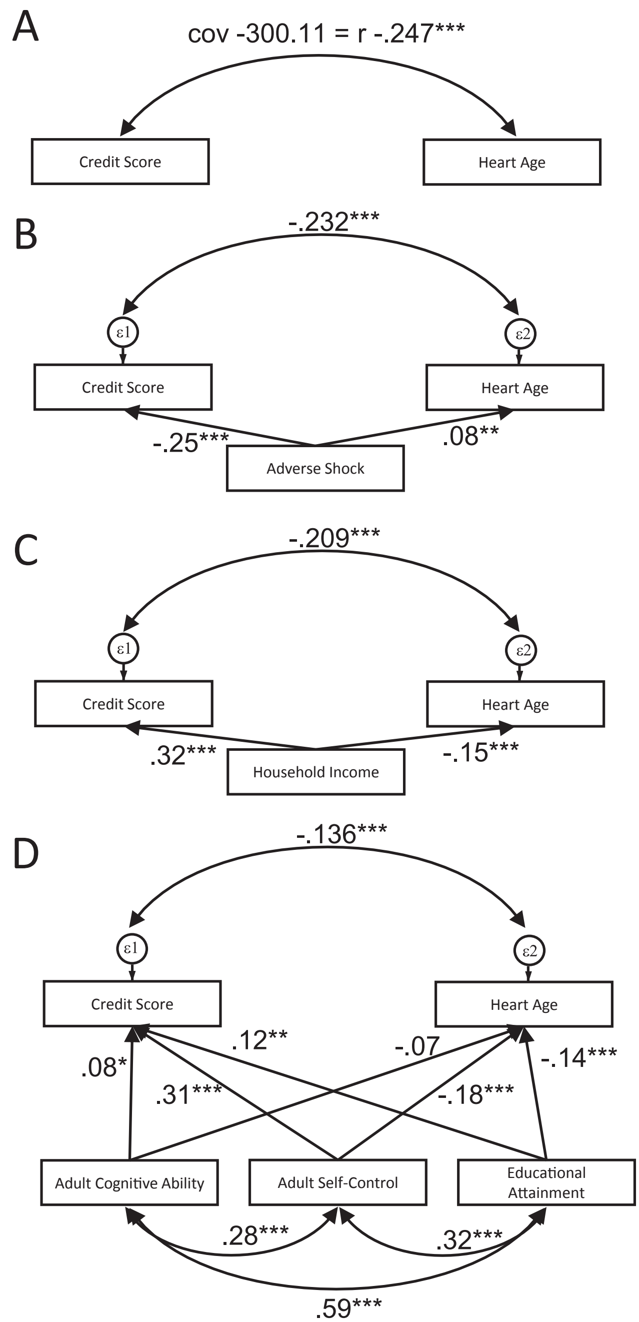

Fig. S1. Effect of income, extraordinary shocks, and adult human capital factors on the covariation between credit scores and heart age. Credit score and heart age are correlated (*A*). Structural equation models illustrate the roles of adverse shocks (*B*), income (*C*), and human capital factors (*D*) on the correlation between credit scores and heart age. Values associated with the paths represent standardized parameter estimates. Single headed arrows represent causal paths and double-headed arrows represent covariances. Sex (not presented) is included as a covariate with paths to all variables. Comparisons of models *B*–*D* to a model where the covariance between credit scores and heart age is constrained to initial levels (covariance of model *A*) showed that only human capital factors accounted for a significant source of the link between credit scores and heart age. **P* < 0.05, ***P* < 0.01, ****P* < 0.001.

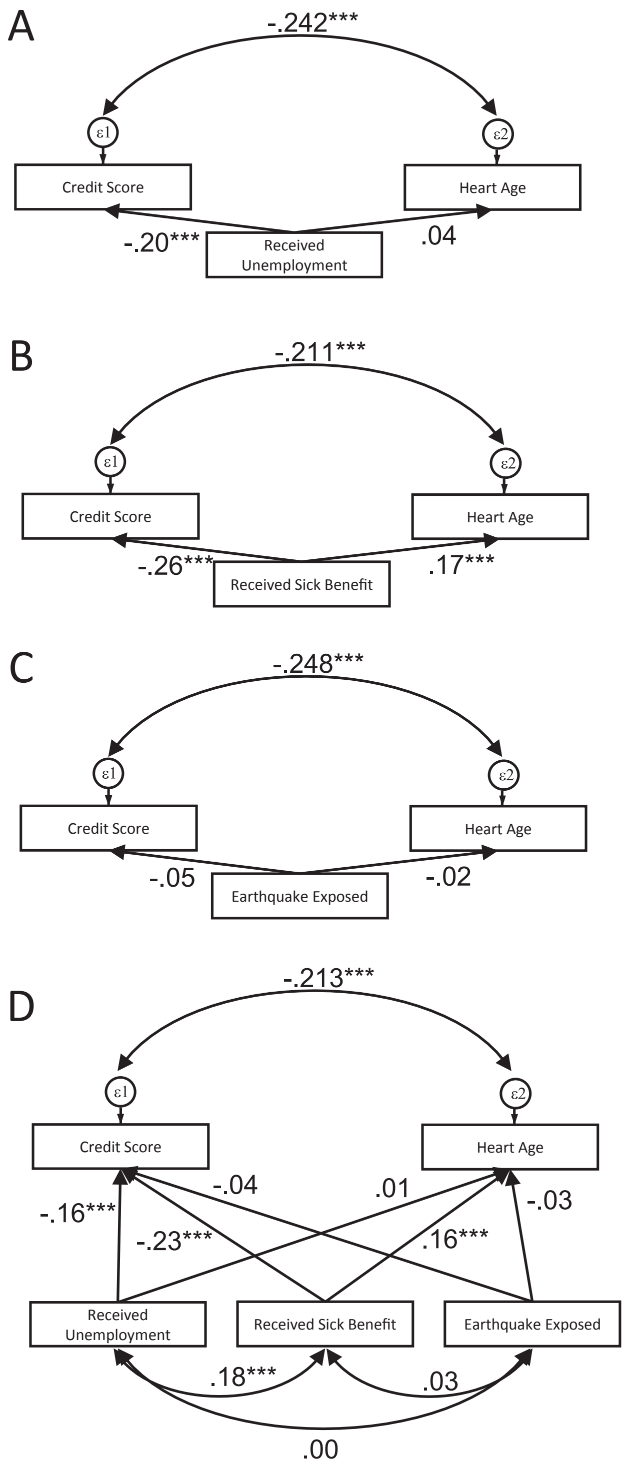

Fig. S2. Effect of extraordinary shocks on credit scores, heart age, and their covariation. The structural equation models presented here illustrate the separate effects of each adverse shock on the covariation between credit scores and heart age: (*A*) received unemployment benefits, (*B*) received sickness benefits, and (*C*) exposed to Christchurch earthquake. *D* shows that controlling for all three shocks simultaneously lowered the correlation between credit scores and heart age from −0.247 (Fig. S1) to −0.213, a reduction of 14%. A comparison with a model where the covariation between credit scores and heart age was constrained to initial levels did not result in significantly poorer fit compared with the unconstrained model {[$\Delta\chi^2(1)$, $n = 817$] = 1.93, $P = 0.165$}, indicating that adverse shocks did not account for a significant portion of the covariance between credit scores and heart age. The values associated with the paths represent standardized parameter estimates. Sex (not presented) is included as a covariate with paths to all variables. $^{*}P < 0.05$, $^{**}P < 0.01$, $^{***}P < 0.001$.

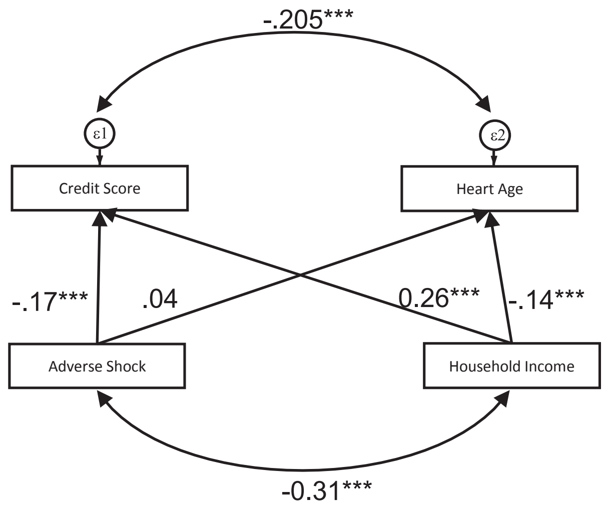

Fig. S3. Combined effect of extraordinary shocks and household income on credit scores, heart age, and their covariation. The structural equation model presented here illustrates the combined effects of adverse shocks and household income on the covariation between credit scores and heart age. Simultaneously controlling for adverse shocks and household income lowered the correlation between credit scores and heart age from −0.247 (Fig. S1) to −0.205, a reduction of 17%. A comparison with a model where the covariation between credit scores and heart age was constrained to initial levels did not result in significantly poorer fit compared with the unconstrained model {[$\Delta\chi^2(1)$, $n = 817$] = 2.95, $P = 0.09$}, indicating that the combined effects of adverse shocks and household income did not account for a significant portion of the covariance between credit scores and heart age. The values associated with the paths represent standardized parameter estimates. Sex (not presented) is included as a covariate with paths to all variables. ***$P < 0.001$.

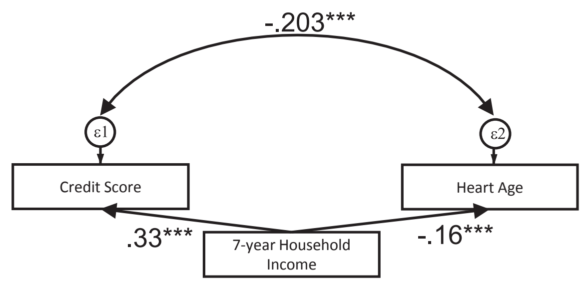

Fig. S4. Effect of 7-y household income on credit scores, heart age, and their covariation. This structural equation model is the same as Fig. S1*C*, except household income at age 38 has been replaced with 7-y household income across ages 32 and 38. The values associated with the paths represent standardized parameter estimates. Sex (not presented) is included as a covariate with paths to all variables. ***$P < 0.001$.

Table S1. Credit scores at age 38 regressed on income and adult human capital factors

	Model 1			Model 2			Model 3			Model 4			Model 5		
Predictor	Coefficient	SE	β	Coefficient	SE	β	Coefficient	SE	β	Coefficient	SE	β	Coefficient	SE	β
Sex	−46.47	10.85	−0.14***	−38.46	10.94	−0.12***	−46.08	10.71	−0.14***	−28.40	10.75	−0.09**	−25.87	10.98	−0.08*
Household income	1.21	0.13	0.31***	0.94	0.14	0.24***	1.01	0.13	0.26***	0.78	0.13	0.20***	0.60	0.14	0.16***
Educational attainment				20.73	4.49	0.18***							10.78	4.89	0.09*
Adult cognitive ability							1.68	0.41	0.15***				0.70	0.45	0.06
Adult self-control										49.82	6.83	0.29***	44.87	6.79	0.26***
R^2	0.11			0.14			0.13			0.18			0.20		

Regression coefficients are reported for age 38 credit scores. Unstandardized β coefficients are reported in column coefficient, robust SEs are reported in column SE, and standardized β coefficients are reported in column β. Sex, female = 0, male =1; household income: annual household income in NZ$ in 000s; educational attainment: 1 = no secondary school qualification, 5 = Bachelor's degree or higher; adult cognitive ability: IQ points; adult self-control: z-score. Model 1, credit scores regressed on income, controlling for sex; model 2, model 1 + educational attainment; model 3, model 1 + adult cognitive ability; model 4, model 1 + adult self-control; and model 5, model 1 + educational attainment, adult cognitive ability, and adult self-control. Level of significance: *$P < 0.05$; **$P < 0.01$; ***$P < 0.001$.

Table S2. Framingham heart age at age 38 regressed on income and adult human capital factors

	Model 1			Model 2			Model 3			Model 4			Model 5		
Predictor	Coefficient	SE	β	Coefficient	SE	β	Coefficient	SE	β	Coefficient	SE	β	Coefficient	SE	β
Sex	6.42	0.51	0.40***	5.97	0.51	0.38***	6.40	0.50	0.40***	5.81	0.53	0.37***	5.62	0.53	0.35***
Household income	−0.03	0.01	−0.14***	−0.01	0.01	−0.06	−0.01	0.01	−0.08*	−0.01	0.01	−0.06	0.00	0.01	0.00
Educational attainment				−1.17	0.20	−0.21***							−0.76	0.21	−0.14***
Adult cognitive ability							−0.09	0.02	−0.17***				−0.04	0.02	−0.08*
Adult self-control										−1.68	0.33	−0.20***	−1.35	0.32	−0.16***
R^2	0.17			0.21			0.20			0.21			0.24		

Regression coefficients are reported for age 38 credit scores. Unstandardized β coefficients are reported in column coefficient, robust SEs are reported in column SE, and standardized β coefficients are reported in column β. Sex, female = 0, male =1; household income: annual household income in NZ$ in 000s; educational attainment: 1 = no secondary school qualification, 5 = Bachelor's degree or higher; adult cognitive ability: IQ points; adult self-control: z-score. Model 1, credit scores regressed on income, controlling for sex; model 2, model 1 + educational attainment; model 3, model 1 + adult cognitive ability; model 4, model 1 + adult self-control; and model 5, model 1 + educational attainment, adult cognitive ability, and adult self-control. Level of significance: *$P < 0.05$; ***$P < 0.001$.

Table S3. Credit scores at age 38 regressed on 7-y income and adult human capital factors

	Model 1			Model 2			Model 3			Model 4			Model 5		
Predictor	Coefficient	SE	β	Coefficient	SE	β	Coefficient	SE	β	Coefficient	SE	β	Coefficient	SE	β
Sex	−44.71	10.78	−0.14***	−37.32	10.87	−0.11***	−44.48	10.68	−0.13***	−27.25	10.65	−0.08*	−24.77	10.89	−0.08*
7-y household income	1.69	0.17	0.33***	1.33	0.18	0.26***	1.41	0.18	0.27***	1.10	0.17	0.21***	0.84	0.19	0.16***
Educational attainment				19.30	4.50	0.17***							10.12	4.88	0.09*
Adult cognitive ability							1.55	0.41	0.14***				0.66	0.45	0.06
Adult self-control										49.01	6.77	0.29***	44.81	6.75	0.26***
R^2	0.12			0.14			0.13			0.19			0.20		

Regression coefficients are reported for age 38 credit scores. Unstandardized β coefficients are reported in column coefficient, robust SEs are reported in column SE, and standardized β coefficients are reported in column β. Sex, female = 0, male =1; household income: annual household income in NZ$ in 000s; educational attainment: 1 = no secondary school qualification, 5 = Bachelor's degree or higher; adult cognitive ability: IQ points; adult self-control: z-score. Model 1, credit scores regressed on income, controlling for sex; model 2, model 1 + educational attainment; model 3, model 1 + adult cognitive ability; model 4, model 1 + adult self-control; and model 5, model 1 + educational attainment, adult cognitive ability, and adult self-control. Level of significance: *$P < 0.05$; ***$P < 0.001$.

Table S4. Framingham Heart Age at age 38 regressed on 7-y income and adult human capital factors

	Model 1			Model 2			Model 3			Model 4			Model 5		
Predictor	Coefficient	SE	β	Coefficient	SE	β	Coefficient	SE	β	Coefficient	SE	β	Coefficient	SE	β
Sex	6.39	0.51	0.40***	5.97	0.51	0.38***	6.38	0.50	0.40***	5.82	0.52	0.37***	5.63	0.53	0.35***
7-y household income	−0.04	0.01	−0.16***	−0.02	0.01	−0.07*	−0.02	0.01	−0.09**	−0.02	0.01	−0.08*	0.00	0.01	−0.01
Educational attainment				−1.12	0.20	−0.20***							−0.74	0.22	−0.13***
Adult cognitive ability							−0.09	0.02	−0.16***				−0.04	0.02	−0.07*
Adult self-control										−1.62	0.33	−0.20***	−1.33	0.32	−0.16***
R^2	0.18			0.21			0.20			0.21			0.23		

Regression coefficients are reported for age 38 credit scores. Unstandardized β coefficients are reported in column coefficient, robust SEs are reported in column SE, and standardized β coefficients are reported in column β. Sex, female = 0, male =1; household income: annual household income in NZ$ in 000s; educational attainment: 1 = no secondary school qualification, 5 = Bachelor's degree or higher; adult cognitive ability: IQ points; adult self-control: z-score. Model 1, credit scores regressed on income, controlling for sex; model 2, model 1 + educational attainment; model 3, model 1 + adult cognitive ability; model 4, model 1 + adult self-control; and model 5, model 1 + educational attainment, adult cognitive ability, and adult self-control. Level of significance: *$P < 0.05$; **$P < 0.01$; ***$P < 0.001$.

Table S5. Mediation of childhood human capital factors by adult human capital factors for credit scores and heart age

Childhood factor	Total effect				Direct effect				Indirect effect				Proportion of effect mediated
	Coefficient	SE	β	*P* value	Coefficient	SE	β	*P* value	Coefficient	SE	β	*P* value	
Credit score													
Socioeconomic advantage	23.60	5.72	0.16	<0.001	3.76	5.39	0.03	0.49	19.84	1.93	0.13	<0.001	0.84
Cognitive ability	2.50	0.67	0.21	<0.001	0.33	0.66	0.03	0.61	2.17	0.14	0.19	<0.001	0.87
Self-control	39.08	6.82	0.23	<0.001	9.70	6.50	0.06	0.14	29.38	2.05	0.17	<0.001	0.75
Heart age													
Socioeconomic advantage	−1.23	0.26	−0.17	<0.001	−0.44	0.25	−0.06	0.08	−0.79	0.06	−0.11	<0.001	0.64
Cognitive ability	−0.11	0.03	−0.19	<0.001	−0.02	0.03	−0.04	0.51	−0.09	0.00	−0.16	<0.001	0.82
Self-control	−1.48	0.32	−0.18	<0.001	−0.30	0.31	−0.04	0.33	−1.18	0.07	−0.14	<0.001	0.80

We used SEM to test the degree to which the effects of childhood human capital factors on heart age and credit scores were mediated by adult human capital. To account for multiple correlated mediators, each SEM model included a childhood human capital factor, all three adult human capital factors (educational attainment, adult cognitive ability, and adult self-control), and our two age 38 outcome measures (credit scores and heart age). SEM allows for the decomposition of childhood human capital effects into direct effects - paths that lead directly from childhood human capital to heart age and credit scores, and indirect effects, all remaining paths whereby the association between childhood human capital factors and credit scores or heart age are mediated by adult human capital factors. For each childhood human capital factor, the proportion of effect mediated represents the proportion of the total childhood human capital effect that is attributable to adult human capital factors.